Health Technical Memorandum 04-01 Safe water in healthcare premises

Part B: Operational management

Consultation draft
December 2015
Executive summary

The development, construction, installation, commissioning and maintenance of hot and cold water supply systems are vital for public health. Healthcare premises are dependent upon water to maintain hygiene and a comfortable environment for patients and staff, and for treatment and diagnostic purposes.

Interruptions in water supply can disrupt healthcare activities. The design of systems must ensure that sufficient reserve water storage is available to minimise the consequence of disruption, while at the same time ensuring an adequate turnover of water to prevent stagnation in storage vessels and distribution systems.

This Health Technical Memorandum gives comprehensive advice and guidance to healthcare management, design engineers, estate managers and operations managers on the legal requirements, design applications, maintenance and operation of hot and cold water supply, storage and distribution systems in all types of healthcare premises. It is equally applicable to both new and existing sites.

Aims of this guidance

This guidance has been written to promote good practice for those responsible for the design, installation, commissioning, operation and maintenance of water services in healthcare premises, by:

- highlighting the need for robust governance arrangements;
- outlining key criteria and system arrangements to help stop the ingress of chemical and microbial contaminants and microbial colonisation and bacteria proliferation;
- illustrating temperature regimes for sanitary outlets to maintain water hygiene;
- ensuring the safe delivery hot water;
- outlining how the selection of safe system components and safe use by occupants can help preserve the quality and hygiene of water supplies;
- providing a point of reference to legislation, standards and other guidance pertaining to water systems;
- providing a basic overview of possible potential waterborne opportunistic pathogens;
- giving an overview of some of the different water systems (including components) and their safe installation, commissioning and operation and maintenance;
- providing typical system layouts and individual component location;
- providing information on thermostatic mixing valve configurations, appropriate usage and maintenance requirements;
• illustrating the importance of “safe” delivery of hot water;

• identifying key commissioning, testing and maintenance requirements for referral by designers, installers, operators and management.

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**Recommendations of Part B**

This version draws together and updates the previous guidance and includes recommendations for the safe management of water systems and how to manage and minimise the risks to health from both microbial and chemical contamination. While *Legionella* control is, in the main, associated with poor engineering configuration and maintenance, with no evidence of patient to patient transfer, *Pseudomonas aeruginosa* may also be transferred to outlets and the water from patients and staff and requires additional investigation and intervention from infection control specialists. The use of genetic typing methods may be necessary to differentiate whether contamination was from persons or the water system itself.

Whereas a temperature control regimen, which is the preferred strategy for reducing the risk from *Legionella* and which will reduce the growth and colonisation of other waterborne organisms within water systems, additional measures are required to reduce the risk of *Pseudomonas aeruginosa* contamination (and retrograde colonisation and growth). To demonstrate effective temperature control, monitoring of temperatures throughout the system is required on a regular basis.

Because of the complexity of hot and cold water distribution systems found in healthcare facilities and the difficulty of maintaining a temperature control regimen in all locations, this guidance suggests that chemical and other water treatments that have been shown to be capable of controlling microbial colonisation and growth may also be considered (for example oxidising disinfectants or dispersing silver and copper ions).
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Steering Group members
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1 Introduction

1.1 This edition of HTM 04-01 supersedes HTM 04-01: ‘The control of Legionella, hygiene, “safe” hot water, cold water and drinking water systems’ published in 2006. It also subsumes the guidance given in Health Technical Memorandum 04-01: Addendum Pseudomonas aeruginosa – advice for augmented care units. It has been revised to take account of revisions to the Health and Safety Executive’s (2013) Approved Code of Practice L8 and technical guidance HSG274.

1.2 This Health Technical Memorandum gives comprehensive advice and guidance to healthcare management, design engineers, estate managers, operations managers and infection control specialists on the legal requirements, design applications, installation, commissioning, maintenance and operation of hot and cold water supply, storage and distribution systems and associated equipment and systems in all types of healthcare premises. It is equally applicable to both new and existing sites.

1.3 In its new form, the document is divided in three parts. This part (Part B) covers operational management, including the control of Legionella, Pseudomonas aeruginosa and other important opportunistic waterborne pathogens. Part A outlines the principles involved in the design, installation, commissioning, and testing of the hot and cold water supply, and storage and distribution systems for healthcare premises. Some variation may be necessary to meet the differing requirements of the various water undertakers and complexity of distribution systems. Part C covers augmented care settings.

General

1.4 Current statutory legislation requires both “management” and “staff” to be aware of their individual and collective responsibility for the provision of wholesome, safe hot and cold water supplies, and storage and distribution systems in healthcare premises.

1.5 Healthcare premises are dependent upon water to maintain hygiene and a comfortable environment for patients, visitors and staff, and for clinical and surgical care.

1.6 The development, construction, installation, commissioning and maintenance of hot and cold water supply systems to minimise the risks of waterborne illness are vital for public health.

1.7 Interruptions in water supply can disrupt healthcare activities. The design of systems must ensure that sufficient reserve water storage is available to minimise the consequence of disruption, while at the same time ensuring an adequate turnover of water to prevent stagnation in storage vessels and distribution systems.

Exclusions

1.8 Although many of this Health Technical Memorandum’s recommendations will be applicable, it does not set out to cover water supply for fire-fighting services nor water supply for technical, industrial or other specialist purposes, other than to indicate precautions that should be taken when these are used in association with “domestic” water
services. The point at which a domestic activity becomes an industrial process, for example in food preparation, has not been defined, and the applicability will need to be considered in each case.

1.9 This Health Technical Memorandum does not cover wet cooling systems such as cooling towers. Guidance on these systems is given in the Health & Safety Executive’s Approved Code of Practice and Guidance document L8.

1.10 While some guidance on other water-service applications is included, it is not intended to cover them fully. For:

- process waters used for laundries, see HTM 01-04 – ‘Decontamination of linen in health and social care’;
- endoscopy units, see HTM 01-06 - ‘Decontamination of flexible endoscopes’
- primary care dental premises, see HTM 01-05 Decontamination in dental practices’.
- renal units, see HBN 07-01 and HBN 07-02 and the UK Renal Association and ISO 13959 and 11663.
- sterile services departments, see Health Building Note 13 – ‘Sterile services
- hydrotherapy pools, see the PWTAG’s ‘Swimming Pool Water; treatment and quality standards for pools and spas http://pwtag.org/the-swimming-pool-water-book/"
- Guidance on birthing pools, see Health Building Note 21 – ‘Maternity’ and PWTAG's 'Swimming Pool Water; treatment and quality standards for pools and spas'.

Definitions
1.11 Definition of terms is as those contained in the Water Supply (Water Fittings) Regulations 1999, BS 6100, BS EN 806 and BS 8558.

Management
1.12 In this document, the statutory duty holder is referred to as 'Management'. This role is defined as the owner, occupier, employer, general manager, chief executive or other person who is ultimately accountable, and on whom the duty falls, for the safe operation of healthcare premises.
2 Governance and management responsibility

2.1 In healthcare premises, the water safety plan (WSP) is recommended as a holistic approach to manage water for all uses, including diagnostic and treatment purposes, so it is safe for all users including those most at risk of waterborne infections as a consequence of their illness or treatment (see paragraphs 6.17–6.23).

2.2 The WSP should demonstrate that any person on whom the statutory duty falls has fully appreciated the requirement to provide an adequate supply of hot and cold water of suitable quality. Though compliance with this guidance may be delegated to staff, or undertaken by contractors, accountability cannot be delegated. The duty holder should appoint a multidisciplinary water safety group (WSG). This group should ensure that appropriate expertise and competence is available to ensure the delivery of safe water for all uses throughout the organisation. The WSG should have clearly identified lines of accountability up to the CEO and board. For membership of the group, see paragraph 6.8.

2.3 The duty holder should appoint in writing a responsible person or persons to implement the WSP (see ACoP) and to be responsible for managing the assessment and controlling any identified risks from *Legionella*, *Pseudomonas aeruginosa* plus any other waterborne pathogens or contaminants of the water services and systems.

2.4 A risk assessment forms an integral component of the WSP and is a legal requirement to identify potential hazards (which may be microbial, chemical or physical) in the system and risks of infection to patients, staff and visitors. These may include failures in the management system or written scheme for controlling any risks, physical elements such as storage capacity, inadequate temperature controls, distribution failures, low water usage, inappropriate materials and equipment, or parameters related to the use of the system which may include occupancy information and their susceptibility to specific water hazards, cleaning procedures or clinical operational procedures and protocols relating to water use and its disposal etc.

2.5 The risk assessment should be carried out by a competent person or persons. If the provision of risk assessments is contracted to an external organisation, it is recommended that those engaged to carry out any risk assessments associated with water safety should be able to demonstrate to the WSG their experience and competence in assessing specific risks from microbiological, chemical and physical hazards on the specific healthcare population and be able to give advice on how to manage the systems / equipment to minimize the risks etc. It is the responsibility of the WSG to determine the method of demonstrating this competence. Core requirements including accredited training and personal examples of recent water safety risk assessments in the healthcare sector presented orally and/or by interview should be considered options. Detailed knowledge and expertise requirements of the Risk Assessor(s) are provided in WHO's (2011) 'Water safety in buildings'.

2.6 The risk assessor(s) should be given access to competent assistance from the client. This may be in the form of engineering and building expertise, as-fitted drawings and
schematic diagrams, clinical expertise, knowledge of building occupancy and use including vulnerability of patient groups, bespoke equipment plus policies, procedures and any protocols for example cleaning of WHBs and disposal of clinical effluent etc. In addition access must be made available to all required areas (and associated systems and equipment) unless deemed inaccessible by legislation e.g. asbestos etc.

2.7 For legionella risk assessments, contractors should be able to demonstrate a full understanding of, and work to, BS 8580:2010. In addition to guidance provided above, the documents below should also be referenced in relation to the specification, procedures and general requirements for completing robust and fit for purpose water safety risk assessments:


2.8 Management procedures must ensure that compliance is continuing and not notional. The prime purpose of the assessment is to be able to demonstrate that the WSG is aware of all the relevant factors that may pose a risk of waterborne illness, that effective corrective or preventive action have been implemented, and monitoring the plans are effective in demonstrating control is ongoing.

2.9 This guidance should be applied to all healthcare premises, however small, where there is a duty of care under the Health and Safety at Work etc Act 1974.

2.10 Where new healthcare premises are planned or existing premises to be altered or refurbished, the WSG should be consulted at the earliest possible opportunity and a water risk assessment be completed for the project. This will enable the total water hygiene requirements to be assessed in the planning stages, and appropriate action taken, including ensuring that any pressure testing, flushing and cleaning does not lead to stagnation or contamination prior to being placed into service. [editorial: move this paragraph to Part A]

2.11 Organisations should also be aware of the legal duty to notify the water undertaker when it is proposed to carry out works on any systems conveying water from the public water supply.

2.12 All regular tests and checks set out in the WSP should be carried out even if they cause minor disruption to healthcare services, and comprehensive records should be maintained in accordance with the management policy.
3 Statutory requirements

3.1 It is the responsibility of management to ensure that their premises comply with all statutes.

3.2 Management (owners or occupiers) of healthcare premises have an overriding general duty of care under the Health and Safety at Work etc Act 1974. Therefore, they should ensure that the water supply, storage and distribution services are installed and operated within the terms of the following legislation.

Health and Safety at Work etc Act 1974

3.3 Employers have a general duty under the Health and Safety at Work etc Act 1974 to ensure, so far as is reasonably practicable, the health, safety and welfare of their patients, staff and the public who may be affected by workplace activities.

3.4 These duties are legally enforceable, and the Health and Safety Executive has successfully prosecuted employers including health authorities and trusts under this statute. It falls upon owners and occupiers of premises to ensure that there is a management regime for the proper design, installation and maintenance of plant, equipment and systems. Failure to have a proper system of working and adequate control measures can also be an offence even if an outbreak of, for example, legionnaires’ disease or other such incident has not occurred.

The Management of Health and Safety at Work Regulations 1999

3.5 These regulations provide a broad framework for controlling health and safety at work. They require every employer to make a suitable and sufficient assessment of all risks to health and safety of employees and the public caused by work activities, and require employers to have access to competent help in applying the provisions of health and safety law. In addition to Legionella, other risks from a hot and cold water distribution system include deterioration of water quality, scalding at hot water outlets and danger due to pipe bursts at excessive pressures.

Control of Substances Hazardous to Health (COSHH) Regulations 2002

3.6 These regulations provide a framework of actions designed to control the risk from a range of harmful substances including microorganisms such as Legionella and the chemicals that may be used to control the growth of microorganisms in water supplies. Employers have a duty to assess the risks from exposure to these substances to ensure that they are adequately controlled.

Public Health (Infectious Diseases) Regulations 1988

3.7 The Public Health (Infectious Diseases) Regulations 1988 require that a properly appointed officer shall inform the chief medical officer for England or for Wales, as the case may be, of any serious outbreak of any disease that to his/her knowledge has occurred in the district.
Note

Appendix 3 of HSE's *Legionella* technical guidance HSG274 (2013) contains further advice and guidance on communication and cooperation with the consultant in communicable disease control (CCDC), and arrangements for support of the CCDC and for this person to have access to provider units including NHS organisations.

**Water Supply (Water Quality) Regulations 2000**

3.8 The Water Supply (Water Quality) Regulations 2000 apply to water supplied by a water undertaker to any premises which is used for domestic purposes such as drinking, cooking, personal hygiene, washing or food production. Two additional sources of advice on drinking water quality are:

a. the director of public health;


3.9 The Private Water Supplies Regulations 2009 cover private water supplies such as boreholes and wells.

**Private Water Supplies Regulations 2009**

3.10 These Regulations cover private sources of water intended for human consumption including drinking, cooking, food preparation or other domestic purposes, such as boreholes and wells. These regulations also place duties for monitoring and control of the quality of public water supplies where these are then further distributed to other users within a site by a person other than the water undertaker or licensed water supplier (often referred to as onward distribution).

**Food Safety Act 1990**

3.11 The Food Safety Act 1990 covers water used for food preparation or food manufacture and also includes water used for drinking. The Food Safety (Temperature Control) Regulations 1995 and the Food Safety (General Food Hygiene) Regulations 1995 are also relevant.

**The Health and Safety Executive’s (4th edition)**

**Approved Code of Practice L8 2013**

3.12 The Health and Safety Executive’s (2013) Approved Code of Practice L8 (4th edition) came into effect on 7 November 2013 which is supported by the technical guidance (HSG274 parts 1-3) and replaced the earlier publication entitled ‘Legionnaires’ disease: The control of legionella bacteria in water systems - Approved Code of Practice and guidance’ (L8 3rd edition). The onus is on management to demonstrate that procedures in place are as good as, or better than, those required by L8.

3.13 The Approved Code of Practice L8 has a special legal status. If a person or organisation is prosecuted for a breach of health and safety law and it is proved that they did not follow the provisions of the Code, they will need to show that they have complied with the law in some other equally effective way or the Court will find them at fault. Health
and safety inspectors seek to secure compliance with the law and may refer to this guidance.

3.14 Compliance with HSG274 guidance document will satisfy the Approved Code of Practice L8.

3.15 The health service, with responsibility for the wider aspects of public health and the operation of NHS premises, is expected to be particularly vigilant.

