a network for the epidemiological surveillance and control of communicable diseases in the Community. As of January 2008, 35 countries (24 European Union (EU) member states and 11 non-EU countries) were contributing or receiving data on travel-associated cases. Liaison with other international authorities takes place if the travel-associated infection is linked to countries outside Europe, e.g. the USA, Australia, Canada, the Caribbean and the Dominican Republic. The European Centre for Disease Prevention and Control will take over and operate this network in 2010.

Through the European Commission Directive for Package Travel 90/314/EEC of 13 June 1990, tour operators in Europe have a legal duty to protect the health and welfare of clients within the package they deliver. Procedures for reporting cases of travel-associated legionnaires’ disease to tour operators were formalised and adopted by some European countries following the implementation of the directive. These procedures were updated in the review of the EWGLI guidelines which came into use on January 2005. As a consequence, tour operators are no longer routinely informed about clusters of cases associated with tourist accommodation. However, the EWGLINET coordinating centre in London informs the International Federation of Tour Operators of large outbreaks or clusters of three or more cases. If a cluster involves three or more cases within a short period of time and one or more cases were in an Irish resident, HPSC as the EWGLINET collaborator in Ireland, would inform the Irish Federation of Tour Operators directly.

8.2.1 Reducing the risk of legionnaires’ disease in hotels and other accommodation sites
The risk of legionnaires’ disease can be avoided. Any organisation or premises (work-related or leisure-related) which does not have an active programme to control the growth of legionellae is negligent in ensuring the safety of its workers, visitors, guests and others (see Chapters 4 and 5 and Appendix H).

8.3 Dental chair unit waterlines
8.3.1 Introduction
Dental chair units (DCUs) are complex medical devices designed to provide the equipment and services necessary for the provision of a wide variety of dental procedures. Water is needed to cool and irrigate a range of instruments and tooth surfaces during dental procedures, as the heat generated can be detrimental to teeth. Water is also needed for oral rinsing during and following dental treatment and to flush the cuspidor (spittoon) bowl after the patient has finished rinsing. Dental unit waterlines (DUWs) are an essential component of modern DCUs and supply water as a coolant and irrigant to turbine handpieces, ultrasonic scalers, three-way air/water syringes, as well as supplying water for the patient rinse cup filler and cuspidor.

Many studies have shown that output water from DUWs is frequently contaminated with very high densities of microorganisms, especially bacteria. This is a universal problem and virtually all DUWs in standard DCUs are likely to be contaminated. Figure 9 shows colonies of bacteria cultured from dental chair unit output water. The different size and colours of the colonies reflect the multi-species population of microorganisms usually found in dental chair unit waterline biofilm.

Figure 9. Colonies of bacteria cultured from dental chair unit output water
Bacterial contamination of DUWs is believed to originate in the DCU water supply which usually contains low levels of microorganisms. The main reason for the extensive contamination present in DUWs is
the complex waterline network within DCUs. This network consists of several metres of tubing with an internal diameter of a few millimeters in which water can stagnate when the equipment is not being used. Microorganisms in water entering the DCU water supply (mainly aerobic heterotrophic Gram-negative environmental bacteria) attach to the internal surfaces of the waterlines where they form microcolonies and eventually give rise to multispecies biofilm. These biofilms are composed mainly of bacterial exopolysaccharide, a slimy polysaccharide material produced by bacteria that is highly hydrated and contains both microcolonies and single cells, interspersed heterogeneously with channels or pores. Biofilm forms because the water at the edges of the narrow-bore DUW tubing flows more slowly than water at the centre of the tubing and thus there is little or no disruption to the microorganisms present on the inside surface of the waterline. Contact with surfaces also causes the bacteria to become more adhesive. This allows the microorganisms to attach and proliferate whilst releasing some to continue on through the water supply, as planktonic forms, where they may be deposited at other sites within the tubing or are delivered directly into the mouths of patients during dental procedures. Thus biofilm provides a reservoir for ongoing contamination of dental unit output water. Most of the bacterial populations found in DUWs also occur in mains water where they are present in lower numbers. Biofilms often exhibit resistance to disinfectants due to delayed penetration into the polysaccharide matrix. Endotoxin consists of lipopolysaccharide (LPS) released from the cell walls of Gram-negative bacteria following cell death. Bacterial endotoxin levels ≥ 1,000 endotoxin units/ml have been recorded in DUW output water. In contrast, the permissible levels of endotoxin allowed for sterile water for injection in the USA is 0.25 units/ml. Significant doses of endotoxin may cause adverse effects in susceptible individuals. The findings of recent studies suggest that temporal onset of asthma may be associated with occupational exposure to contaminated DUWs among dentists.

8.3.2 Risk to patients and dental healthcare personnel
The presence of high densities of microorganisms in dental unit water is a potential risk of infection for dental patients and staff and is incompatible with good hygiene and cross-infection control and prevention practices. Furthermore, studies have shown that waterborne bacteria are aerosolised during dental procedures and that dental personnel and patients are exposed to these microorganisms and fragments of biofilm. DUW contamination is of particular concern in the treatment of immunocompromised and medically compromised individuals. These groups of individuals frequently seek routine care in the modern dental surgery.

