



CPD4dentalhygienists

YOUR FUTURE IN YOUR HANDS

Disinfection and Decontamination **Legionella and Dental Unit Waterline Management**

Aims: This article will give an overview on Legionnaires disease and dental unit water aseptis.

Objectives: On completion of this verifiable CPD article the participant will be able to demonstrate, through completion of a questionnaire, the ability to:

- Define what Legionella is and how it is transmitted
- Identify the conditions in which legionella is more likely to thrive
- Identify the risk factors for Legionnaires' disease
- Demonstrate knowledge of the signs and symptoms of Legionnaires' disease
- Demonstrate knowledge of the responsibilities of the dental practice
- Know how to manage dental unit water lines
- Pass an assessment, scoring over 70%

Introduction

The demonstration of high concentrations of microbial accumulation in coolant water from high-speed dental handpieces was first reported by Blake in 1963.¹ Bacterial species found in aquatic environments, although present in low numbers in drinking water, can be found in very high numbers in the water lines of dental units. Numerous studies have shown that the water inside dental units, hoses for water-spray handpieces, and three in one syringes are contaminated heavily with bacteria. When waterborne bacteria enter the dental unit, they attach to the inside walls of the water lines. These bacteria then form a biofilm on the inside walls of the water lines that then releases bacteria as the water flows out of the lines.² A mature biofilm will form in a new dental unit plumbed to the mains within a few weeks.

Although over 30 different types of bacteria may be present in dental unit water, there are some pathogens that are of particular interest because of their potential for causing opportunistic infections. Legionella pneumophila causes Legionnaires' disease and Pontiac fever, and Pseudomonas aeruginosa is an opportunistic pathogen that can cause several harmful infections.² Non-tuberculous Mycobacterium spp is also an opportunistic pathogen responsible for respiratory disease.

HTM01-05 states that "Registered managers of dental practices have an overriding duty of care under the Health and Safety at Work Act 1974. Therefore, they should

ensure that the water supply, storage, and distribution services should comply with the practice guidance given in:

- The Health and Safety Commission's 'Legionnaires' disease - the control of Legionella bacteria in water systems. Approved Code of Practice and Guidance (L8)'; and,
- Health Technical Memorandum 04-01 'The control of Legionella, hygiene, 'safe' hot water. Cold water and drinking water systems.'"

This article will discuss Legionnaires' disease and outline the recommendations for dental unit waterlines and management of biofilm.

Legionellae



Legionellosis is a collective term for diseases caused by legionella bacteria. The most serious of these is Legionnaires' disease. However, legionellae can also cause the similar but less serious conditions of Pontiac fever and Lochgoilhead fever. Legionnaires' disease is a potentially fatal form of pneumonia.

The condition known as Legionnaires' disease was named after an outbreak of a severe pneumonia like disease that occurred at a convention of the American Legion in a hotel in Philadelphia, USA in 1976. Water droplets in the form of an aerosol contaminated the hotel's air conditioning systems allowing the bacteria to come into contact with the convention guests who were a highly susceptible population.⁴

Legionellae are water borne bacteria and are not spread from person to person, but due to exposure to contaminated aerosols. *L. pneumophila* and more than 30 other species of Legionella commonly exist in natural and domestic waters, but most of the cases of Legionnaires' disease are presumed to result from water handling systems rather than from lakes or streams. Such handling systems include the following:

- Air conditioning
- Cooling towers
- Humidifiers
- Ultrasonic nebulisers
- Vegetable misters
- Shower heads
- Respiratory therapy equipment
- Fountains
- Spas

- Water distribution systems in some buildings²

Individuals Most at Risk

Individuals most at risk of Legionnaires' disease include the following:

- Males
- Over 45
- Smokers
- Heavy drinkers
- People with a suppressed immune system
- Those with chronic respiratory or kidney disease
- Diabetics⁵

Symptoms of Legionnaires' Disease

Legionnaires' disease represents over 4% of all community-acquired pneumonias. An additional unknown number of people are infected with the *Legionella* bacterium but have only mild symptoms or no symptoms at all (so-called Pontiac fever). The symptoms of Legionnaires' disease are similar to the symptoms of flu:

- High temperature
- Cough
- Muscle pains
- Headache
- Pneumonia
- Diarrhoea and signs of mental confusion⁴

Symptoms usually begin two to fourteen days after being exposed to the bacteria.