3.16 The incidence of healthcare-associated waterborne illness including legionnaires’ disease is relatively small, but cases and outbreaks are considered to be avoidable. Management must also acknowledge that incidents or outbreaks cause widespread concern, especially if associated with healthcare premises. Investigation of these outbreaks has shown that they are generally related to a breakdown in management systems. Design flaws and defects and poor commissioning, however, have also been implicated as the cause of some outbreaks, but by far the greatest contributor to outbreaks of Legionella is poor or inappropriate maintenance and control procedures.

3.17 Hence, managers need to satisfy themselves by validation of new control regimes or when changes are made to existing regimes that these are effective in the system to which they are applied and that monitoring is carried out to verify ongoing control is maintained.

**Water Supply (Water Fittings) Regulations 1999**

3.18 These Regulations set legal requirements for the design, installation, operation and maintenance of plumbing systems, water fittings and water-using appliances. They have a specific purpose to prevent misuse, waste, undue consumption or erroneous measurement of water and, most importantly, to prevent contamination of drinking water.

3.19 These Regulations apply in all types of premises supplied, or to be supplied, with water from a water undertaker. They apply from the point where water enters the property’s underground pipe, to where the water is used in plumbing systems, water fittings and water-using appliances. However they do not apply in premises that have no provision of water from the public mains supply.

3.20 These Regulations are set out – along with the Department for Environment, Food and Rural Affairs’ (Defra) guidance on the Regulations and the water industry’s recommendations for fulfilling these provisions – in the ‘Water Regulations Guide’ published by the Water Regulations Advisory Scheme (‘WRAS’).

**British Standards**

- BS EN 805 is the British Standard specification for design, installation requirements for systems and components outside buildings.

- The BS EN 806 series is the British Standard specification for design, installation, testing and maintenance of services supplying water for domestic use within buildings and their curtilage.

- BS 8558 provides UK specific complementary guidance to BS EN 806 series of standards, replacing BS 6700
• BS 1710 is the British Standard specification for identification of pipelines and services.

• PD 855468 – ‘Guide to the flushing and disinfection of services supplying water for domestic use within buildings and their curtilages’

• BS 8551 – ‘Provision and management of temporary water supplies and distribution networks (not including provisions for statutory emergencies) - code of practice’.

• BS 8554 Code of practice for the sampling and monitoring of hot and cold water services in buildings

• BS 7592 sampling for Legionella bacteria in water systems - Code of practice
4 Legionella pneumophila: overview

Source of the bacteria
4.1 *Legionella* are bacteria which are ubiquitous, surviving and multiplying in water in both the natural and, constructed aquatic environment. It is widespread in natural fresh water including rivers, lakes, streams and ponds and may also be found in damp soil. Airborne dispersal may occur when aerosols or droplet nuclei (tiny water droplets) are created. There is a strong likelihood of very low concentrations of the bacteria existing in all open water systems including those of building services, and so the main emphasis is on preventing *Legionella* from multiplying into large numbers that may constitute an infective dose.

4.2 The risk is related to the multiplication of and types of *Legionella* in the water at the point of use.

Ecology
4.3 The following conditions have been found to influence the colonisation and growth rate of *Legionella*:

a. water temperature between 20°C and 45°C will proliferate growth. The optimum laboratory temperature for the growth of the organism is 37°C. *Legionella* are typically killed within a few hours at temperatures above 50°C or minutes at temperatures of 60°C and do not multiply above 45°C (see Yee and Wadowsky, 1982).

Note
The death curve is logarithmic with time for a given temperature (see diagram on next page).

b. areas of poor flow or stagnation within a system or components may result in the loss of control due to heat loss in HWS and heat gain in CWS and, where used, low biocide concentrations, thus providing the ideal conditions for microbial colonisation and growth; i.e. biofilm formation;

c. biofilms play an important role in harbouring and providing favourable conditions in which microorganisms can grow (including legionellae). An important consideration is that where biofilms are present control is much more difficult to achieve: microorganisms which grown within biofilms are physiologically different to their free swimming counterparts and are inherently resistant to biocides with much longer contact times required for a given concentration of biocide.
Biofilms form when bacteria adhere to surfaces in aqueous environments and secrete polysaccharides that anchor the bacteria to materials such as metals and plastics. Biofilms in water systems are heterogeneous and will consist of many species of bacteria as well as fungi, algae, protozoa, debris and corrosion products. Essentially, biofilms may form within water systems and their components on any interface exposed to microorganisms.

Biofilms develop where the conditions (including temperature and nutrient availability) support colonisation and growth. Nutrients can be provided to the biofilm from the incoming water, particularly where there is increased turbidity and also from scale, sediment, corrosion products, or trapped organic and inorganic molecules supplied by the flowing water as well as from a range of surface materials. Iron salts are also required for Legionella growth.

d. Waterborne pathogens including Legionella have been shown to colonise certain types of water fitting, pipework and material used in the construction of water systems. Water quality can deteriorate within the system and components such as terminal fittings, particularly when utilisation is low. Thermostatic mixing valves and the pipework downstream of them pose a particular problem as the mixed water can then be delivered at a temperature favoured by pathogens such as Legionella. For this reason where the risk assessment indicates temperature control is required to prevent scalding of vulnerable groups, the mixing valve should be as close to the outlet as possible (i.e. at the outlet, which is known as a thermostatic mixing tap).
e. *Legionella* can survive but not grow in sterile water as they require other microorganisms for growth. Commonly-encountered organisms in water systems such as algae, amoebae and other bacteria serve as an additional nutrient source for *Legionella*. Algal slime provides a stable habitat for multiplication and survival. Whilst exposure to direct sunlight may inhibit the growth of legionellae, it does stimulate growth of algae and the formation of slimes. *Legionella* have also been shown to proliferate rapidly in association with some water-borne protozoa including amoebae;

f. stagnant water encourages microbial colonisation.

**Epidemiology**

4.4 Legionnaires’ disease, often described as an atypical acute pneumonia of rapid onset often with gastrointestinal symptoms which can confuse the diagnosis. Legionnaires’ disease is predominantly caused by inhalation of *Legionella pneumophila* serogroup 1 is the commonest cause of legionnaires’ disease accounting for around 85% of cases within the EU (ECDC data) however it is important to note that other non-pneumophila species have been shown to cause disease in hospital patients’ data. Pontiac fever is a self-limiting form of legionellosis which resolves spontaneously and usually requires no treatment. Outbreaks of Pontiac fever have been associated with patients showering.

4.5 The risk of healthcare-associated legionellosis depends on a number of factors such as:

- the presence of *Legionella* in sufficient numbers;
- conditions suitable for multiplication of the organisms (for example temperatures between 20°C and 45°C (where biocides are used; low biocide levels) and stagnant water);
- a source of nutrients (for example scale, sludge, rust, protozoa, and other available organic carbon, bacteria and biofilms);
- a means of creating and disseminating aerosols which are too small to be seen by the naked eye but small enough to be inhaled deep into the lungs (<5 microns) and contain at least one viable *Legionella* (potential sources for example include evaporative cooling towers, showers and most other water draw-offs that are capable of creating a spray or causing splashing). Note: Some cases of Legionnaires’ disease in healthcare premises have been associated with aspiration of contaminated ingested water rather than inhalation of aerosols.
- the presence of people who may be exposed to contaminated aerosols, especially those who are vulnerable to *Legionella* infection (for example those with compromised immune or respiratory systems).

4.6 Many, if not all, of these factors are likely to be encountered in healthcare premises.

**Control measures**
See also Chapter 4 in Part A on water treatment and control programmes for hot and cold water systems.

4.7 Original guidance on the control of Legionella in hot and cold water services relied on a temperature control regimen: that is, maintaining cold water below 20°C and hot water above 50°C (55°C in healthcare building). Because of the complexity of hot and cold water systems found in hospitals and the responsibility of maintaining a temperature control regimen at all times, in all areas, chemical and other water treatments that have been shown to be capable of controlling Legionella may need to be considered – but should not be used as the primary control measure.

4.8 Residual biocidal techniques such as chlorine dioxide and silver/copper ionisation (evaluated by BSRIA in TN 2/98: ‘Chlorine dioxide water treatment – for hot and cold water services’; and TN 6/96: ‘Ionisation water treatment for hot and cold water services’) are outlined in Chapter 4 and Chapter 15 of Part A. Due to their residual effect, these techniques can inhibit free-floating and attached bacteria with varying degrees of efficiency.

4.9 Ozone and ultraviolet (UV) treatment have a limited effect as UV is non-dispersive and only acts on the microorganisms as they pass the UV output and ozone rapidly degrades and therefore has only a short-term residual effect. Ozone and UV are not effective at removing biofilm from hot and cold water distribution systems.

4.10 Monitoring to ensure that any of the control measures remain effective is essential. Monitoring and testing is covered in chapters 9 and 10. The monitoring of treatment programmes should demonstrate that they are working within legislation and the established guidelines and are effective in controlling the target water-borne organisms. The frequency of monitoring and test procedures will vary according to the method selected.

4.11 The use of biocides require meticulous monitoring to be effective. Their use must be monitored with regard to other operational departments that may be affected by the introduction of biocides, e.g. neonatal units, and renal and haemodialysis units where fatalities have occurred due the presence of chemicals in the water.

**Route of infection**

4.12 The principal route of infection for Legionnaires’ disease is through inhalation of the bacteria into the lungs via aerosols. The risk rises with increasing numbers of inhaled bacteria. Aspiration of contaminated drinking water into the airways has also been described as a mode of transmission of Legionnaires’ disease. For some patients, there is the additional risk of Legionella infection from the use of nasogastric tubes. Aspiration can be a significant source of legionellosis in certain vulnerable patients including stroke patients, those taking sedatives and narcotics, those with MND. Sucking ice made from contaminated water has been linked to some nosocomial cases of Legionnaires’ disease.

**Aerosol generation**

4.13 Contaminated water presents a risk when dispersed into the air as an aerosol. This risk increases with reduced droplet size, as smaller droplets remain airborne for longer, and smaller aerosols (<5 µm diameter) penetrate deeply into the lungs (alveoli) and cannot easily be expelled. However, larger droplets can evaporate and still contain the initial
number of organisms. Amoebic vacuoles, typically 3 µm, may contain many *Legionella* and potentially provide an infectious dose.

4.14 In both a cooling tower and evaporative condenser, water is actively recirculated around these systems, which increases the opportunity for aerosols to be produced. Water services are also capable of generating aerosols from the impaction of water onto hand-wash basins, sinks, baths and in shower cubicles and the flushing of toilets. In whirlpools and spas, the agitation of the water is achieved by the combination of air jets and pulsating water flow. Splashing water and air bubbles bursting as they break through the water surface create an aerosol immediately above the water surface.

**Number of infectious bacteria**

4.15 The number of organisms that cause infection has not been reliably determined and is likely to vary from person to person.

4.16 Two factors determine the number of bacteria deeply inhaled:

a. the concentration of bacteria in the air is determined both by the concentration of bacteria in the water and by the amount of contaminated water dispersed into a given air volume. The concentration of live bacteria in the air falls rapidly with distance from the source however this depends on the humidity. Where a cooling tower and the fresh-air inlet to a building are both at roof level, it may be possible for contamination from the evaporative cooling tower to reach the air inlet and, hence, enter the building;

Note: Cooling towers are not covered in this HTM; see HSG274 Part 1.

b. the duration of exposure to the contaminated air:

(i) exposure in a shower is usually limited to a few minutes, while exposure in a bath, particularly a spa, is much longer. Exposure to airborne *Legionella* distributed from a contaminated water-cooling system may take place whenever the tower is operating – this may be most of the day during the summer;

(ii) the risk increases with the number of *Legionella* in the air, the respiratory rate of the individual and the length of time the person is exposed. The chances of *Legionella* infections occurring increase with the number, and susceptibility, of people exposed.

**Susceptibility of individuals**

4.17 While previously healthy people may develop Legionnaires’ disease, there are a number of factors that increase susceptibility:

a. increasing age, particularly above 50 years (children are rarely infected);

b. males are approximately three times more likely to be infected than females (this may change with altered smoking habits);

c. existing respiratory disease that makes the lungs more vulnerable to infection;
d. illnesses and conditions such as cancer, diabetes, kidney disease or alcoholism, which weaken the natural defences;

e. smoking, particularly heavy cigarette smoking, because of the probability of impaired lung function;

f. patients on immunosuppressant drugs that inhibit the body’s natural defences against infection.
5 *Pseudomonas aeruginosa*: overview

**Ecology**
5.1 *P. aeruginosa* is a Gram-negative bacterium, commonly found in wet or moist environments. It is commonly associated with disease in humans with the potential to cause infections in almost any organ or tissue, especially in patients compromised by underlying disease, age or immune deficiency. As a pathogen the significance of *P. aeruginosa* is exacerbated by its resistance to antibiotics, virulence factors and its ability to adapt to a wide range of environments. And as a reservoir of resistance

5.2 *P. aeruginosa* thrives in relatively nutrient-poor environments such as water systems at a range of different temperatures and can exist in biofilms where the mixed bacterial population is bound to surfaces. Bacteria in biofilms can become detached which will contaminate the water phase.

**Transmission**
5.3 *P. aeruginosa* is an opportunistic pathogen that can colonise and cause infection in patients who are immunocompromised or whose defences have been breached (for example, via a surgical site, tracheostomy or indwelling medical device such as a vascular catheter). In most cases, colonisation will precede infection. Some colonised patients will remain well but can act as sources for colonisation and infection of other patients. As a microorganism that is often found in water, the more frequent the direct or indirect contact between a susceptible patient and contaminated water, and the greater the microbial contamination of the water, then the higher the potential for patient colonisation or infection.

5.4 Contaminated water in a hospital setting can transmit *P. aeruginosa* to patients through the following ways:

- direct contact with the water through:
  - ingesting
  - bathing
  - contact with mucous membranes or surgical site, or
  - through splashing from water outlets or basins (where the flow from the outlet causes splashback from the surface);
- inhalation of aerosols from respiratory equipment, devices that produce an aerosol or open suctioning of wound irrigations;
- medical devices/equipment rinsed with contaminated water;
• indirect contact via healthcare workers’ hands following washing hands in contaminated water, from surfaces contaminated with water or from contaminated equipment such as reusable wash-bowls.

Source

5.5 It is generally accepted in the case of Legionella that the source of bacteria in hot- and cold-water systems is the incoming water supply and that it becomes a problem where there is a failure of the recommended control measures (for example, maintenance of temperatures or water treatment regimens).

5.6 In contrast to Legionella, the origin of P. aeruginosa is less certain and its presence becomes evident at outlets (for example taps), particularly within the last two metres before the point of discharge. Devices fitted to, or close to, the tap outlet (for example thermostatic mixer valves, solenoids or outlet fittings) may exacerbate the problem by providing the nutrients which support microbial growth, providing a high surfaces are to volume ratio or a high surface area for oxygenation of water and leaching of nutrients from materials such as EPDM. The source, therefore, could be:

• the incoming water supply from the water provider;
• the water supply within the building (both from the storage and distribution system), usually within biofilms;
• the waste-water system (see Breathnach et al. 2012); or
• via external retrograde contamination from:
  o – clinical areas due to the discarding of patient secretions or where medical equipment may have been washed in the wash-hand basin
  o – outlet users where hands may have been contaminated by P. aeruginosa
  o – poor hygiene or processes during cleaning resulting in contamination from the outlet to the outlet fitting
  o – splashback from contaminated drains.