Some of the bacteria found in dental unit water are known to cause disease in humans. Of particular concern are Pseudomonas, Legionella and non-tuberculosis Mycobacterium species. Pseudomonas species, especially P. aeruginosa, are well-known opportunistic pathogens that can survive on a limited supply of nutrients, and which often exhibit resistance to antibiotics and disinfectants. It is important to emphasise that only a few cases of infectious disease transmission related to DUWs and related biofilm have been reported in the literature. However, there is considerable potential for infection with bacterial pathogens such as P. aeruginosa, L. pneumophila as well as other organisms. In 1987, Martin reported that abscesses caused by strains of P. aeruginosa in two immunocompromised patients were attributable to exposure to contaminated dental unit water. Martin also isolated P. aeruginosa from the oral cavities of 78 healthy patients for 3-5 weeks following exposure to dental unit water contaminated with P. aeruginosa.

There is no evidence that any patient has ever contracted legionellosis from a dental chair. Several studies however, have reported the presence of Legionella in DUWs. In 1995, Atlas et al., reported the death of a Californian dentist resulting from legionnaire’s disease possibly due to exposure to dental unit water. Occupational exposure to aerosols of waterborne bacteria, generated by dental unit handpieces, can also lead to colonisation of dental staff and a higher prevalence of antibodies to Legionella. One study of a group of dental staff with more than two years clinical experience revealed that 23% were IgG antibody-positive and 19% were IgM antibody-positive for L. pneumophila compared to IgG antibody-positive levels of 8% for individuals who had no clinical experience. The possibility still remains that DUW-associated infections have gone unrecognised or unreported because of the failure to associate exposure to DUW aerosols with the development of specific infections. Sporadic infections not requiring hospital admission are also less likely to be investigated or notified. There are also the recognised risk factors for legionnaires’ disease to be taken into account (see Chapter 1, Section 1.5).

In recent years, there has been increased media and public concern about the lack of infection control within the healthcare system in general. Currently there are no microbial quality standards imposed for dental unit output water within the EU. However, it is not unreasonable to expect that the quality of dental unit output water should approximate the potable drinking water standards. The potable water (drinking
water quality standards set for the EU, the USA and Japan are 100 cfu/ml, 500 cfu/ml and 100 cfu/ml, respectively, of aerobic heterotrophic bacteria. In 1995, the American Dental Association (ADA) established a goal for the year 2000 of ≤ 200 colony forming units (cfu) per ml of aerobic heterotrophic bacteria for dental unit output water. However, this has not been achieved in practice. The current CDC guidelines for infection control in dental healthcare settings recommend that dental unit output water should contain ≤ 500 cfu/ml of aerobic heterotrophic bacteria.

A recent symposium entitled Microbiology of dental unit water lines; setting standards for the future, that was held as part of the Pan-European Federation/International Association for Dental Research meeting held at Trinity College, Dublin, during September 2006 debated setting a standard for DUW output water quality. The symposium was the first occasion that scientists and clinicians from academia and dental practice came together in Europe to discuss the universal problem of DUW biofilm and practical solutions. The consensus from the symposium was that in the absence of an EU standard for DUW output water quality, every effort should be employed to ensure that DUW output water quality in Europe complies with the ADA standard of < 200 cfu/ml.

8.3.3 Control of Legionella bacteria in dental chair unit waterlines

Numerous suggestions for reducing the bacterial density in dental unit output water have been proposed but none have been universally accepted which are both efficient at eliminating biofilm, as well as being safe for patients. One widely used practice for reducing the bacterial density in dental unit output water involves flushing DUWs with water. Flushing DUWs at the start of the clinical session to reduce the microbial density in output water does not affect waterline biofilm or reliably improve the quality of the output water used during dental treatment. Using tap water, distilled water or sterile water in a self-contained bottle reservoir system will not eliminate bacterial contamination in output water if waterline biofilms are not effectively controlled. While flushing can result in a reduction in microbial density by several orders of magnitude, studies have reported that microbial densities after flushing were still unacceptably high.

The most efficient means of maintaining good quality DUW output water is regular disinfection of DUWs with a disinfectant or biocide that removes biofilm from the waterlines resulting in output water of potable quality. Very few studies have actually investigated the efficacy of disinfectants to achieve these desired effects in DCUs. However, a number of recent studies have demonstrated the efficacy of a range of disinfectant products approved for DUW disinfection that efficiently remove biofilm and reduce bacterial density to potable water quality or better. However, biofilm regrowth can occur within a week or so following disinfection and so DUWs should be disinfected at least once weekly with an appropriate disinfectant. Disinfectants that contain a coloured dye are particularly useful as they permit the individual undertaking waterline disinfection to ensure that each waterline is filled with disinfectant by visual observation of the elution of the dye from handpiece, scaler, cupfiller and three-in-one syringe waterlines, etc. Care should be taken to avoid exposure to aerosolised waterline disinfectant.