Treatment of Legionnaires' Disease

Legionnaires' disease can be very serious, and mortality can be 5-30% depending on the susceptibility of the individual. Many antibiotics are highly effective against *Legionella* bacteria. The two most potent classes of antibiotic are the macrolides (azithromycin), and the quinolones (ciprofloxacin, levofloxacin, moxifloxacin, gemifloxacin, trovofloxacin). Other agents that have been shown to be effective include tetracycline, doxycycline, minocycline, and trimethoprim/sulfamethoxazole.

Erythromycin, the former antibiotic of choice, has been replaced by more potent and less toxic antibiotics.⁴

Dental Unit Water Lines and Water Quality

UK water suppliers place the highest priority on assuring the quality of water provided to their customers. Strict standards for the quality of the UK public supply are laid down in national regulations derived from the EU Drinking Water Directive. These standards are based on advice from the



World Health Organization (WHO) and are regularly reviewed.

Water quality is also closely checked and regulated by independent drinking water inspectorates in England and Wales, Scotland and Northern Ireland, who report each year.

Latest figures for drinking water quality compliance with the strict UK and European standards:

- England Wales 99.97% (*reported 2022*)
- Scotland 99.91% (*reported 2020*)
- Northern Ireland 99.86% (*reported 2022*)

The legal standards for drinking water are set down in national regulations (for England and for Wales), which originally came from European law. The health-based standards are based on expert global opinion documented in World Health Organisation guidelines. These standards are very strict. We also have some additional national standards set to maintain the high quality of drinking water in England and Wales.

UK regulations follow the EU directive, but some aspects are stricter than, or in addition to, those defined by the directive, reflecting the high standards of water supplies in the UK. These include - The Water Supply (Water Quality) Regulations for:

- England (2018)
- Wales (2018)
- Scotland (2022)
- The Private Water Supplies Regulations in Northern Ireland (2017), as well as other related regulations.

The law requires that drinking water is wholesome and clean. It sets down maximum acceptable concentrations for a number of potential contaminants. In addition, there is a general clause, which requires:

*"Water is free from any micro-organisms and parasites and from any substances which, in numbers or concentrations, constitute a potential danger to human health."*⁷

The usual guideline for the number of colony forming units (cfu) accepted in potable water is less than 10 cfu/ml at 37°C (or 100 to 200 cfu/ml at 22°C)³. Since the fine spray produced during treatment is probably inhaled by both the patient and the dental staff and almost certainly swallowed by the patient, these guidelines have been interpreted as the standard desired for water emerging from dental units.

[Legionella Cases in Dentistry](#)



In Rome, Italy, an 82-year-old woman died in 2011 from Legionnaire's disease that was contracted from a dental surgery. During the incubation period, the woman only left her home to attend two dental appointments and testing of her home water was negative to Legionella. However, three different sources of water from the dentist's tap, dental unit water and high-speed turbine tested positive to Legionella pneumophila. Genetic sequencing confirmed that the bacteria found in the water line directly matched the bacteria that killed the patient.⁸

Studies investigating occupational exposure to Legionellae in the dental surgery found higher titres of Legionellae antibodies among dental personnel compared to the general population. The magnitude of Legionella antibody titres correlated directly with the length of time spent in clinical dentistry. Dentists had a higher incidence of antibodies than other members of the dental team. However, two dental schools in London reported Legionella in the waterlines but found no correlation with respiratory illness in their staff.⁹

Risk Assessment

The following conditions can increase the risk of legionella:

- The water in all or some parts of the system is between 20-45 °C.
- Water is stored and/or recirculated.
- There are deposits that can support bacterial growth, such as rust, sludge, scale, organic matter, and biofilms.
- There is a means of creating and spreading breathable droplets e.g., aerosol from dental handpieces and scaler tips.