5.7 Given this variety, the challenge for managers and staff involved in the WSG is to risk-assess their particular operational practices in an attempt to minimise inoculation from any of these sources.

5.8 The WSG should consider that there are a range of opportunistic waterborne microorganisms that may be important when considering an infection risk where water may be a vector e.g. Mycobacterium (nont-tuberculous).

5.9 There are approximately 90 recognised species of Mycobacteria, over 20 of which are known to cause disease in humans. There are approximately 175 species of the genus Mycobacterium that do not belong to the Mycobacterium tuberculosis complex and thus are called non-tuberculous mycobacteria (NTM). Waterborne NTM have been associated with hospital (nosocomial) outbreaks worldwide. These disease outbreaks usually involve sternal wound infections, plastic surgery wound infections or post-injection abscesses.
Mycobacterial infections in patients undergoing dialysis treatment have also been reported. Other infections that have occurred include situations where water has been used in heater cooler units used in cardio pulmonary by pass operations where the water was used indirectly to control the temperature of the patient – a number of whom later suffered from infections of heart valves due to *M. chimera*.

**Stenotrophomonas**

5.10 There are at least 14 species of Stenotrophomonas; the most important waterborne opportunistic pathogen is *Stenotrophomonas maltophilia*. This is an emerging opportunistic environmental pathogen that causes hospital acquired infections and is found in aqueous habitats, including water sources. *S. maltophilia* is an organism with various molecular mechanisms for colonization and infection and can be recovered from polymicrobial infections, most notably from the respiratory tract of cystic fibrosis patients with *P. aeruginosa*. Its habits within the healthcare environment are very similar to *Pseudomonas aeruginosa* and include taps/tap water, sinks/sink traps, showers, hydrotherapy pools, ice-makers, disinfectant solutions, haemodialysers, nebuliser chambers, humidifier reservoirs, bronchoscopes, ventilator circuits. *Stenotrophomonas maltophilia* isolated from tap water has been shown to have been responsible for the colonisation/ infection in 5 neonates in an NICU.

**Management of control**

5.11 Management of water systems to reduce the risk of microbial growth including opportunistic pathogens such as *Legionella* and *P. aeruginosa* is vital to patient safety. It requires surveillance and maintenance of control measures including temperature control, usage, cleaning and disinfection measures as identified within the risk assessment and WSP for both hot- and cold-water systems.

5.12 To prevent the growth of opportunistic pathogens such as *P. aeruginosa*, controls are necessary to manage the water system before and after the outlet.

5.13 The WSG should ensure that estates and facilities staff have up to date accurate records and drawings/diagrams showing the layout and operational manuals of the whole water system. Estates and facilities staff should have received adequate training and be fully aware of the extent of their responsibilities. There should be strict adherence to the recommendations in HSG 274 and HTM 04-01.

5.14 The WSG should also ensure that IPC teams ensure application of, and compliance with, the evidence-based guidelines for preventing healthcare-associated infections in NHS hospitals in England (see Pratt et al. (2007) and ensure best practice advice relating to wash-hand basins is followed to minimise the risk of contamination due to opportunistic pathogens such as *P. aeruginosa*.

5.15 The ‘Health and Social Care Act 2008: Code of Practice on the prevention and control of infections and related guidance’ (the HCAI code of Practice) sets out the criteria against which a registered provider’s compliance with the requirements relating to cleanliness and infection control will be assessed by the Care Quality Commission. It also provides guidance on how the provider can interpret and meet the registration requirement and comply with the law. Regulations 12 and 15 state that providers should provide and maintain a clean and appropriate environment in managed premises that facilitates the prevention and control of infections.
5.16 IPC teams should continue to monitor clinical isolates of *P. aeruginosa* in risk-assessed augmented care units as an alert organism and be aware of possible outbreaks or clusters of infection with this microorganism.
6 Operational management

Introduction
6.1 Healthcare organisations have an explicit duty under the Health and Safety at Work Act etc 1974 to assess and manage the risks posed by water systems on their premises. In accordance with the HCAI Code of Practice, the healthcare organisation’s chief executive is responsible for having systems in place to manage and monitor the prevention and control of infection. These systems should make use of WSPs and risk assessments to consider how susceptible patients are at risk from their environment and from others. Ensuring these elements are in place will assist the organisation to fulfil its duties in relation to the provision of safe water systems. A programme of audit should be in place to ensure that key policies and practices are being implemented appropriately. This will inform the organisation’s assurance framework.

6.2 Each healthcare organisation, through its WSP, should be able to demonstrate that they have suitable governance, competence and accountability arrangements in place to deliver safe water in healthcare premises.

Management
6.3 Management is defined as the owner, occupier, employer, general manager, chief executive or other person who is ultimately accountable, and on whom the duty falls, for the safe operation of healthcare premises.

6.4 Management is required to have demonstrable evidence to meet the regulatory requirements and a WSP setting down the principles and procedures for controlling water safety risks. This will involve:

• ensuring the chief executive (duty holder) and management teams (duty holders) are aware of, and coordinate, the trust policy for managing water safely and are familiar with their devolved responsibilities, duties and relevant procedures;

Note:

In estate management, it is increasingly common for there to be several duty holders in one building. In such cases, duties may arise where persons or organisations have clear responsibility through an explicit agreement, such as a contract or tenancy agreement.

The extent of the duty will depend on the nature of that agreement. For example, in a building occupied by one leaseholder, the agreement may be for the owner or leaseholder to take on the full duty for the whole building or to share the duty. In a multi-occupancy building, the agreement may be that the owner takes on the full duty for the whole building. Alternatively, it might be that the duty is shared where, e.g. the owner takes responsibility for the common parts while the leaseholders take responsibility for the parts they occupy. In other cases, there may be an agreement to pass the responsibilities to a managing agent. Where a managing agent is used, the management contract should clearly specify who has responsibility for maintenance and safety checks, including managing the risk from waterborne hazards.
Where there is no contract or tenancy agreement in place or it does not specify who has responsibility, the duty is placed on whoever has control of the premises, or part of the premises

- ensuring that the duty holder appoint in writing a competent responsible person(s) to manage the risks from waterborne infections (see ACoP L8);

- providing adequate facilities, resources and competency training to support, implement and maintain all aspects of the policy and the water safety plan;

- providing a WSG to support, coordinate and review operational management and controls in accordance with statutory and mandatory requirements;

- requesting assurance from the WSG that all elements of the WSP across the organisation are being managed.

**The Water Safety Group (WSG)**

6.5 The WSG is a multidisciplinary group formed to oversee the commissioning, development, implementation and review of the WSP. The aim of the WSG is to ensure the safety of all water used by patients/ residents, staff and visitors, to minimise the risk of infection associated with water, including *Legionella*. It provides a forum in which people with a range of competencies can be brought together to share responsibility and take collective ownership for ensuring it identifies microbiological hazards, assesses risks, identifies and monitors control measures and develop incident protocols.

6.6 The WSG should have clearly identified lines of accountability up to the CEO and board. The roles, responsibility and accountability of the WSG should be defined.

6.7 The group should ensure that there is the appropriate expertise available to ensure that all elements of the WSP are fully implemented. The WSG may typically comprise personnel who:

- are familiar with all water systems and associated equipment in the building(s) and the factors which may increase risk of legionella infection, i.e. the materials and components, the types of use and modes of exposure, together with the susceptibility to infection of those likely to be exposed;

- have knowledge of the particular vulnerabilities of the ‘at risk’ population within the facility and, as part of its wider remit, the WSG should include representatives from areas where water may be used in therapies, medical treatments or decontamination processes (e.g. hydrotherapy, renal, sterile services) where exposure to aerosols may take place.

6.8 This would normally involve representation from estates (operations and projects), infection control, medical microbiology, nursing, augmented care, housekeeping / support services, authorising engineer/independent adviser, medical technical officers, specialist users of water such as renal and aquatherapy, sterile services departments (SSDs).
6.9 The WSG should be led and chaired by a person who has appropriate management responsibility, knowledge, competence and experience. Where required, it may appoint in writing an independent professional adviser /Authorising Engineer (Water) with a brief to provide services in accordance with this HTM and HSE Guidance.

**Remit of the WSG**

- to work with (and report to) the infection control team;
- to ensure effective ownership of water quality management for all uses.;
- to determine the particular vulnerabilities of the “at risk” population;
- to determine that water is fit for purpose and for each type of patient;
- to review the risk assessment and scheme of control;
- to ensure new buildings/equipment etc. are designed, installed, commissioned and maintained to required water standards;
- to ensure maintenance and monitoring procedures are in place
- to review monitoring data;

Example WSG structure
to agree and review remedial measures and actions, and ensure an action plan is place, with agreed deadlines, to ensure any health risks pertaining to water quality and safety are addressed;

to determine best use of available funds;

to be responsible for training and communication on water related issues;

to oversee the design and commissioning of new builds, refurbishments and modifications to the water system(s); installation and commissioning of all components; equipment;

water treatment with operational control monitoring and appropriate response to out of target parameters;

adequate supervision, training and competency;

surveillance – both clinical and environmental monitoring;

communication and documentation;

keeping the WSP under review.

6.10 Detailed minutes of the group meetings should be recorded, distributed promptly and retained in accordance with the management policy to demonstrate good management, appropriate and timely actions and good governance.

6.11 The WSG should always act in an appropriate and timely manner. Individual responsibilities should not be restricted by the need to hold formal meetings.

6.12 As part of its wider remit, the WSG should include representatives from areas where water may be used in therapies, diagnostic and medical treatments or decontamination processes.

6.13 Episodes of colonisation or infection of patients that could be related to the water system should be reported by the IPC team to the chair of the WSG, who will be expected to initiate an appropriate investigation.

6.14 The WSG should monitor any proposed developments on the design or installation of the water distribution system and check that they are:

• likely to minimise the risk to patients, especially those treated in augmented care settings;

• compliant with all extant legislation and DH policy and guidance.

6.15 All systems and equipment that use water to which patients, staff and visitors could be exposed should be approved by the WSG.

6.16 The WSG will need to ensure that decisions affecting the safety and integrity of the water system do not go ahead without being agreed by them.
Note:

Where estates & facilities provider services are part of a contract (including PFI), it is essential that these providers participate fully in all aspects of estate & facilities management that can affect patients. This includes responding to specific requests from the IPC team and WSG, which may be in addition to relevant guidance and documentation.

**Water safety plans (WSPs)**

6.17 To assist with understanding and mitigating risks associated with waterborne hazards in distribution and supply systems and associated equipment, healthcare providers should develop a WSP, which provides a risk-management approach to the safety of water and establishes good practices in local water usage, distribution, supply (see Figure 1). It will identify potential microbiological hazards, consider practical aspects and detail appropriate control measures.

6.18 Those organisations with existing robust water management policies for waterborne hazards will already have in place much of the integral requirements for developing a WSP.

6.19 The WSP is a living document. It should be kept under continual review and ensure the adequate assessment and control of the risks from a wide range of waterborne pathogens, including legionellae in healthcare and care home settings. It should be a standing agenda item at WSG meetings.

6.20 The first step in the development of a WSP is to gain a comprehensive understanding of the water system, including the range of potential hazards, hazardous events and risks that may arise during storage, delivery and use of water. It may require an understanding of the quality and management of the water as provided and how that water is used. Fundamental to this and any subsequent investigation or review is the provision and availability of accurate records. Schematic diagrams are useful for assisting understanding of how entire water systems operate, however more advanced drawings (as built) are often needed in complex buildings.

6.21 WSPs include the need to:

- assess the risks which may be posed to patients (including those with particular susceptibility), employees and visitors;
- put into place appropriate management systems to ensure the risks are adequately controlled;
- ensure there are supporting programmes, including communication, training and competency checks.

6.22 With respect to waterborne hazards, the WSP should incorporate:

- clinical risk assessment to identify those settings where patients are at significant risk from waterborne contamination associated with water use and its distribution system;
• an engineering risk assessment of the water system;
• operational monitoring of control measures and record-keeping methodology
• links to clinical surveillance which can offer an early warning of poor water quality;
• plans for the sampling and microbiological testing of water in identified at-risk units (see Appendices E and F).
• adequate supervision, training and competency for all levels of staff
• communication and documentation;
• installation and commissioning of all components and equipment.

Note:

Appendix F has been developed to provide technical guidance for a range of laboratories, including NHS, Public Health England (PHE) and commercial laboratories that have the capability and capacity to undertake water sampling and testing.

• changes to the water system to remedy high counts for *P. aeruginosa* and *Legionella* and other opportunistic pathogens where appropriate;
• adjustments to clinical practice until remedial actions have been demonstrated to be effective;
• regular removal/cleaning/descaling or replacement of the water outlets, hoses and TMVs and other components where risk assessment necessitates;
• amendments when changes are carried out and at annual review, including new builds, refurbishments and recently decommissioned clinical departments or units.

6.23 The WSP should identify potential alert organisms and microbiological hazards caused by *Legionella*, *P. aeruginosa* and other opportunistic pathogens, consider practical aspects and detail appropriate control measures.

**Question to consultees:**

Are the definitions under WSG and WSP detailed enough and helpful for users?
Figure 1 Documentation of management procedures (adapted from Figure 4.1 in WHO's 'Water safety in buildings')
Risk assessments

6.24 The risk assessments that inform the WSP should identify potential hazards caused by *Legionella*, *P. aeruginosa* and other opportunistic pathogens, chemicals, temperature and events that may arise during storage, delivery and use of water in healthcare settings.

6.25 Once potential hazards and hazardous events have been identified, the severity of risk needs to be assessed so that priorities for risk management can be established. The risk assessment needs to consider the likelihood and severity of hazards and hazardous events in the context of exposure (type, extent and frequency) and the vulnerability of those exposed. Although many hazards may threaten water quality, not all will represent a high risk. The aim should be to distinguish between high and low risks so that attention can be focused on mitigating risks that are more likely to cause harm (see HSG274 Part 2 for an example *Legionella* risk assessment). Typical examples of issues to consider may include the following:

- governance and accountability
- the susceptibility of all who may be exposed to water (including ice) and for diagnosis and treatment;
- scalding risk;
- clinical practice where water may come into contact with patients and their invasive devices;
- the appropriate cleaning of the environment and equipment;
- the disposal of blood, body fluids and patients’ wash-water;
- the maintenance and cleaning of wash-hand basins and associated taps, specialist baths and other water outlets;
- change in use (for example, clinical area changed to office accommodation or vice-versa) due to refurbishment or operational necessity;
- other devices that increase/decrease the temperature of water (for example, ice-making machines, water chillers) which may not be appropriate where patients are at particular risk such as in augmented care settings;
- engineering assessment of water systems, including correct design installation, commissioning, maintenance and verification of the effectiveness of control measures (see also the Water Supply (Water Fittings) Regulations);
- underused outlets;
- previous risk assessment, current control measures and documentation
- policies and procedures;
- the unnecessary use of flexible hoses and any containing inappropriate lining materials;
• sampling, monitoring and testing programme that needs to be put in place;
• the need for outlets at wash-hand basins that use sensor operation and TMVs (remote/ integral);
• backflow protection;
• education and training.