A wide variety of commercial waterline cleaning products and systems are available. Dental practitioners should contact the manufacturer of their specific DCU model for advice on products and procedures for waterline disinfection. In DCUs supplied with a bottle reservoir, approved biocides can be added to the bottle, aspirated into the waterlines and left for an appropriate time to disinfet. Following disinfection, all of the waterlines should be thoroughly flushed to eliminate biocide. In DCUs supplied with mains water, dental practitioners should contact the DCU manufacturer for advice on biocide delivery. Some brands of DCU are supplied with an integrated waterline cleaning system. When choosing a biocide, users should ensure that the efficacy and safety of biocides for dental unit waterline disinfection have been determined independently and the results published in international peer-review journals. Manufacturers should be able to provide this information.

For patient comfort, some DCU models provide heated water (approximately 20°C) to dental handpieces, ultrasonic scalers and air/water syringes - ideal conditions for the proliferation of Legionella bacteria. It is recommended that qualified maintenance personnel, having consulted the DCU manufacturer, should decommission the water heaters in such DCUs.

Dental healthcare personnel should be educated regarding water quality, biofilm formation, water treatment procedures and adherence to maintenance protocols. Dental practitioners should seek advice from the manufacturer of their dental unit or water delivery system to determine the most appropriate method for maintaining acceptable output water quality. In general, waterlines should be disinfected at least once a week with an approved biocide.
Microorganisms, blood and saliva from the oral cavity can enter the dental unit waterline system during patient treatment. Thus handpieces, ultrasonic scalers and air/water syringes should be operated for a minimum of 20 to 30 seconds after each patient to flush out retracted material. Even for devices fitted with antiretraction valves, flushing devices for a minimum of 20 to 30 seconds after each patient is appropriate. Care should be taken not to inhale the aerosol generated.

Water may be supplied to DUWs from a number of sources. These include connections to the public water supply mains, water storage tanks and independent reservoirs within the DCU. Disinfectant can be introduced into DUWs from independent reservoir bottles, or from disinfectant delivery devices connected to the DCU water supply. In the case of DCUs connected to public water mains supply, it is imperative that the connection is turned off prior to DUW disinfection to prevent contamination of mains water with disinfectant. After disinfection, DUWs should be thoroughly flushed with clean water before DCUs are used for patient treatments. The water distribution systems in some DCU models are fitted with an air gap that physically separates the water within DUWs from the supply water, thus preventing backflow of disinfectant or contaminated water into the supply water network. Saliva, blood and oral microorganisms can be aspirated into DUWs during patient treatments due to faulty handpiece antiretraction valves. This is more likely to be a problem in older DCU models, older handpieces and poorly maintained handpieces, although a recent Italian study of 54 DCUs, comprising 18 different models by six different DCU manufacturers demonstrated an antiretraction device failure rate of 74% (40/54 DCUs tested). Dental handpieces that are connected to DUWs and which are used in the oral cavity, such as turbines, ultrasonic scalers and air/water syringes, should be run for a minimum of 30 seconds after each patient treatment to flush out patient material that may have been retracted into DUWs during use of the handpiece during patient treatment.

There is an onus on DCU manufacturers to consider the problem of DUW biofilm contamination when designing DCUs. In fact a variety of disinfection devices and systems are currently available for DUW disinfection, although detailed comparative studies have yet to be undertaken. Regular disinfection of DUWs with an approved treatment regimen and biocide should also effectively control the levels of Legionella in DUWs. There is no need for additional disinfection protocols. Dental healthcare personnel should be familiar with the HPSC guidance for control of Legionella. Each practice should undertake a formal Legionella risk assessment which should be revisited and revised annually. All water systems (water tanks, etc.) should be maintained as outlined in Chapters 4 and 5. In relation to the water distribution system supplying the dental clinic, hot water should be circulated at a temperature of at least 50°C and cold water should be circulated at <20°C to minimise growth of Legionella. All redundant or seldom used sanitary ware (i.e. showers, wash hand basins, toilets) should be removed along with their supply pipes to prevent dead legs (areas where water can stagnate).

8.3.4 Portable ultrasonic scalers and mobile DCUs
Portable auxiliary units used by dental hygienists, such as independent ultrasonic scalers, also require cooling water. The DUWs in these units should also be subject to regular disinfection (at least once a week) with an approved biocide. The unit manufacturer should be consulted in relation to the type of biocide to be used. The DUWs of portable DCUs, such as those that may be used by defence forces medical units as part of mobile field hospitals or by Civil Defence units, should be subject to disinfection in the same way as conventional DCUs. Portable DCUs should have their DUWs drained when not in use or during storage. Following storage or during periods of infrequent use, DUWs should be disinfected prior to patient treatment.

8.3.5 Record keeping, equipment maintenance, quality assurance and periodic review of procedures
All DCUs should be serviced at appropriate intervals as recommended by the manufacturer. The efficacy of waterline cleaning should be tested (total viable counts) periodically (six monthly) using validated procedures. This can be achieved by determining the aerobic heterotrophic bacterial count in DCU output water immediately following disinfection on R2A agar following seven days incubation at room temperature (approx. 20°C). A variety of commercial laboratories can provide this service.

Written or electronic records of weekly waterline disinfection, equipment maintenance and periodic waterline cleaning efficacy testing should be retained.