If conditions are favourable, the bacteria may multiply, increasing the risk of Legionnaires' disease, and it is therefore important to control risks by introducing appropriate measures.



The risks need to be controlled by introducing measures which do not allow proliferation of the organisms in the water systems and reduce, as far as possible, exposure to water droplets and aerosol. This will reduce the possibility of creating conditions in which the risk from exposure to legionella bacterial is increased.⁶

All dental practices are required to have a written scheme and a Legionella risk assessment of their hot and cold-water plumbing and dental unit water lines in accordance with the Health and Safety Commission's (2000) Approved Code of Practice L8 and HTM 01-05 and should be reviewed every 24 months. In view of the expertise required in this specialised field, HTM 01-05 recommends that practices (through the registered manager) engage with an external specialist to assist in meeting the recommendations given in Section 3 of HTM 01-05. This may be a locally based engineering consultant with specialist knowledge of Legionella and other water-borne organisms. Practice registration with the Legionella Control Association or other recognised body is also recommended.³



The schemes should be written by an experienced and competent person and the risk assessment should include drawings of the water systems (which can be obtained from third parties such as architects)³ The risk assessment is carried out in order to identify and assess the risk of exposure to legionella from work-based activities and water systems on the premises and any precautionary measures needed. The risk assessment should identify and evaluate potential sources of risk and:

- The particular means of preventing exposure to legionella bacteria; or,
- If prevention is not reasonably practicable, the particular means of controlling the risk from exposure to legionella bacteria.⁷

The registered manager should implement a programme of staff training to ensure that those appointed to devise strategies and carry out control measures are appropriately informed and trained.³

Accurate records should be kept and kept for a minimum of five years. Full details of the records that need to be kept can be found on page 69 of HTM 01-05 and page 19 of the L8 document.

Monitoring Programme

Controls include ensuring that there is an adequate turnover of water to prevent stagnation occurring in hot and cold-water storage tanks and pipework and dental unit water lines. Legionellae grow between 20°C and 45°C so monitoring of the temperature of the hot and cold-water services is required. If control measures are to remain effective, regular monitoring of the systems and control measures is essential.⁶ Table 1 provides an overview of the check list for hot and cold-water services. Further information should be obtained from HTM- 01-05, HTM 01-04 and L8 Code of Practice.

Table 1: Check List for Hot and Cold Water Services³

<u>Services</u>	<u>Task</u>	<u>Frequency</u>
Hot water services	Temperature checks. After running for 1 minute, temperature should be above 50°C.	Monthly
	Manual check to confirm secondary hot water recirculation pumps are operating effectively.	Monthly
	Visually check internal surfaces of calorifiers/water heaters for scale and sludge.	Annually
Cold water services	Temperature checks. After running for 1 minute, temperature should be below 20°C.	Monthly
	Visually inspect cold water storage tanks and carry out remedial works as necessary.	Annually
	Check tank water temperature remote from in-coming ball valve and mains temperatures. Note maximum temperatures recorded by fixed max/min thermometers, where fitted.	6 monthly
Dental Equipment	Drain down and clean	At the end of each working day
Emergency eye-wash sprays	Flush through and purge to drain	6 monthly or as recommended by manufacturers
Mixed-temperature outlets	Check delivery temperature in accordance with D08	6 monthly
Shower heads	Dismantle, clean and descale showerheads and hoses (if applicable).	Quarterly
Sporadically used outlets	Flush through and purge to drain, or purge to drain immediately before use without use of aerosols.	At least twice weekly

Dental Unit Waterlines

Water inside the dental unit waterlines becomes stagnant when not in use such as:

- Between patients
- Lunchtimes
- Overnight
- Weekends



Measures need to be introduced to aid biofilm control. A variety of products are available to use for the disinfection of waterlines and the manufacturers' guidelines should always be followed.