6.26 Although not under the category of augmented care, situations will arise where surgical wounds may become contaminated from water outlets such as showers. Similarly the practice of soaking leg ulcers or syringing ears may require consideration of the microbiological quality of water used and will require local assessment.

6.27 The likelihood of hazardous events is influenced by the size and complexity of the water system and can be exacerbated by poor or overcomplicated design, construction, commissioning, operation and maintenance.

**Staff training and competence**

6.28 Management should implement a programme of staff training to ensure that those appointed to devise strategies and carry out control measures and undertake associated monitoring are appropriately informed, instructed and trained, and should be assessed as to their competency. It is also essential that they have an overall appreciation of the practices affecting water hygiene and safety, and that they can interpret the available guidance and perform their tasks in a safe and technically competent manner.

6.29 The rate of change in building service technology is not great, but management should review the competence of staff on a regular basis, and refresher training should be given; records of training attendance would need to be maintained. Although training is an essential element of ensuring competence, it should be viewed within the context of experience, knowledge and other personal qualities that are needed to work safely. Competence is dependent on specific needs of individual installations and the nature of risks involved.

**Water hygiene training**

6.30 It is important that any person working on water distribution systems or cleaning water outlets has completed a water hygiene awareness training course in order that they can gain an understanding of the need for good hygiene when working with water distribution systems and water outlets, and how they can prevent of contamination of the water supply and/or outlets.

**Water hygiene training**

As part of helping to ensure the delivery of safe, wholesome water at all outlets and preventing contamination, which may lead to HCAI, it is recommended that healthcare organisations implement a Water Hygiene training scheme.

Consideration should also be given to integrating a health screening element into the training to help ensure those undergoing the training are not carriers of any waterborne diseases on date of training and are aware of their responsibilities towards the water
supply. It is important that individuals are aware of their duty to protect the health of patients, staff and visitors and that they are responsible for ensuring that they inform their line manager if they come into contact with any disease that has the potential to cause harm.

The course should encompass the following topics:

- The ways in which water distribution system and water outlets can become contaminated.
- The responsibilities of individuals to prevent the contamination of the water distribution system and water outlets
- How the safety of water can be maintained by good hygiene practices.
- When you personally should not work with drinking water.
- Personal hygiene along with dealing with clothing, footwear, cleaning equipment/materials, tools and storage when considering water hygiene.
- How to store and handle pipes,
- components/accessories (taps, TMVs)
- disinfection and cleaning equipment/materials
- How to recognise risks of contamination and deal with contamination when it occurs.
- What is the impact if you get it wrong?

**Management of water safety risks and issues**

6.31 Identified water safety risks and issues should be assessed, prioritised and included on a risk register for discussion and management by the WSG.

6.32 When the risks have been identified, an action plan needs to be developed with defined roles and responsibilities, and agreed timescales to minimise these risks. The action plan should include:

- appropriate remedial actions, monitoring details and schedules for validation that show the remedial actions are effective and subject to ongoing verification. Completion dates should be defined.
- any training and competency issues required to ensure compliance with this guidance.

**Documentation**

6.33 All records pertaining to the risk assessment and action plan should be held and managed by the WSG.
Protecting augmented care patients from exposure to *P. aeruginosa*

6.34 The following paragraphs give examples of best practice advice aimed at protecting the susceptible patient and ensuring a safe environment:

a. For direct contact with patients, water of a known satisfactory quality should be used, that is:

(i) water supplied through a point-of-use (POU) filter; or

(ii) sterile water (for example, for skin contact for babies in neonatal intensive care units or making ice in sterile containers or ice bags for augmented care patients. Ice machines should not be present in augmented care units).

b. Water outlets should be reviewed where there may be direct or non-direct contact with patients. This may also include reviewing the need for the outlets/showers and their potential removal.

c. For patient hygiene, single-use wipes should be considered.

d. Rigorous reinforcement of standard infection control practices, including refresher training, should be implemented.

e. The cleaning of clinical wash-hand basins and the taps should be undertaken in a way that does not allow cross-contamination from a bacterial source to the tap (see HTM 04-01 Part C on augmented care units).

f. The cleaning of patient contact equipment (for example, tap handles, incubators, humidifiers, nebulisers and respiratory equipment) should be reviewed. Options would be to:

(i) use single-use equipment;

(ii) if locally reprocessed – even if used on the same patient – clean equipment with water of a known satisfactory quality (see (a) above);

(iii) use single-use detergent wipes for cleaning incubators. If a disinfectant is used, it is important that it will not cause damage to the material of the incubator. Manufacturers’ instructions should be followed. Disinfectants should not be used to clean incubators while occupied.

g. All other uses of water on augmented care units should be considered (for example, the use of ice machines, drinking water fountains, bottled water dispensers, wet shaving of patients who have a central venous catheter inserted into the jugular vein and washing patients with indwelling devices) and appropriate action/changes to operational procedures taken.

Notes:

1. Tap water should not be used in neonatal units for the process of defrosting frozen breast milk or for topping up humidifier units in neonatal incubators.
2. Water features should not be installed in augmented care units.

h. All patient equipment should be stored clean, dry and away from potential splashing with water.

i. All preparation areas for aseptic procedures and drug preparation and any associated sterile equipment should not be located where they are at risk of splashing/contamination from water outlets.

j. All taps that are used infrequently on augmented care units should be flushed regularly (at least daily in the morning for one minute). If the outlet is fitted with a POU filter, the filter should not be removed in order to flush the tap unless the manufacturer's instructions advise otherwise. A record should be kept of when they were flushed. Some taps can be programmed to flush automatically; such flushing may be recorded on the building management system.

k. TMVs and associated components should be serviced, including descale and decontamination, at recommended intervals (see the TMV approval scheme at http://www.buildcert.com/tmv3.htm).

l. A TMV that is integral to the body of the tap/shower should be considered. A TMV should always draw cold water through every time the outlet is used, thus helping to minimise the risk of stagnation.

m. Where taps and showers are designed to be easily removed for maintenance purposes, they should be periodically removed for descaling and decontamination and/or placed in a washer-disinfector (subject to the tap manufacturer's instructions).

n. It should be ensured that:

(i) accurate records and drawings cover all the hot- and cold-water systems and that they have been updated following any modification;

(ii) all services are properly labelled such that the individual services can be easily identified;

(iii) staff who are engaged in the installation, removal and replacement of outlets and associated pipework and fittings are suitably trained to prevent contamination of the outlet and water system.

In these high risk areas it may be preferable to provide separate small-scale systems. Such systems should have independent supply and local heating sources.

6.35 Additionally, local water treatment may be considered necessary. It is also vital that cold water should be maintained below 20°C.

Note
Circulation of cold water and refrigeration should only be considered in the most critical of these areas, the aim should be to promote turnover of cold water by means of the design of the distribution circuitry. It is important to maintain regular movement of water in both hot and cold water distribution systems.

**Safe hot water temperature and personal hygiene**


6.37 To reduce the risk of scalding, thermostatic mixing devices will be required for specific hot water outlets (see Table 4 in Part A). A risk assessment will be necessary to establish the need and type of device to be installed.

6.38 As with any safety device, routine checks will be essential (see HTM 04-01 Supplement Chapter 11) to ensure continued satisfactory operation. Such devices, however, should not be a substitute for caution, and there are circumstances where nursing staff should always use a thermometer. For example, when performing assisted bathing, it is often necessary to set the delivery temperature to a higher level than that normally considered “safe” to allow for the cooling effect of large baths that are required.

6.39 Before lowering or assisting patients into the bath, the water temperature must be checked with a thermometer to ensure that it has fallen to a “safe” value.

**Utilisation**

6.40 One of the critical factors affecting the quality of water within hot and cold water distribution systems is the extent of utilisation.

6.41 Where stagnation occurs or utilisation is low, cold water temperature can increase significantly and approach the range that is conducive to the growth of a variety of water-borne pathogenic microorganisms such as *Legionella*. Where hot and cold water is mixed, further opportunities arise for deterioration in water quality.

6.42 TMVs should not be installed in series with mixing taps (thermostatic or manual) (see paragraphs 6.54–6.62). Any underused outlet should be flushed daily in augmented care units and twice weekly elsewhere.

6.43 Management needs to ensure that there is good liaison between the estates officers/maintenance providers and clinicians to ensure that the water services are sufficiently used.

6.44 Showers generate the highest risk of transmission of *Legionella* because of their capacity to produce aerosols and the potential under-utilisation; even when patients require assisted bathing, they are likely to use WCs and hand-wash basins, and water usage for these will be maintained. This may be less of a problem in multi-bed wards in which other patients are capable of using showers with or without assistance.

6.45 It will be essential to build into the management of the premises a mechanism to ensure that such facilities are routinely operated to draw off water. HSG274 *Legionella* technical guidance (2013) recommends that generally, for sporadically used outlets, flushing is carried out once a week but that in healthcare facilities the risk assessment may
indicate a higher frequency, and water draw-off should form part of the daily cleaning process. The procedure for such practice should be fully documented and covered by written instructions.

**Note**

Regular flushing applies to all sporadically used outlets.

**Temporary closure of wards/departments**

6.46 During temporary closure of wards or departments, a procedure for flushing the hot and cold water service systems should be instituted. This should include opening all taps and showers for a period of time sufficient to ensure that all distribution pipes are refreshed and flushing WC cisterns etc on a twice-weekly cycle. This can be determined by flushing until stable systemic temperatures are achieved.

6.47 Alternatively, when this is impracticable, the disinfection procedure recommended for new installations may be carried out immediately prior to occupation. This should be applied upstream of the closed area. Advice and guidance is provided in BSI's PD855468.

**Query to consultees: is paragraph 6.46 correct as stands?**

**Leak detection/water conservation**

6.48 It is essential to regularly check systems and all components for signs of leakage; for example, a tap left dripping can waste in excess of 14,000 L of water each year.

6.49 Consumption should be monitored; if it increases for no apparent reason, this may indicate a leak. Wet or soggy patches of ground may identify underground leaks, for example areas of greenery that are more lush than their surroundings.

6.50 Where water conservation measures are to be considered, a risk assessment should be undertaken to ensure there is no detrimental impact that may cause stagnation or low water usage in the existing water or drainage systems.

6.51 For further guidance, see HTM 07-04 ‘Water management and conservation’.

**Chloramine water treatment undertaken by local water undertaker**

6.52 In some areas, local water undertakers are using chloramine as the residual disinfectant in public water supplies on the grounds that they are more stable and effective in preserving water quality to consumers. Chloramines can present problems for dialysis water systems (see Appendix 2 in Part A). It is recommended that regular contact is maintained with the local water undertaker to keep up to date to changes which may affect water quality or other operational changes affecting the premises.

**Energy management policy**

6.53 An energy management policy should be set up to define actions that should be taken to minimise energy consumption. An effective maintenance plan will also contribute

**Maintenance practice**

See also the maintenance section in HTM 04-01 Supplement – D08.

6.54 Any contractor should be able to demonstrate that they have completed a water hygiene training course.

6.55 There are legal, operational and economic reasons for introducing good maintenance practice. There is a legal requirement under the Water Supply (Water Fittings) Regulations 1999 to maintain water fittings to comply with the regulations. It sets requirement to protect and preserve the safety of staff, patients and the public. Complying with the law is generally given the highest priority and is the minimum requirement that must be satisfied. Chapter 3 lists specific statutes that must be complied with. Additional advice is provided in BS EN 806-5 and BS 8558.

6.56 Regulations require notification to the water undertaker of any proposed changes and additions to the water supply system in the premises. Prior to making any changes, a risk assessment should be carried out and audited by an independent assessor. Further details can be found on the WRAS website https://wras.co.uk/plumbing_professionals/advice_for_plumbing_professionals/notification/

6.57 Maintenance will be required to achieve optimum economic life and maintain maximum operational efficiency of the plant.

6.58 To decide the appropriate level of maintenance (for example scheduled, corrective or condition-based) for the different items of plant, there should be a risk assessment for the different items of plant. The following questions must be addressed:

   a. Would a breakdown of a particular service during working, or outside normal, hours pose a risk to patient wellbeing?

   b. How long can a breakdown of particular plant be tolerated?

   c. What cost can be justified to avoid breakdown of particular plant such as stand-by pumps, dosing pumps etc?

   d. The availability of suitable spares.

6.59 If response to failure is critical for certain items of plant, the maintenance organisation will require a planned strategy of calling out skilled staff to achieve an agreed response time and to minimise the interval between breakdown and the diagnosis and repair of the plant.

6.60 Management is ultimately responsible for the provision of a wholesome water supply in the premises under its authority.

6.61 The approach for healthcare premises should be based on that of planned preventative maintenance, as any failure in the water services would be seriously detrimental to the provision of healthcare.
6.62 Planned preventative maintenance involves a series of inspections at regular intervals and monitoring operating parameters to avoid failure by implementing timely remedial work.

**Maintenance responsibility**

6.63 A maintenance manager must be given responsibility for implementation of a risk based operational maintenance strategy. These responsibilities will include:

   a. the provision of adequately trained and supervised labour (see also paragraph 6.30 on water hygiene training);

   b. clear definitions of the equipment and services to be maintained, together with the procedures to be carried out on them;

   c. monitoring of the quality of the work carried out to ensure that it is consistently acceptable;

   d. the implementation of financial control procedures.

**Contract maintenance**

6.64 The increasing complexity of building services equipment has resulted in a growing reliance on contractors for the provision of maintenance services. The decision to use either a contractor or in-house staff must be taken in the light of local circumstances.

6.65 Contracts between the hospital/healthcare premises and service providers should clearly define the responsibilities of both parties. BSRIA’s (1992) Application Guide AG 4/89.2: ‘Maintenance contracts for building engineering services’ provides advice on aspects to be considered when obtaining contract maintenance.

6.66 Reference should also be made to:

   • Scottish Health Technical Note 2 – ‘Domestic hot and cold water systems for Scottish health care premises’;

   • Scottish Health Technical Note 6 – ‘The safe operation and maintenance of thermostatic mixing valves’; and


6.67 All staff who work on or with the water systems must have the necessary qualifications, regulatory knowledge, competence and experience needed to complete safely and effectively their specific tasks. Each individual should have a full understanding of their role and the impact of their actions on patient care (see also paragraph 6.30 on water hygiene training).

6.68 Only installers with the appropriate qualifications, regulatory knowledge and competence, should be used to install and maintain water installations. There are seven Approved Contractors’ schemes (APHC, Aplus, CIPHE, Snipef, Taps, WaterMark and WIAPS) authorised through the Water Supply (Water Fittings) Regulations 1999. In
addition to plumbing installers, four schemes (Aplus, Taps, WaterMark and WIAPS) operate sector memberships for specialist areas of work covering external water services (below ground pipe etc), catering equipment and point-of-use (chilled water) equipment.

6.69 The WaterSafe register holds details from all seven Approved Contractors’ Schemes for businesses that have registered plumbing installers.

6.70 A recognised benefit to using an Approved Contractor (including sector installers) is they can carry out some work without the need to provide advanced notification to the water undertaker and their work will be certified upon completion. A ‘work completed’ certificate issued by a WaterSafe recognised plumber provides a defence for property owners who are challenged by a water undertaker enforcing the Water Supply (Water Fittings) Regulations 1999 or during legal proceedings.

6.70a Any contractor should be able to demonstrate that they have completed a water hygiene training course.

