Legionella and Dental Unit Waterline Management
(Disinfection Decontamination)

Aims: This article provides an overview of Legionnaires' disease and outlines best practice in managing dental unit waterlines (DUWLs) to maintain water asepsis in line with UK guidance.

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 environmental conditions that allow legionella to thrive.
- Recognise the risk factors for Legionnaires' disease.
- Describe the signs and symptoms of Legionnaires' disease.
- Understand the legal and professional responsibilities of the dental practices.
- Apply current guidance to manage dental unit water lines effectively.
- 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.

Over 30 different bacterial species may be present in DUWLs. Of particular concern are:

- Legionella pneumophila – causes Legionnaires' disease and Pontiac fever.
- Pseudomonas aeruginosa – an opportunistic pathogen.
- Non-tuberculous mycobacteria (NTM) – responsible for respiratory infections.

Dental procedures generate aerosols, which can expose both patients and staff to these organisms.[2]

Dental practices are required to comply with:

- HTM 01-05: Decontamination in primary care dental practices.
- HTM 04-01: The control of Legionella, hygiene, 'safe' hot and cold-water systems.
- Health and Safety at Work Act 1974.
- HSE L8: Legionnaires' disease – the control of Legionella bacteria in water systems (Approved Code of Practice and Guidance).
- HSG274 Part 2: Hot and cold-water systems.

In Scotland, dental practices are required to comply with SHTM 01-05 and SHTM 04-01.

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. Legionella 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, fountains and spas.
- Respiratory therapy equipment.
- Water distribution systems in some buildings.[2]

Individuals Most at Risk

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

- Adults over 45.
- Smokers.
- Heavy drinkers.
- Individuals with chronic respiratory/kidney disease, diabetes, or immunosuppression.[5]

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 aches and pains.
- Headache.
- Pneumonia.
- Diarrhoea and signs of mental confusion.[4]

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. Treatment is with appropriate antibiotics such as macrolides or fluoroquinolones, following current national clinical guidelines.[4]

Dental Unit Water Lines and Water Quality Standards

UK drinking water is tightly regulated by the Drinking Water Inspectorate (England & Wales), DWQR (Scotland) and DRD (Northern Ireland), with >99% compliance to World Health Organisation (WHO) based standards.

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]

- Potable water should contain <10 CFU/mL at 37 °C (or 100–200 CFU/mL at 22 °C).
- These values are used as the benchmark for dental water output, since patients and staff may inhale or swallow DUWL water during procedures.

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 suggesting occupational exposure, even though confirmed disease is rare.[9]

Risk Assessment and Legal Duties

Under UK law, all dental practices must:

1. Appoint a duty holder (usually the registered provider/manager).
2. Nominate a responsible person (water) to manage risks.

3. Undertake a Legionella risk assessment for the whole water system, including DUWLs.
4. Prepare a written scheme of control, proportionate to the level of risk.
5. Keep records of all monitoring, flushing and maintenance for at least 5 years.
6. Review the risk assessment regularly and whenever system changes or failures occur (not a fixed 24-month interval).

Care Quality Commission (CQC) inspectors will check that these steps are in place. The CQC state that:

All dental practices must meet the following specific requirements:

1. All systems require a risk assessment, though some may only need simple control measures.

2. All premises are required to have a written waterline management scheme and 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. Experienced and competent people should write these schemes. A competent person is someone with the necessary skills, knowledge, and experience to carry out this function.[10]

(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]

3. The registered manager must implement all recommendations from the scheme and risk assessment.

4. Water and air lines must have anti-retraction valves fitted in accordance with EU regulations.

5. You must control legionella within the dental waterline system, though no single treatment is completely effective. [10]

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 demonstrating compliance with health and safety legislation should be kept which can help to protect dental practices in the event of litigation related to Legionella outbreaks.

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 Services[3]

Service	Task*	Frequency
Hot water services	Arrange for samples to be taken from hot water calorifiers/ water heaters in order to note condition of drain water	Annually
	Check temperatures in flow and return at calorifiers/water heaters	Monthly [4]
	Check water temperature after draw-off from outlets for 1 minute to ensure that 50°C has been achieved in sentinel outlets [1,2,5]	Monthly [4]
	Visually check internal surfaces of calorifiers/water heaters for scale and sludge. [5] Check representative taps for temperature as above on a rotational basis	Annually
	Manual check to confirm secondary hot water recirculation pumps are operating effectively	Monthly
Cold water services	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 [4]
	Check temperature in sentinel outlets after draw-off for 2 minutes to establish that it is below 20°C [2,3]	Monthly
	Visually inspect cold water storage tanks and carry out remedial work where necessary. Check representative taps for temperature, as above, on a rotational basis	Annually
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 more frequently if recommended by manufacturers
Mixed-temperature outlets	Check delivery temperature in accordance with D08	6-monthly
Showerheads	Dismantle, clean and descale showerheads and hoses	Quarterly, or as necessary
Sporadically-used outlets	Flush through and purge to drain, or purge to drain immediately before use without release of aerosols	At least twice weekly [6]

Notes:

* See paragraph 182 in the Health & Safety Commission's Approved Code of Practice L8 for further guidance on tasks that should be undertaken.

1. For effective operation of hot water services, the minimum equilibrium temperature should be 55°C and be achieved within seconds.
2. For thermostatic mixing devices, temperatures should be measured at the inlet.
3. For satisfactory operation of cold water services, temperature equilibrium to below 20°C should be achieved well within one minute.
4. Temperatures should be continuously monitored by the BMS.
5. Additional checks should be made on the hot water circulating system and systems using trace heating at distal points.
6. Risk assessment may indicate the need for more frequent flushing of outlets. It is preferable that this form part of the daily cleaning routine where appropriate. Alternatively, self-purging showers that discharge water to a drain prior to use and without the release of aerosols can be considered.

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 processors.[3]

Surgical Irrigation

Only sterile water or isotonic saline from a separate single use source should be used for surgical irrigation.[3]

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 22ºC. 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, 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

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3. HTM 01-05 (2013) Available at: https://www.england.nhs.uk/wp-content/uploads/2021/05/HTM_01-05_2013.pdf (accessed 01/09/2025)

4. Legionella Control (2015) Legionella Knowledge. Available at: https://legionellacontrol.com/knowledge (accessed 01/09/2025)

5. BDA (2008) Contaminated Dental Unit Water Lines. British Dental Association. Available at: https://www.nature.com/articles/bdjopen20167 (accessed 01/09/2025)

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 01/09/2025)

7. Water UK (2015) Water quality standards. Available at www.water.org.uk (accessed 01/09/2025)

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 01/09/2025)

9. Pankhurst, C.L (2003) Risk Assessment of Dental Unit Waterline Contamination . Available at: https://pdfs.semanticscholar.org/afa3/3c3c6ee5d8dbd8672124e21e0affb363e401.pdf (accessed 01/09/2025)

10. CQC (2025) Available from: https://www.cqc.org.uk/guidance-providers/dentists/dental-mythbuster-5-legionella-dental-waterline-management#:~:text=All%20systems%20require%20a%20risk,in%20accordance%20with%20EU%20regulations. (accessed 01/09/2025)