The recommendations below are taken from HTM 01-05.

Self-contained water bottles

HTM 01-05 states that "the self-contained water supplies used with dental care systems should be distilled or RO water. Certain systems recycle water back to a storage facility. Where this is done, repurification will be necessary at each cycle. If self-contained water bottles are not used, a Type A air gap should separate the DUWLs from the mains water supply. Such arrangements should be subject to consideration of local water quality, particularly where hard water is used.



- Guidance from L8 advises that at-risk systems, particularly those used with the patient, be drained down at least at the end of each working day. Where manufacturers provide protocols for daily cleaning, these should be applied.
- Self-contained water bottles (bottled water system) should be removed, flushed with distilled or RO water and left open to the air for drying overnight. They should be stored inverted.
- Where visual contamination is present, flushing with a suitable disinfectant followed by thorough washing is necessary. The manufacturer's instructions will specify the disinfectant to be used and may also require the continuous presence of antimicrobial agents to prevent the build-up of biofilms.³ There are many biocides marketed for DUWLs. Continuous dosing with a biocide has been found to be more effective.⁵

Flushing of Dental Unit Waterlines (DUWLs)

DUWLs should be flushed at the following times:

- For at least two minutes at the beginning and end of the day.
- For at least two minutes after any significant period when they have not been used (for example, after lunch breaks).
- For at least 20–30 seconds between patients.



HTM 01-05 states that “Some water-purification systems are capable of supplying DUWLs and may be able to reduce microbiological risks. Disinfection of DUWLs should be carried out periodically. In all cases, the manufacturer’s instructions should be consulted. Sodium hypochlorite and isopropanol and a number of other agents have been shown to be effective in the removal of biofilm as well as the reduction of micro bacterial contamination. However, these agents should only be used where recommended by manufacturers. If they are used, care should be taken to ensure that DUWLs are thoroughly flushed after disinfection and before being returned to clinical use.”³

Decommissioning of DUWLs

The manufacturer’s guidance should be followed for the decommissioning of DUWLs. In the absence of manufacturers’ guidance, DUWLs should be flushed, drained and left disconnected during any temporary closure of the surgery (for example staff holidays). If this is not practicable, they should be flushed on a weekly basis as per the guidance below.

Recommissioning of DUWLs

In the absence of manufacturers’ guidance, flush the DUWL for at least three minutes, disinfect the DUWL with a suitable disinfectant (as recommended by the manufacturer for routine disinfection of the DUWL), then flush for a further three minutes. Where in-line filters are used, these will require treatment using a cleansing solution that has been recommended by the manufacturer. This step should be performed after first flushing the DUWL.

Anti-retraction valves

Dental equipment requiring protection against backflow should have anti-retraction valves incorporated on all handpieces and ultrasonic scalers. Responsible persons should ensure these are fitted where required. They must be regularly monitored and maintained. If the valve is not fitted or is malfunctioning, it is estimated that approximately 0.9ml, containing 25,000 oral bacteria, could contaminate the handpiece each time the air turbine is stopped.⁵

Examples of dental equipment requiring backflow protection are:

- Dental spittoons
- Three-in-one syringes
- Wet-line suction apparatus
- Self-filling automatic radiographic processors³

Emergency Action

Contingency plans should be available in the event of the following:

1) A power failure. This may:

- Result in a failure to maintain temperature in the hot water system.
- Will restrict the amount of distilled water that can be produced in a set time period if the dental practice produces its own distilled water.

2) A mains-water failure that could last beyond the period for which storage capacity has been designed. This may:

- Result in the temporary cessation of the production of RO water.
- Require the temporary cessation of sterile supply activities.
- Result in hygiene issues for patient and staff WCs/washrooms.