**Maintenance brief**

6.71 The maintenance manager requires a brief that is in line with all the requirements of the WSP and approved by the WSG. This will include:

a. the scope of work;
b. budgeting – overall and single item limits;
c. level of reliability;
d. response time required to correct faults;
e. criteria for quality of service, works and equipment;
f. reporting procedure;
g. accountability and responsibility;
h. energy-saving policy;
j. health and safety policy;
k. environmental and sustainability factors.

6.72 The above requirements are necessary regardless of whether the work is carried out by contractors or in-house staff.

**Performance monitoring**

6.73 This involves the regular inspection of systems and records, which should be in such detail as to enable management to form an opinion regarding compliance with the agreed criteria.

6.74 If a contractor is commissioned to carry out maintenance and in-house expertise is not available to monitor their performance, it may be necessary to seek advice from an
independent professional adviser (this may be available from a neighbouring NHS organisation). Using another maintenance contractor in a monitoring role could lead to a conflict of interest.

6.75 Performance monitoring should establish that:

a. the required level of service is met;
b. all the required plant is being maintained;
c. system performance is being maintained (where water treatment is provided as part of the control strategy, it will be necessary to test for Legionella);
d. maintenance is being carried out to the agreed standard;
e. correct replacement parts are being used;
f. the agreed spares stocks are being held on site;
g. records are being correctly maintained;
h. the agreed standards, number of staff, and number of visits are being achieved;
j. plant is being operated to achieve optimum energy usage;
k. health and safety requirements are being complied with;
m. only agreed subcontractors are being employed (see paragraphs 6.64–6.66);
n. the client and typical users of the building are satisfied;
p. invoices accurately reflect the work carried out, including materials expended;
q. breakdowns do not occur too often;
r. adequate consideration is being given to the potential environmental impact of contractors’ action, for example disposal of lubricants, chemicals, worn parts etc that cannot be recycled.

**Emergency action**

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

a. a power or energy interruption or a plant failure resulting in the temperature control strategy or the delivery of effective control measures being maintained as designed.
b. a water supply failure which could last beyond the period for the designed storage capacity.
c. poor results that could impact on patient safety.
d. emergency action in the event of a case or an outbreak of healthcare-waterborne infection (see Appendix B).
6.77 Guidance on temporary supplies is provided in BS 8551 – ‘Provision and management of temporary water supplies and distribution networks (not including provisions for statutory emergencies) - code of practice’.

Note:

Under the Security and Emergency Measures Direction, water suppliers should liaise with healthcare authorities to develop emergency plans to maintain supplies for domestic purposes to healthcare premises.

These plans might include:

- Adequate storage cistern capacity and distribution arrangements within the hospital to provide minimum volumes of water at the outset of a major incident to maintain hygiene and health for an initial period until other temporary arrangements can be introduced.

- The provision of facilities to connect to, and distribute water from, temporary storage cisterns such as pillow tanks at key locations within the site. Ground level storage cisterns will require provision of booster pumps to either lift the water to existing storage cisterns or to distribute it directly through existing or temporary site water mains.

- The provision of connection points to existing storage cisterns at suitable locations for delivery of emergency supplies of water, for example from tankers.

- Plans for the supply and distribution of bottled water for drinking to vulnerable patients and those unable to collect supplies from distribution points within the hospital.

Data management and record-keeping

6.78 There is a legal requirement for the retention of documentation relating to monitoring and remedial actions (see L8). Given the amount of data that must be managed to facilitate the effective management of large and complex water systems, it is recommended that electronic data management tools be utilised to facilitate the intelligent use of data for the WSG to easily monitor trends and analyses chemical and microbiological parameters.

6.79 It is essential to have comprehensive operational manuals for all items of plant that include requirements for servicing, maintenance tasks and frequencies of inspection.

6.80 This information should be kept together with all commissioning data.

6.81 Documentation should also be drawn up as part of the health and safety file for the building or hospital (see Chapter 17, Part A).

As-fitted drawings

6.82 The availability of accurate as-fitted drawings is essential for the safe operation of hot and cold water service systems. The drawings will be necessary to perform the temperature control checks on the systems and will assist in identifying any potential
problems with poor hot water circulation and cold water dead-legs where flow to sporadically used outlets can be low. Such information should identify all key components in the installations, for example water meters, storage tanks (filtration equipment, where fitted), calorifiers, and the location of isolating valves in the systems. Separate schematic drawings should be prepared and displayed in plantrooms such that all plant items, control valves etc. can be identified. Drawings should be kept up to date and amended when any changes are made to the system.

Note:

All drawings should be available to each person working on the systems and while conducting risk assessments.

6.83 In addition to drawings, there should be comprehensive schedules of outlets, lists of sentinel taps (outlets), other outlets to be tested annually and other components in the system.

**Asset register**

6.84 It is a requirement to have an up to date asset register (see L8). Management should ensure that an accurate record of all assets relating to the hot and cold water distribution systems is set up and regularly maintained. They must also ensure that records of all maintenance, inspection and testing activities are kept up-to-date and properly stored. Records should be kept throughout the period they are current and for at least two years afterward. Records of any monitoring inspection, test or check carried out should be kept for at least five years.

6.85 As a minimum, the following items should be recorded:

a. the names and positions of those responsible for conducting the risk assessment, managing and implementing the written scheme;

b. the significant findings of the risk assessment;

c. the written scheme and its implementation;

d. details of precautionary measures that have been carried out, including sufficient detail to identify that the work was completed correctly and when the work was carried out; and

e. results of any monitoring inspection, test or check carried out.

6.86 Planned preventive maintenance will help to ensure that systems perform correctly, and an essential element of this process is the maintenance of accurate records.

6.87 When alterations to plant or systems are implemented, the record drawings should be updated to reflect the modifications carried out.

6.88 An asset register for the engineering services would provide a structure for recording, retrieving and analysing information.

Note:
BIM will over time assist in recording assets and their associated information.

6.89 The asset register should be designed to provide the following information:

a. an inventory of plant and water associated equipment;

b. a basis for identifying plant details;

c. a basis for recording the maintenance requirements;

d. a basis for recording and accessing information associated with maintenance;

e. a basis for accounting to establish depreciation and the provision needed for plant replacement;

f. information for insurance purposes.

6.90 When completing records, it is essential that the individual concerned signs and dates the entries, and that there is an audit trail in place. Pro forma log sheets for temperature checks are included in Appendix C.

6.91 Further information on the monitoring of performance and effectiveness in carrying out maintenance tasks can be found in CIBSE’s (2000) ‘Guide to ownership, operation and maintenance of building services’.

6.92 The Responsible Person(s) should be fully conversant with the design principles and requirements of water systems and should be fully briefed in respect of the cause and effect all waterborne hazards. [where does this para fit?]
7 Description of systems, operational considerations and requirements

Source of supply
7.1 See Chapter 2 in Part A for comprehensive guidance and information on sources of water supply.

7.2 If supplies are taken from local boreholes or wells etc, the water should be tested to comply with the requirements of the Private Water Supplies Regulations 2009. The results of all analyses should be kept and recorded.

Water supply hygiene, treatment and control procedures
7.3 Where biocides are used to treat water systems the WSG should be satisfied that the design, specification and commissioning will enable the water treatment systems to achieve the required biocide concentrations throughout the system at all times to minimize microbial risk. The impact of treated water on the materials and components of the existing system must be taken into account along with advice from the necessary suppliers and installers. Within a healthcare facility the detrimental effects of biocide treatment, such as corrosion of metal components and deterioration of plastics, must be taken into consideration as biocide use may shorten the life span of particular components.

7.4 All biocides used must meet the European Biocidal Products Regulation (BPR, Regulation (EU) 528/2012) which regulates the use of biocidal products; and the Drinking Water Directive, transposed into law in the Water Supply (Water Quality) Regulations 2000 (as amended), for public water supplies, and in the Private Water Supplies Regulations 2009, for private supplies.

For more information, see Chapter 4 of HTM 04-01 Part A.

Thermal disinfection (of hot water service systems)
7.5 This process introduces a serious scalding risk, and it is essential that steps are in place to ensure that access is limited to authorised personnel only until such time that the system has returned to normal operating temperature; it is unlikely to be a practical alternative for a large system.

7.6 Where considered practical, this process can be performed by raising the temperature of the entire contents of the calorifier, followed by circulating the water throughout the system for at least an hour. The process, however, is impractical for all but small systems or where there is complete control of the system during the disinfection process. The calorifier temperature must be sufficiently high to ensure that the temperature in all parts of the circulating system, and at the calorifier return, does not fall below 60°C. After this period, each tap or outlet should be run sequentially, with the draw-off at the furthermost tap or outlet being for a period of five minutes.
7.7 In the case of non-recirculating systems that have trace heating, the whole system should similarly be raised to 60°C for at least an hour before draw-off commences.

**Metal contamination**
7.8 See Chapter 5 in Part A.

**Water softening**
7.9 See Chapter 6 in Part A.

**Filtration**
7.10 See Chapter 7 in Part A.

**Metering**
7.11 Metered data should be logged and recorded by an automatic metering system (see also HTM 07-04). Where water meters are installed in below-ground meter chambers, the chambers should be kept clean of debris and water; this will enable quick and accurate reading of the meters.

7.12 Meters should be periodically checked to ensure that they are operating and providing accurate readings.

7.13 Meters, other than the water undertaker’s meter, should be removed at such intervals as recommended by the manufacturers for cleaning and renewal of worn parts and should be tested for accuracy prior to replacement.

7.14 Meters should ideally provide a pulse output that can be monitored by BMS but if not should be read on a regular basis (monthly) and consumption monitored. A bar graph will highlight unusually large consumption, which can then be investigated. Where it is desirable to connect to the water undertaker’s meter their authorisation must be gained in advance.

7.15 Consumption should be checked against the utility bill and any discrepancies investigated.

**Water storage**
7.16 For general information on water storage, see Chapter 8 in HTM 04-01 Part A.

7.17 The Water Supply (Water Fittings) Regulations 1999 and relevant parts of BS EN 806 and BS 8558 specify minimum standards for cold water storage cisterns to ensure that the stored water is retained at a wholesome standard suitable for domestic use. It is necessary to minimise stagnation and stratification of the stored water. A nominal 12 hours’ total on-site storage capacity is recommended. The quantity of the water stored should be carefully assessed in relation to the daily requirement so that a reasonable rate of turnover is achieved. The storage capacity should be reduced where it is known or established that it is excessive and where it is practicable to do so.

7.18 All cold water storage cisterns and cold feed cisterns must be examined at least annually, paying particular attention to the presence of foreign objects, biological material
and excessive corrosion. On completion of the examinations, the cisterns should be cleaned, if required, and any remedial work carried out. Before the cisterns and system are put back into use, they should be disinfected in accordance with the procedure detailed in Chapter 17 of Part A. Where consideration is being given to the removal of a storage cistern, a full assessment of the downstream system is needed to ensure any consequential impacts are properly understood. These may include, but not limited to, changes in pressure for pipes or equipment, backflow prevention protection the cistern may have been providing (e.g. pathology equipment, endoscopes, sluices rooms etc).

7.19 Any chemicals or biocidal products used in the cleaning or maintenance of cisterns must meet the necessary regulatory requirements (see paragraph 7.3), e.g. be listed in the DWI’s ‘List of Approved Products’. http://dwi.defra.gov.uk/drinking-water-products/approved-products/index.htm

7.20 Cistern insulation should be checked to ensure that it is adequately positioned and in good condition.

7.21 Float-operated valves should be checked to ensure that they are securely fixed and set to achieve a correct water level in accordance with the Water Supply (Water Fittings) Regulations 1999.

7.22 Overflow/warning pipes should be checked to ensure that they do not rise in level and they are clear and correctly routed to give an obvious visual alarm of an overflow condition. A weatherproof label fixed adjacent to the warning pipe, identifying the tank and its location together with the person/department to be contacted in the event of a discharge, would contribute to a quick and accurate defect report which could then be acted upon, so minimising water wastage.

7.23 A schematic drawing, illustrating piping and valve arrangements for break-tank operation during normal running and maintenance periods, is shown in Figure 2 of Part A.

**Pressurisation/supply pumps**

7.24 Where two or more pumps are installed for pressurising systems, automatic control should be provided to cyclically and sequentially operate the pumps to minimise any danger of stagnation.

7.25 The maintenance carried out on this type of equipment should be in accordance with the manufacturer’s recommendations. Secondary recirculation pumps should be manually inspected at least monthly to ensure that they are operating effectively.

**Cold water distribution system**

7.26 The design and installation of the cold water distribution system should comply with the Water Supply (Water Fittings) Regulations 1999 and relevant parts of BS EN 806-2 and BS 8558 (see Chapter 9 of Part A for further information).

7.27 The control of water temperature in the cold water service will essentially rely on good insulation and water turnover. Maintaining regular movement of cold water in sections prone to stagnation and guarding against excessive heat gain are effective control measure for legionella and other waterborne pathogens. Measures that encourage the movement of cold water in areas of the distribution system that are prone to stagnation
and heat gain should be considered. Cold water services should be sized to provide sufficient flow and should be kept away from areas where they are prone to thermal gains. Stagnation must be avoided. Special attention should be given to the maintenance and monitoring of these systems.

**Note**

Automatic flushing of urinals can also be used to assist in water turnover. (Automatic flushing devices should not be installed in accommodation in which patients may become disturbed.)

7.28 Schematic diagrams (or as built drawings) of the system with numbered and labelled valves will reduce confusion and save time in trying to identify appropriate isolating valves and other system components.

7.29 Checks and actions should be carried out to show that:

a. the system components show no sign of leakage or corrosion;

b. the system insulation is in good condition;

c. the system filters have been changed and/or cleaned in accordance with manufacturers' recommendations. Regularly check and clean strainers;

d. all isolating valves have periodically been worked through their full range of travel;

e. every water outlet complies with the backflow protection requirements of the Water Supply (Water Fittings) Regulations 1999.

**Drinking water**

7.30 Current guidance does not draw a distinction between drinking and general cold water services and separate systems are no longer recommended.

7.31 The installation of separate drinking water supplies has been standard policy. But in many cases where such systems have been installed, the quality of drinking water (particularly at sporadically used draw-offs, for example washrooms) has generally been inferior to that of the general cold water supply.

7.32 If separate drinking water supplies are provided, reference should be made to paragraphs 8.13 and 8.14 in Part A.

**Hot water storage and distribution**

7.33 Hot water services should be designed and installed in accordance with the Water Supply (Water Fittings) Regulations 1999 and relevant parts of BS EN 806-2 and BS 8558. The hot water system may be of either the vented or the unvented type (see Chapter 10 of Part A for further information).

7.34 To control possible colonisation by *Legionella*, it is essential to maintain the temperature within the hot water circulating system. To some extent, if properly maintained, the calorifier/water heater will provide a form of barrier to *Legionella* and other
water-borne organisms. The minimum flow temperature of water leaving the calorifier/water heater should be 60°C.

7.35 The minimum water temperature at the connection of the return to the calorifier/water heater should be 50°C. To achieve the required circulating temperatures, it will be necessary to maintain the balance of flows to individual pipe branches and draw-off points.

7.36 Calorifiers should be subjected to regular procedures that include the following:

- cleaning and maintenance;
- quarterly drain flushing to minimise the accumulation of sludge. This may be extended to annual draining if, during inspection, it is found that there is little accumulation of debris;
- whenever dismantled, for statutory inspection, or every year in the case of indirect calorifiers, calorifiers should be thoroughly cleaned to remove sludge, loose debris and scale;
- whenever a calorifier is taken out of service, it should be refilled, drained, refilled again and the entire contents brought up to, and held at, the nominal operating temperature of 60°C for at least an hour;
- The calorifier should remain isolated until the procedure is completed. When bringing calorifiers back on line, it is important that service valves are opened slowly to avoid any disturbance of sediment debris. Calorifiers that are to be taken out of service for more than a few days should be drained and should not be refilled until ready for return to service. The drain valve should be left open while the calorifier is out of use;
- users are reminded that if a calorifier is colonised by *Legionella* and is then drained and opened for maintenance purposes, there can be a risk of infection to maintenance personnel and personal protective equipment will be necessary;
- where it is known, or established, that gross over-capacity exists in a calorifier, and where it is practicable to do so, it should be removed;
- approximate calorifier emptying times are shown in Table 3 (Part A).

**Notes**

Ball-type valves should be specified to avoid clogging. The drain from the gully should be of sufficient size to take the flow from the calorifier drain.

7.37 Hot water circulating pumps should be of adequate performance to ensure a minimum available temperature at draw-off points of 55°C and an absolute minimum of 50°C at the return connection to the calorifier. If it is essential to have a stand-by hot water service circulating pump, it should be automatically controlled so that each is regularly brought into operation (every three hours).
7.38 It is not permissible to shut down the pumped circulation. To do so will lead to the loss of the required system temperatures.

**Instantaneous water heaters for single or multi-point outlets**

7.39 These devices usually serve one draw-off only and are either electrically or gas-heated. In essence:

a. the flow rate is limited and is dependent upon the heater’s hot water power rating;

b. where restricted rates of delivery are acceptable, the heater can deliver continuous hot water without requiring time to reheat;

c. they are susceptible to scale formation in hard water areas, where they will require frequent maintenance;

d. this form of hot water heating should only be considered for smaller premises or where it is not economically viable to run hot water distribution to a remote outlet.

e. They should be monitored to ensure they operate above 55°C (see HSE summary checklist)

7.40 Where electrical trace heating is used, it should be checked routinely (at least monthly) to ensure that it maintains the water temperature above 55°C. Care should be taken to ensure there are no cool spots. Consideration should be given to monitoring the temperatures by means of a building management system (BMS) (sensors should be located at the most distal points).

**Safe hot water delivery devices**

7.41 Thermostatic mixing taps should only be installed where a risk assessment indicates their need. This will include all cases where there is total body immersion. For further guidance and for a list of the types of mixing devices used, see Table 4 on page 61 of Part A.

7.42 It is essential to check the temperature settings and operation of water mixing devices regularly (see HTM 04-01 Supplement D08 and manufacturers’ instructions). Other maintenance should be strictly in accordance with the manufacturer’s instructions. The local water quality will influence the maintenance frequency for any installation. A relatively small piece of debris may restrict the operation of the temperature control and fail-safe mechanisms.

7.43 Recommendations in Part A regarding safe water temperature apply to all in-patient accommodation, residents’ rooms and those areas to which patients, residents and visitors have free access (including public areas). Until the recommended precautions are put into effect, staff should be made aware of the potential danger and take the necessary steps to protect patients, residents and visitors. Areas that do not meet these recommendations should be identified, and plans to comply as soon as reasonably practicable should be devised.

**Note:**
When bathing, or assisting patients, healthcare staff must always check the water temperature with a thermometer.

**Temperature control regimen**

7.44 Temperature control regimen is the preferred strategy to maintain systems free from *Legionella* and other waterborne organisms. This will require monitoring on a regular basis.

7.45 Whereas many of the checks will, of necessity, require the use of separate thermometric equipment, some of the temperature checks can be carried out by continuous monitoring by a BMS. Where a BMS is used, it will be essential to ensure that regular calibration and physical tests are performed in accordance with the manufacturer’s instructions.

7.46 More extensive use of BMS should be considered: hot water service flow and return temperatures should be monitored at the entry to individual wards, and cold water service(s) at the most distal point(s). In other departments where bathing/showering is less likely, monitoring should be provided on branches serving up to 50 outlets. The BMS can also be used to monitor the temperature in non-recirculating systems that have trace heating – the alarm level should be 50C.

**Showers**

7.47 Hyper-chlorination of showerheads and angle valve strainers has only a short-lived effect on *Legionella*. Manual cleaning to remove scale and other deposits should be carried out as based on the risk assessment (at least quarterly), and more frequently if required. Automatic drain valves are ineffective in maintaining a reduction in the number of *Legionella* in shower water, and they should not be installed (see the Health and Safety Executive’s (2014) HSG 274 Part 2). Regular flushing of showers reduces *Legionella*, but *Legionella* can significantly increase in number if regular flushing should cease. The most effective management of showers will be achieved by the removal of unnecessary ones and the regular use of others. Where showers are removed, it is important to cut back all the associated pipework to avoid creating dead-legs.

7.48 Where it is difficult to carry out flushing to the recommended frequency, stagnant and potentially contaminated water from within the shower and associated dead-leg should be purged to drain immediately before the appliance is used. This procedure must be carried out with minimum production of aerosols. It is important to note the distinction between self-purging and self-draining showers. Self-purging showers can be an effective *Legionella* control procedure, while self-draining showers can support the proliferation of *Legionella*.

**Point-of-use filtration**

7.49 Where point-of-use filters are installed as a temporary measure whilst appropriate remedial work is carried out, they should be changed in accordance with the manufacturers’ recommendations, typically at least once a month. When changing filters, it is recommended that sampling of water quality take place at outlets identified as sentinel points, before refitting a replacement filter. Except where taking samples as above, once point-of-use filtration has been introduced, taps or showers must not be used without a filter in place.
7.50 Where point-of-use filters are no longer required, the outlet and associated pipework must be disinfected to remove any accumulated biofilm before the system is returned to service.

**Summary checklist**

7.51 A summary checklist for hot and cold water systems is shown on the following three pages (reproduced from HSG274 Part 2 by kind permission of the Health & Safety Executive).
# Checklist for hot and cold water systems

<table>
<thead>
<tr>
<th>Service</th>
<th>Action to take</th>
<th>Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Calorifiers</strong></td>
<td>Inspect calorifier internally by removing the inspection hatch or using a boroscope and clean by draining the vessel. The frequency of inspection and cleaning should be subject to the findings and increased or decreased based on conditions recorded. Where there is no inspection hatch, purge any debris in the base of the calorifier to a suitable drain. Collect the initial flush from the base of hot water heaters to inspect clarity, quantity of debris, and temperature. Check calorifier flow temperatures (thermostat settings should modulate as close to 60 °C as practicable without going below 60 °C). Check calorifier return temperatures (not below 50 °C).</td>
<td>Annually, or as indicated by the rate of fouling. Annually, but may be increased as indicated by the risk assessment or result of inspection findings. Monthly.</td>
</tr>
<tr>
<td><strong>Hot water services</strong></td>
<td>For non-circulating systems: take temperatures at sentinel points (nearest outlet, furthest outlet and long branches to outlets) to confirm they are at a minimum of 50 °C within one minute (55 °C in healthcare premises). For circulating systems: take temperatures at return legs of principal loops (sentinel points) to confirm they are at a minimum of 50 °C (55 °C in healthcare premises). Temperature measurements may be taken on the surface of metallic pipework. For circulating systems: take temperatures at return legs of subordinate loops, temperature measurements can be taken on the surface of pipes, but where this is not practicable, the temperature of water from the last outlet on each loop may be measured and this should be greater than 50 °C within one minute of running (55 °C in healthcare premises). If the temperature rise is slow, it should be confirmed that the outlet is on a long leg and not that the flow and return has failed in that local area. All HWIS systems: take temperatures at a representative selection of other points (intermediate outlets of single pipe systems and tertiary loops in circulating systems) to confirm they are at a minimum of 50 °C (55 °C in healthcare premises) to create a temperature profile of the whole system over a defined time period.</td>
<td>Monthly. Quarterly (ideally on a rolling monthly rota). Representative selection of other sentinel outlets considered on a rotational basis to ensure the whole system is reaching satisfactory temperatures for legionella control.</td>
</tr>
<tr>
<td><strong>POU water heaters (no greater than 15 litres)</strong></td>
<td>Check water temperatures to confirm the heater operates at 50–60 °C (55 °C in healthcare premises) or check the installation has a high turnover.</td>
<td>Monthly—six monthly, or as indicated by the risk assessment.</td>
</tr>
</tbody>
</table>

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<table>
<thead>
<tr>
<th><strong>Combination water heaters</strong></th>
<th>Inspect the integral cold water header tanks as part of the cold water storage tank inspection regime, clean and disinfect as necessary. If evidence shows that the unit regularly overflows hot water into the integral cold water header tank, instigate a temperature monitoring regime to determine the frequency and take precautionary measures as determined by the findings of this monitoring regime</th>
<th>Annually</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Check water temperatures at an outlet to confirm the heater operates at 50-60 °C</td>
<td>Monthly</td>
</tr>
<tr>
<td><strong>Cold water tanks</strong></td>
<td>Inspect cold water storage tanks and carry out remedial work where necessary</td>
<td>Annually</td>
</tr>
<tr>
<td></td>
<td>Check the tank water temperature remote from the ball valve and the incoming mains temperature. Record the maximum temperatures of the stored and supply water recorded by fixed maximum/minimum thermometers where fitted</td>
<td>Annually (Summer) or as indicated by the temperature profiling</td>
</tr>
<tr>
<td><strong>Cold water services</strong></td>
<td>Check temperatures at sentinel taps (typically those nearest to and furthest from the cold tank, but may also include other key locations on long branches to zones or floor levels). These outlets should be below 20 °C within two minutes of running the cold tap. To identify any local heat gain, which might not be apparent after one minute, observe the thermometer reading during flushing</td>
<td>Monthly</td>
</tr>
<tr>
<td></td>
<td>Take temperatures at a representative selection of other points to confirm they are below 20 °C to create a temperature profile of the whole system over a defined time period. Peak temperatures or any temperatures that are slow to fall should be an indicator of a localised problem</td>
<td>Representative selection of other sentinel outlets considered on a rotational basis to ensure the whole system is reaching satisfactory temperatures for legionella control</td>
</tr>
<tr>
<td></td>
<td>Check thermal insulation to ensure it is intact and consider weatherproofing where components are exposed to the outdoor environment</td>
<td>Annually</td>
</tr>
<tr>
<td><strong>Showers and spray taps</strong></td>
<td>Dismantle, clean and descale removable parts, heads, inserts and hoses where fitted</td>
<td>Quarterly or as indicated by the rate of fouling or other risk factors, eg areas with high risk patients</td>
</tr>
<tr>
<td><strong>POU filters</strong></td>
<td>Record the service start date and lifespan or end date and replace filters as recommended by the manufacturer (0.2 μm membrane POU filters should be used primarily as a temporary control measure while a permanent safe engineering solution is developed, although long-term use of such filters may be needed in some healthcare situations)</td>
<td>According to manufacturer’s guidelines</td>
</tr>
<tr>
<td><strong>Base exchange softeners</strong></td>
<td>Visually check the salt levels and top up salt, if required. Undertake a hardness check to confirm operation of the softener</td>
<td>Weekly, but depends on the size of the vessel and the rate of salt consumption</td>
</tr>
<tr>
<td></td>
<td>Service and disinfect</td>
<td>Annually, or according to manufacturer’s guidelines</td>
</tr>
</tbody>
</table>

*Continued on next page*
<table>
<thead>
<tr>
<th><strong>Multiple use filters</strong></th>
<th>Backwash and regenerate as specified by the manufacturer</th>
<th>According to manufacturer’s guidelines</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Infrequently used outlets</strong></td>
<td>Consideration should be given to removing infrequently used showers, taps and any associated equipment that uses water. If removed, any redundant supply pipework should be cut back as far as possible to a common supply (eg to the recirculating pipework or the pipework supplying a more frequently used upstream fitting) but preferably by removing the feeding ‘T’. Infrequently used equipment within a water system (ie not used for a period equal to or greater than seven days) should be included on the flushing regime. Flush the outlets until the temperature at the outlet stabilises and is comparable to supply water and purge to drain. Regularly use the outlets to minimise the risk from microbial growth in the peripheral parts of the water system, sustain and log this procedure once started. For high risk populations, eg healthcare and care homes, more frequent flushing may be required as indicated by the risk assessment.</td>
<td>Weekly, or as indicated by the risk assessment</td>
</tr>
<tr>
<td><strong>TMVs</strong></td>
<td>Risk assess whether the TMV fitting is required, and if not, remove. Where needed, inspect, clean, descale and disinfect any strainers or filters associated with TMVs. To maintain protection against scald risk, TMVs require regular routine maintenance carried out by competent persons in accordance with the manufacturer’s instructions. There is further information in paragraphs 2.152–2.168.</td>
<td>Annually or on a frequency defined by the risk assessment, taking account of any manufacturer’s recommendations</td>
</tr>
<tr>
<td><strong>Expansion vessels</strong></td>
<td>Where practical, flush through and purge to drain. Bladders should be changed according to the manufacturer’s guidelines or as indicated by the risk assessment.</td>
<td>Monthly–six monthly, as indicated by the risk assessment</td>
</tr>
</tbody>
</table>
8 Other operational considerations

8.1 The WSG need to identify other waterborne hazards (the list below is not exhaustive but provides examples).

8.2 *Legionella* may colonise other areas where droplets of contaminated water of a size suitable for deep inhalation are generated. Such aerosol-generating plant and equipment should not be installed next to patient accommodation. Some patients may be particularly susceptible to infection (see also HSG274 Part 3).

**Hydrotherapy pools, spa pools and whirlpool baths**

8.3 Hydrotherapy pools, spa pools and whirlpool baths provide conditions that potentially favour the growth of *Legionella*. While there have been no reported cases of *Legionella* infections associated with hydrotherapy pools, there have been several outbreaks associated with spa pools or whirlpools. These types of pool are ideally suited to the proliferation and dissemination of *Legionella*. In addition, because of the small volume of water in circulation and the number of bathers (typically three to six people), spa pools can become a source of infection. Careful maintenance and chemical treatment is essential to maintain water quality. A log must be kept of water treatment and filter cleaning, and the results of tests for pH, free residual halogen and other treatment parameters. (For further guidance on hydrotherapy pools, see the PHE/HSE’s ‘Management of spa pools: controlling the risks of infection’.)

8.4 Spa pools and whirlpool baths which provide a single fill for each individual use do not appear to present the same hazard. There remains concern, however, about retention of water in these systems. Regular cleaning and disinfection after each use in accordance with manufacturer’s instructions is recommended.

8.5 The Swimming Pool and Allied Trades Association (SPATA) and the Pool Water Treatment Advisory Group (PWTAG) provide advice on the operation of whirlpool baths.

8.6 All staff operating/maintaining this type of equipment should receive adequate training to ensure that appropriate safety procedures and effective water treatment regimes are adopted.

8.7 Maintenance for this equipment should be carried out in accordance with the manufacturer’s recommendations.

**Vending, chilled water and ice-making machines**

8.8 See paragraphs 9.24–9.26 in Part A for guidance on installation of this equipment.

8.9 Where equipment is hand-filled, there should be clear instructions on the water used; it should be hygienically collected and decanted into the equipment from a clean vessel.