The emergency action to be taken during an outbreak of healthcare-associated legionellosis is covered in Health Technical Memorandum 04-01 Part B Appendix 1.³

Microbiological monitoring

HTM 01-05 states that “Apart from situations where there are indications from taste or odour, microbiological monitoring using dip slides for total viable counts (TVCs) is not considered essential. However, some companies and other institutions offer comprehensive water purification services that include periodic microbiological sample monitoring. Such services, provided they are quality-controlled, may contribute usefully to risk reduction in this area.

Where monitoring is undertaken, the TVC should be expected to lie in the range 100 to 200 colony forming units per millilitre (cfu/ml). In general, incubation should be at 22°C. These measurements can be carried out by commercial microbiological services or by Public Health England.”³

Conclusion

When waterborne bacteria enter the dental unit, they attach to the inside walls of the water lines. These bacteria then form a biofilm on the inside walls of the water lines that then releases bacteria as the water flows out of the lines. Over 30 different types of bacteria may be present in dental unit water, however this article has discussed the risks of legionella bacteria.

The current advice on the management of DUWLs is risk-led. The Health and Safety Commission’s Approved Code of Practice L8 has special legal status, and we recommended that further non verifiable reading in this specialist area is carried out.

Personal Development Plan and Reflective Learning

This CPD is linked to the following GDC Enhanced CPD Development Outcome:

C. Maintenance and development of knowledge and skill within your field of practice.

Reflective learning is now a requirement of the GDC Enhanced Professional Development Scheme. As such, you will be given the option to answer some reflective learning questions, before your certificate is generated.

Please remember that you can choose if you wish to fill this in on completion of the exam, but you can also update this at any time from your CPD log. If you take a few moments to write your reflection on completion, you will have fulfilled the Enhanced CPD requirements.

We recommend that you take time to review the following documents: which can be accessed from the links below:

HTM 01-05

https://www.england.nhs.uk/wp-content/uploads/2021/05/HTM_01-05_2013.pdf

HTM 04-01

<https://www.england.nhs.uk/publication/safe-water-in-healthcare-premises-htm-04-01/>

L8 The control of Legionella Bacteria in Water Systems. Approved Code of Practice and guidance on regulations

<http://www.hse.gov.uk/pUbns/priced/l8.pdf>

References

1. Blake GC (1963) "The incidence and control of bacterial infection of dental units and ultrasonic scalers." *British Medical Journal*: Vol 5 (3), pp. 413-416
2. Miller, C.H (2014) *Infection Control and Management of Hazardous Materials for the Dental Team* 5th edn. Elsevier:Missouri
3. HTM 01-05 (2013) Available at: https://www.england.nhs.uk/wp-content/uploads/2021/05/HTM_01-05_2013.pdf (accessed 02/09/2024)
4. Legionella Control (2015) Legionella Knowledge. Available at: <https://legionellacontrol.com/knowledge> (accessed 02/09/2024)
5. BDA (2008) Contaminated Dental Unit Water Lines. British Dental Association. Available at: <https://www.nature.com/articles/bdjopen20167> (accessed 02/09/2024)
6. Health and Safety Executive (2013) L8 The Control of Legionella Bacteria in Water Systems. Approved Code of Practice and guidance on regulations. Available at: <http://www.hse.gov.uk/pubns/books/l8.htm> (accessed 02/09/2024)
7. Water UK (2015) Water quality standards. Available at www.water.org.uk (accessed 02/09/2024)
8. RDH (2015) Legionnaires' disease and dental unit water. Available at: <http://www.rdhmag.com/articles/print/volume-32/issue-3/features/legionnaires-disease-and-dental-unit-water.html> (accessed 02/09/2024)
9. Pankhurst, C.L (2003) Risk Assessment of Dental Unit Waterline Contamination . Available at: <https://pdfs.semanticscholar.org/afa3/3c3c6ee5d8dbd8672124e21e0affb363e401.pdf> (accessed 02/09/2024)