**Notes**

Proprietary water containers for water dispensing machines should be returned to the supplier.
8.10 Chilled-water drinking fountains normally include a reservoir to assist in the cooling cycle; if machines are turned off, water quality can deteriorate. Drinking fountains should be connected to a mains water supply and not fed from a bottle dispenser.

8.11 Ice machines should not be placed in augmented care units.

8.12 Ice should not be allowed to stagnate in an ice-making machine’s storage bin, but should be changed frequently. Appropriate cleaning and hygienic procedures, agreed by the WSG, including the cleaning and disinfection of scoops etc. should be put in place. For guidance on infection-control precautions with regard to ice-making machines, see HBN 00-09 – ‘Infection control in the built environment’.

8.13 Maintenance for ice-making machines should be carried out in accordance with the manufacturer’s recommendations. Care should be taken to ensure that the water supply to the ice-making machine is not subjected to heat gain.

**Portable/room humidifiers**

8.14 Designs should not include the use of “portable” or “room” self-contained humidifiers (having a water supply that is sprayed/atomised into the room space). In clinical/patient areas the decision to use this type of humidifier must rest with the infection control team. See Safety Notice NHSE SN(96)06: ‘Evaporative type cooling fan’.

**Non-potable water storage**

8.15 Non-wholesome water is sometimes stored for emergency use (for example for firefighting purposes). These systems should be kept isolated from others by appropriate means that prevent back-flow and microbial contamination. They should be treated regularly using chlorine tablets or other form of treatment to ensure that water quality is maintained. This should be checked by total viable counts (TVC) sampling.

**Deluge showers**

8.16 Deluge showers are intended for use in an emergency where a staff member or a patient has suffered external chemical contamination. Similarly, there may be other special outlets used for personal emergencies, for example eyebaths. These should not be installed on the end of lines and should be flushed in accordance with the recommendations in HSG274 Part 2.

**Trolley wash procedures**

8.17 Trolley washing using high-pressure hoses is known to result in the generation of aerosols. The water supply should be taken from the potable system via a suitable air gap to prevent backflow contamination.

**Lawn sprinklers and garden (or similar) hoses**

8.18 In certain conditions, lawn sprinklers may retain stagnant water in the pipework/hose supplying the sprinkler head; they may also produce an aerosol spray. The pipework may be installed underground or via a flexible hose over ground. In either case it is very unlikely that they can be completely drained down after use or when not required; at certain times in the year the retained water may be at temperatures suitable for the colonisation by, and multiplication of, *Legionella*. There are evidence-linking cases of
Legionnaires’ disease with permanently installed systems using underground supply plumbing. Irrigation systems and hoses for these purposes must be supplied via backflow prevention devices giving fluid category 5 protection – typically an air gap of Type AA or AB, which requires a break tank and booster pump to provide adequate pressure to the irrigation nozzle or hose outlet.

**Vehicle washing plant**

8.19 Vehicle washing is carried out either using a hand-held pressure spray or by a "frame wash" that consists of a bay containing a rectangular pipework frame fitted with several high-pressure sprays. In the latter case, this equipment should be flushed regularly. Pressure washers and frame washers must be supplied via backflow prevention devices giving fluid category 5 protection – typically an air gap of Type AA or AB, which requires a break tank and booster pump to provide adequate pressure to the outlets.

8.20 Permanent hard-standing areas for vehicle-washing purposes should have an even surface to avoid ponding and have a slope or dish to a suitable drain.

**Decorative internal and external water features**

8.21 Ornamental fountains have been implicated in cases of legionellosis. They should not be situated under trees where fallen leaves or bird droppings may contaminate the water. Exposure to high winds should be avoided as they can disperse spray beyond the immediate confines of the basin/pond. The apex of the water column/jet should not exceed the distance to the nearest edge of the basin/pond, for the same reason. An overflow/outlet to a suitable drain should be provided for easy emptying and cleaning. Where possible, a permanently installed freshwater supply pipe with topping-up device should be provided. Their provision should be subject to a risk assessment, and appropriate action is required to minimise the risk. Any top-up supply from a wholesome water supply should be supplied via backflow prevention devices giving fluid category 5 protection – typically an air gap of Type AA or AB.

8.22 Internal ornamental water features, (for example a water cascade in the main entrance hall) are susceptible to airborne contamination and are not recommended.

**Sanitary assemblies**

8.23 Hoses used with sanitary assemblies such as variable-height baths should be provided with quick connectors to permit their removal for draining. All baths and showers used by patients in healthcare premises require fluid category five backflow protection on their filling arrangements and any flexible spray hoses (see HBN 00-10 Part C – 'Sanitary assemblies'). Hoses should not have an EPDM internal lining.

**Wet fire systems**

8.24 Wet fire protection systems have been implicated in outbreaks of legionellosis. All hose reels, sprinkler systems and wet risers should be isolated from the potable water supply by a method permitted by the Water Supply (Water Fittings) Regulations 1999. Many fire authorities are not in favour of local fire-fighting, preferring early professional intervention. It may, therefore, be possible to remove hose reels, thus avoiding their hazards. (Any redundant pipework should be cut back to the connection point including replacing the branch ‘T’ with a straight coupling.)
**Respiratory nebulisers**

8.25 Respiratory nebulisers are intended for the delivery of a variety of medicinal products. They should be used strictly in accordance with the manufacturer's recommendations, and in no circumstances should they be used in association with domestic water supplies. They should always be allowed to dry thoroughly before use.

**Flowers and plants**

8.26 Consideration should be given to providing specific facilities for regularly disposing of wastewater and compost outside ward areas. This should not be provided in sluice rooms.

**Buried pipelines**

8.27 Pipelines made of plastics are susceptible to hydrocarbons such as fuels and oils. These chemicals can travel through plastic pipes if they are nearby and contaminate the water supply and it may take days, weeks or even months before a noticeable taste can be detected in the water supply. Whenever spills are reported an assessment of services within the area should be undertaken.

8.28 Where there is a risk of hydrocarbon contamination of the supply, barrier pipe can be used instead. This is a double layer plastic pipe with a barrier layer (usually aluminium) in between.

**Summary checklist**

8.29 A summary checklist for the systems covered in this chapter, showing recommended frequency of activity, is given in HSG274 Part 3.
9 Microbiological monitoring

9.1 Apart from situations where there are taste or odour problems, microbiological monitoring for TVCs is not considered to be necessary.

9.2 If performed for these purposes, the detection of low TVCs is not necessarily an indication of the absence of *Legionella*, but are an indication of the overall water quality and signify a generally unfavourable environment for bacteria.

**BS 8554 4.10.1 Note**

The need to sample drinking water provided though refrigerated and/or filtered dispensers depends on the objectives and scope of sampling. Outlet quality is often tested for Coliforms and E. coli transferred by human contact, while TVC counts are compared with supply counts to identify significant change.

9.3 Experience to date has shown no meaningful correlation between the presence and count of *P. aeruginosa* and total viable counts (TVCs) of bacteria. Consequently, the determination of TVCs does need not be done in parallel with testing for *P. aeruginosa*.

9.4 All microbiological measurements should be by approved methods and/or be carried out by United Kingdom Accreditation Service (UKAS)-accredited laboratories. Dip slides are not acceptable.
10 Testing for Legionella

10.1 *Legionella* can exist within many systems at extremely low levels or below the threshold of detection (100 cfu/L). Up to now, in the absence of evidence of healthcare-associated infection, testing (which is complex and expensive) has not been considered necessary.

10.2 The infection control team, however, will need to consider the level of risk before deciding that *Legionella* testing is indicated. For example, testing may be required:

a. when storage and distribution temperatures do not achieve those recommended under the temperature control regimen and systems are treated with a biocide regimen, a monthly frequency of testing for *Legionella* is recommended. This may be reduced as confidence in the efficacy of the treatment regimen is established;

b. in systems where the control regimens are not consistently achieved, for example temperature or biocide levels (weekly checks are recommended until the system is brought under control);

c. when an outbreak is suspected or has been identified;

d. on hospital wards with at-risk patients - for example those who are immunocompromised.

<table>
<thead>
<tr>
<th>Legionella bacteria</th>
<th>Action required</th>
</tr>
</thead>
<tbody>
<tr>
<td>Not detected or up to 100</td>
<td>The primary concern is protecting susceptible patients, so any detection of <em>Legionella</em> should be investigated and, if necessary, the system re-sampled to aid interpretation of the results in line with the monitoring strategy and risk assessment. Either:</td>
</tr>
<tr>
<td>&gt;100 and up to 1000</td>
<td>• If the majority of samples are positive, the system should be re-sampled. If similar results are found again, review the control measures and risk assessment to identify and remedial action necessary, or</td>
</tr>
<tr>
<td></td>
<td>• If the majority of samples are positive, the system may be colonised, albeit at a low level. An immediate review of control measures and a risk assessment should be carried out to identify any other remedial action required. Disinfection of the system should be considered.</td>
</tr>
</tbody>
</table>
The system should be re-sampled and an immediate review of the control measures and risk assessment carried out to identify any remedial actions, including possible disinfection of the system. Re-testing should take place a few days after disinfection and at frequent intervals thereafter until a satisfactory level of control is achieved.

10.3 As a minimum, samples should be taken as follows:

- from the cold water storage and the furthermost outlet from the tank;
- from the calorifier flow, or the closest tap to the calorifier, and the furthermost tap on the hot water service circulating system;
- additional samples should be taken from the base of the calorifier where drain valves have been fitted;
- additional random samples may also be considered appropriate where systems are known to be susceptible to colonization in line with BS 7592 guidance.
- in accordance with BS 7592 – 'sampling for Legionella bacteria in water systems. Code of practice'.

10.4 The sampling analysis for Legionella should be in accordance with ISO 11731:2004. A UKAS-accredited laboratory that takes part in Public Health England's water external quality assessment (EQA) scheme for the isolation of Legionella from water should test samples (visit http://www.hpaweqa.org.uk for further information). The laboratory should also apply a minimum theoretical mathematical detection limit of \( \leq 100 \) Legionella bacteria/litre sample.

10.5 Action following Legionella sampling in hot and cold water systems is given in the following flowchart.
Appendix A Examples of the use of water within a healthcare facility and water quality types

[Question for stakeholders: Would the addition of this annex, (please note more work is required to complete and check references, etc.) be a useful addition to the HTM?]

[DN: Need to acknowledge French Government guide and IFOWAHB for this adopted and amended text. Also Susanne’s old comments probably need to come out]

All water and water systems in healthcare facilities must be risk assessed according to their intended use and patient immune status taking into account any identified inherent hazards within the facility and the quality of the water supply to the systems being assessed. The assessment of risk should take account of the most vulnerable population likely to be exposed to each potential source.

For example; during procedures where medical devices, such as endoscopes, are introduced into patients through non-sterile routes, the risk of nosocomial infection by a patient’s own flora i.e. “auto-contamination” should not be increased by the introduction of water-borne facultative or opportunistic pathogens from using contaminated water during instrument processing. Depending on the procedure, if the patient is at high risk of infection, i.e. highly immunocompromised, then sterile or filtered water may be recommended even if the medical device has to take a non-sterile route.

Examples of different categories of water for differing uses are shown in the following tables:

<table>
<thead>
<tr>
<th>Quality 1. (Q1)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Water of potable quality which is not subjected to, or doesn’t require, any further treatment when it enters the hospital;</td>
</tr>
<tr>
<td>Q.1.1.</td>
</tr>
<tr>
<td>Water used for drinking and food preparation</td>
</tr>
<tr>
<td>Q.1.2.</td>
</tr>
<tr>
<td>Water for normal personal hygiene purposes such as bathing, hand washing etc.,</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Quality 2. (Q2)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Water which is treated in the hospital, to achieve the risk assessment based criteria which have been defined appropriate to use e.g. for preparation of foodstuffs, sanitation or for treatment of patients;</td>
</tr>
<tr>
<td>Q.2.1.</td>
</tr>
<tr>
<td>Water which meets defined microbiological criteria for defined patient uses</td>
</tr>
<tr>
<td>Q.2.2.</td>
</tr>
<tr>
<td>Distributed hot water</td>
</tr>
</tbody>
</table>
### Q.2.3. Water for hydrotherapy pools

### Q.2.4. Water for dermatology showers, other patient treatment regimens e.g. footbaths, sonication baths, dental chairs, birthing pools etc., spa and whirlpool baths*

*Note* A comprehensive risk assessment and scheme for controlling risks from waterborne infections should be carried out before any equipment is installed in healthcare premises. This is particularly important for equipment which has an inherently high risk of transmitting healthcare related infections such as spa pools; whirlpool baths etc.

### Q.2.5. Water for haemodialysis

### Q.2.6. Purified water

### Q.2.7. Ultra-purified water

### Q.2.8. Water for drinking fountains

### Q.2.9. Water to final washing of critical medical devices

### Quality 3. (Q3)
Sterile water; the requirements and appropriate uses for this kind of water are described in detail in the International Pharmacopoeia (2015) (1).

### Q.3.1. Water for injectable products (see International Pharmacopoeia (2015)

### Q.3.2. Water for irrigation of wounds etc. (see International Pharmacopoeia (2015)

### Q.3.3. Sterile drinking water

### Quality 4. (Q4)
Water for technical purposes such as cooling tower water, recycled and grey water etc. These are not included in this HTM (see HTM 07-04 for more information on the use of water of lower quality on healthcare premises)

### Table XX: Quality required for water depending on use

<table>
<thead>
<tr>
<th>1. Gastric endoscopy</th>
<th>Particular hazards (based on an assessment for each system)</th>
<th>Water quality required</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Colonoscopy</td>
<td>Intermediate rinse</td>
<td>Q.1.1. or Q.1.2.</td>
<td></td>
</tr>
</tbody>
</table>

65
| Terminal rinse | P. aeruginosa,  
Coliforms including E.coli  
Acinetobacter | Q.1.2. or Q.2.1 | Risk of biofilms formation within the instruments may favour Q.2.1. |
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Gastric fibroscope</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Intermediate rinse</td>
<td></td>
<td>Q.1.1. or Q.1.2.</td>
<td></td>
</tr>
</tbody>
</table>
| Terminal rinse | Helicobacter pylori/ Mycobacteria,  
P. aeruginosa,  
Coliforms including E.coli  
Acinetobacter | Q.1.2. or Q.2.1. | Risk of biofilm formation within the instruments may favour Q.2.1  
Q.3. advised for the immunosuppressed |
| **Retrograde cholangiography** | Pseudomonas aeruginosa | Q.3.1 | |
| **Evacuative enema** | | Q.1.1. | |
| **Hydrosoluble enema** | | Q.1.1. | |
| **Gastric lavage** | | | |
| **Cold water (haemorrhage)** | | Q.3.2. | Presence of wound, ? usage facility |
| **Evacuative** | | Q.1.1. | |

### 2. Oral surgery

<table>
<thead>
<tr>
<th>Particular hazards and risks</th>
<th>Water quality required</th>
<th>Comments</th>
</tr>
</thead>
</table>
| **Hand piece water during surgery** | Sphingomonas, Pseudomonas,  
Acinetobacter,  
Non tuberculous mycobacteria,  
Legionellae | Q.3.2. | |

### 3. Digestive system

<table>
<thead>
<tr>
<th>Particular hazards</th>
<th>Water quality required</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Enteral nutrition, gavage solution</strong></td>
<td>Microbiological and chemical e.g. (minerals, salts and metals)</td>
<td>Packaged water or Q.3.3.</td>
</tr>
<tr>
<td><strong>Parenteral nutrition</strong></td>
<td>Microbiological and chemical (minerals, salts and metals)</td>
<td>Q.3.1.</td>
</tr>
</tbody>
</table>
| **Drinking water and ice for the immunosuppressed particularly for patients in the protected environments** | Microbiological and chemical (mineral salts and metals) | Q.2.1.  
Q.3.3 | Depending on the level of immuno-suppression. Water should be replaced frequently |
| **Water for preparing bottles for neonates and infants** | Nitrites nitrates (methemoglobinemia),  
chlorates and chlorites,  
Cronobacter sakazakii | Packaged water or Q.2.1. | The chemical parameters of packaged water must be compatible with the maximum mineral salt content of the food for the intended age group. Bottles should be made up immediately before use and not stored. |
<table>
<thead>
<tr>
<th>Water for preparing hot drinks</th>
<th>Scalding, chemicals from metal corrosion</th>
<th>Q.1.1.</th>
<th>Distributed hot water Q.2.2. is not recommended for preparing drinks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Refrigerated fountain water</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>From mains supply</td>
<td>Risk of contamination or proliferation of microorganisms such as pseudomonads within the pipeline,</td>
<td>Q.2.8.</td>
<td>The risk of growth increases with increased temperature, particularly within the range of 25 °C to 45 °C. Increased risk of infection with water treated at the outlet (e.g. presence of carbon for removing chemical treatment such as chlorine)</td>
</tr>
<tr>
<td>From a stored water piped supply</td>
<td>Risk of contamination or proliferation of microorganisms such as pseudomonads, and legionellae</td>
<td>Q.2.8.</td>
<td>Increased risk of infection because of prolonged stagnation of water. Not recommended.</td>
</tr>
<tr>
<td>From a changeable water container (typically 5-15L)</td>
<td>Particular risk of contamination and proliferation of microorganisms</td>
<td>Packaged water</td>
<td>Increased risk if containers are recycled under poor conditions. Storage volume often inappropriate. Not recommended.</td>
</tr>
<tr>
<td>Oral treatment (e.g. dilution)</td>
<td></td>
<td>Q.1.1.</td>
<td>Depending on the immune status of the patient</td>
</tr>
<tr>
<td>Post-surgical oral treatment</td>
<td>Q.1.2. or Q.3.2.</td>
<td>Depends on treatment</td>
<td></td>
</tr>
<tr>
<td>Surgical oral treatment</td>
<td></td>
<td>Q.3.2.</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>4. Respiratory Medicine /Surgery ear nose and throat medicine,</th>
<th>Particular hazards</th>
<th>Water quality required</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Terminal rinse for Ear nose and throat endoscopes</td>
<td>Klebsiella spp.  Staph aureus  Pseudomonas, Viruses( are there data ?) ,Non Tuberculous mycobacteria, Legionellae particularly Legionella pneumophila</td>
<td>Q.1.2. or Q.2.1.</td>
<td>Risk of formation of biofilms may favour Q.2.1.</td>
</tr>
<tr>
<td>Terminal rinse for bronchial endoscopes</td>
<td>Q.2.1  Q.3.2</td>
<td>The presence of pulmonary tropism germs (legionella, mycobacteria, viruses) may favour sterile water</td>
<td></td>
</tr>
<tr>
<td>Humidifiers, nebulisers, cascades, Aerosols</td>
<td>Legionellae particularly Legionella pneumophila Pseudomonads Klebsiella spp. and others Endotoxins</td>
<td>Q.3.2.</td>
<td>The use of potable water is unfortunately all too frequent and should be banned. Masks can be washed in potable water (for the same patient) but should be carefully dried before use. Watch out for instruments which have not been used but may have been exposed to contamination.</td>
</tr>
<tr>
<td>Oxygen therapy</td>
<td></td>
<td>Q.3.2.</td>
<td>Single use preferred</td>
</tr>
<tr>
<td>Humidification and thermal regulation in incubators</td>
<td>Pseudomonas, Coliforms, Acinetobacter Legionellae NTM</td>
<td>Q.3.2.</td>
<td>For the attention of recipients. Ideally use a sterile vessel. Frequent change of water and recipient minimum once every 24 hours.</td>
</tr>
<tr>
<td>Rinsing of catheters and tracheal aspiration tubes</td>
<td>Pseudomonas, Coliforms, Acinetobacter</td>
<td>Q.3.2.</td>
<td>Disposable catheters (single penetration into upper airways). Some care teams keep catheters in pure or dilute disinfectant; this practice is not recommended. Tubes should be rinsed with dilute antiseptic appropriate for purpose.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>5. Contact with skin or mucosa</th>
<th>Particular hazards and risks</th>
<th>Water quality required</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Showers</td>
<td>Risk of infection legionellae particularly Legionella pneumophila</td>
<td>Q.2.2. &lt; 10 CFU/l Legionella pneumophila</td>
<td>Aerosolisation increases the risk of infection</td>
</tr>
<tr>
<td>Non high risk patients</td>
<td>Risk of infection Pseudomonas, Coliforms, Acinetobacter Non Tuberculous Mycobacteria</td>
<td>Q.2.1. and absence of Legionella pneumophila</td>
<td>Significant absence in the sense of standard NF T90-431 dated September 2003: &quot;&lt;250 CFU/l&quot; and &quot;Legionella pneumophila not detected&quot;</td>
</tr>
<tr>
<td>High risk patients</td>
<td>Risk of infection Pseudomonas, Coliforms, Acinetobacter Non Tuberculous Mycobacteria</td>
<td>Q.2.1. or Q.3.2.</td>
<td>Contamination by siphons and shower heads in baths. Q.3.2. should be used for large premature babies in incubators</td>
</tr>
<tr>
<td>Washing neonates</td>
<td>Risk of infection Conjunctivitis e.g. Pseudomonas aeruginosa</td>
<td>Q.1.2.</td>
<td>Skin barrier destroyed</td>
</tr>
<tr>
<td>Washing burns</td>
<td>Very significant risk of infection with Pseudomonas spp.</td>
<td>Q.2.2.</td>
<td></td>
</tr>
<tr>
<td>Preparation of surgical patients</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Preoperative disinfectant shower</td>
<td></td>
<td>Q.1.2.</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Q.2.2.</td>
<td></td>
</tr>
<tr>
<td><strong>Rinse during use of disinfectant soap</strong></td>
<td>Q.1.2. or Q.2.2. Q.3.2. or surgical block for operative field</td>
<td>Coherence principle</td>
<td></td>
</tr>
<tr>
<td>------------------------------------------</td>
<td>---------------------------------------------------------------</td>
<td>---------------------</td>
<td></td>
</tr>
<tr>
<td><strong>Baths and care of damaged skin</strong></td>
<td>Risk of infection with pseudomonads, NT mycobacteria,</td>
<td>e.g. burns, post-surgery e.g. shower with closed scar and treatment of bedsores</td>
<td></td>
</tr>
<tr>
<td><strong>Rinsing external auditory canal</strong></td>
<td>Risk of infection: Pseudomonas aeruginosa, Klebsiella, mycobacteria</td>
<td>Maintenance procedures for the &quot;bulb&quot; used for washing ears should require as a minimum an intermediate level of disinfection(30) and ideally should be autoclaved</td>
<td></td>
</tr>
<tr>
<td>Balance testing</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Misting Devices</strong></td>
<td>These bottles are not sterile and should be handled with caution for immunosuppressed patients. Risk of infection, particularly Legionella pneumophila, Pseudomonas aeruginosa</td>
<td>Tap water must not be used, bottles and nozzles etc. should be regularly disinfected</td>
<td></td>
</tr>
</tbody>
</table>

### 6. Urology

<table>
<thead>
<tr>
<th><strong>Particular hazards and risks</strong></th>
<th><strong>Water quality required</strong></th>
<th><strong>Comments</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Vesicular catheter for balloon inflation</td>
<td>Q.3.1.</td>
<td></td>
</tr>
<tr>
<td>Vesicular lavage</td>
<td>Q.3.2.</td>
<td></td>
</tr>
<tr>
<td>Non-autoclavable cystoscope</td>
<td>Q.1.2.</td>
<td></td>
</tr>
<tr>
<td>Intermediate rinse</td>
<td>Q.3.2.</td>
<td></td>
</tr>
<tr>
<td>Terminal rinse</td>
<td>Parvovirus, NT mycobacteria</td>
<td>Q.3.2.</td>
</tr>
</tbody>
</table>

### 7. Gynaecology

<table>
<thead>
<tr>
<th><strong>Washing and vaginal douches</strong></th>
<th><strong>Pseudomonas</strong></th>
<th>Q.1.2.</th>
<th><strong>Comments</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Perineal antisepsis</td>
<td>Q.3.2.</td>
<td>With recent wound or scar</td>
<td></td>
</tr>
</tbody>
</table>

### 8. Non-sterile drugs preparation

<table>
<thead>
<tr>
<th><strong>Oral drops, syrup external use (ointment) antiseptic</strong></th>
<th><strong>Microbiological and chemical dangers (metal and mineral salts)</strong></th>
<th><strong>Q.2.6. or Q.2.7. is better bacteriological quality required Q.3.1. in ampoule used for small volumes Q.3.2. used for large volumes</strong></th>
<th><strong>Comments</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>? see International Pharmacopoeia</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
### 9. Sterile drugs preparation

<table>
<thead>
<tr>
<th>Particular hazards and risks</th>
<th>Water quality required</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Drug production (series preparation in hospital)</td>
<td>Microbiological and chemical dangers (metal ions and mineral salts)</td>
<td>Q.3.1.</td>
</tr>
<tr>
<td>Reconstitution or dilution for external use (eye drops, chemotherapy)</td>
<td>Microbiological and chemical dangers (metal ions and mineral salts)</td>
<td>Q.3.1.</td>
</tr>
<tr>
<td>Irrigation</td>
<td></td>
<td>Q.3.1.</td>
</tr>
</tbody>
</table>

### 10. Sterilisation

<table>
<thead>
<tr>
<th>Particular hazards and risks</th>
<th>Water quality required</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cleaning instruments</td>
<td></td>
<td>Q.1.1.</td>
</tr>
<tr>
<td>Manual cleaning</td>
<td></td>
<td>Q.4. demineralised water or water treated with osmosis</td>
</tr>
<tr>
<td>Mechanical cleaning</td>
<td></td>
<td>Q.4. softened water or water treated with osmosis</td>
</tr>
<tr>
<td>Steam production</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### 11. Site and surface maintenance

<table>
<thead>
<tr>
<th>Particular hazards and risks</th>
<th>Water quality required</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Site and surface maintenance</td>
<td></td>
<td>Q.1.1.</td>
</tr>
<tr>
<td>Maintenance material functioning</td>
<td>Interference of physical-chemical qualities by detergent and disinfectant products</td>
<td>Q.1.1.</td>
</tr>
</tbody>
</table>

### 12. Various

<table>
<thead>
<tr>
<th>Particular hazards and risks</th>
<th>Water quality required</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ice for cooling, equipment and drinks and sucking</td>
<td>Contamination from handling and contamination of equipment in contact with the ice e.g. syringes Legionella Pseudomonas</td>
<td>Q.1.2.</td>
</tr>
<tr>
<td>Plaster of Paris</td>
<td></td>
<td>Q.1.1. or Q.1.2.</td>
</tr>
<tr>
<td>Water for leeches</td>
<td>Aeromonas hydrophila</td>
<td>Packaged natural spring water</td>
</tr>
<tr>
<td>Double boiler for surgical department</td>
<td>Aerosolisation Handling</td>
<td>Q.3.2.</td>
</tr>
<tr>
<td>Washing up</td>
<td></td>
<td>Q.1.1.</td>
</tr>
<tr>
<td>Flowers in vases</td>
<td>Multiple microbial contamination possible</td>
<td>Q.1.1.</td>
</tr>
<tr>
<td>-----------------</td>
<td>------------------------------------------</td>
<td>-------</td>
</tr>
<tr>
<td>Aquaria</td>
<td>Mycobacterium marinum</td>
<td>Q.1.1.</td>
</tr>
<tr>
<td></td>
<td>Aeromonas</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Decorative fountains</td>
<td>Legionella pneumophila</td>
<td>Q.1.1</td>
</tr>
<tr>
<td>Decorative installations within water recycling sites which produce aerosols (fountains, jet pool etc.)</td>
<td>Legionella pneumophila</td>
<td>Q.1.1. and absence of Legionella pneumophila</td>
</tr>
</tbody>
</table>

Note: the hazards and their occurrence will depend on the source water quality. Therefore the associated risks should be calculated taking into account local conditions.
Appendix B Action in the event of an outbreak of legionellosis

**Legal obligations**

1. In England and Wales, Legionnaires’ disease is notifiable under the Health Protection (Notification) Regulations 2010 and in Scotland under the Public Health (Notification of Infectious Diseases) (Scotland) Regulations 1998. Under these Regulations, human diagnostic laboratories must notify Public Health England (PHE), Public Health Wales (PHW) or Health Protection Scotland (HPS) (see ‘Further sources of advice’) of microbiologically confirmed cases of legionnaires’ disease.

2. An outbreak is defined as two or more cases where the onset of illness is closely linked in time (weeks rather than months) and where there as epidemiological evidence of a common source of infection, with or without microbiological evidence. An incident/outbreak control team should always be convened to investigate outbreaks. It is the responsibility of the Proper Officer to declare an outbreak. The Proper Officer, appointed by the Local Authority, is usually a Consultant in Communicable Diseases Control (CCDC) in England and Wales, or the Consultant in Public Health Medicine (CPHM) in Scotland. If there are suspected cases of the disease, medical practitioners must notify the Proper Office in the relevant local authority.

3. Local Authority will have jointly established incident plans to investigate major outbreaks of infectious diseases, including legionellosis, and it is the Proper Officer who activates these and invokes an Outbreak Committee, whose primary purpose is to protect public health and prevent further infection.

4. HSE or local Environmental Health Officers may be involved in the investigation of outbreaks, their aim being to pursue compliance with health and safety legislation. The local authority, Proper Officer or EHO acting on their behalf will make a visit for public health reasons, often with the relevant officer from the enforcing authorities (i.e. HSE or the local authority) for health and safety reasons. Any infringements of relevant legislation may be subject to a formal investigation by the appropriate enforcing authority.

5. There are published guidelines (by PHE, PHW and HPS) for the investigation and management of incidents, clusters, and outbreaks of legionnaires disease in the community.

There are, for England and Wales, Guidance on the Control and Prevention of Legionnaires’ Disease in England and for Scotland, Guidelines on Management of *Legionella* Incidents, Outbreaks and Clusters in the Community.

**Practical actions**

If a water system is implicated in an outbreak of Legionnaires’ disease, emergency treatment of that system should be carried out as soon as possible in accordance with the site incident plan as follows:

a. shut down any processors that are capable of generating and disseminating airborne water droplets and keep them shut down until sampling procedures and any
remedial cleaning or other work has been done. Final clearance to restart the system may be required;

b. take water samples from the system before any emergency disinfection is undertaken. This will help the investigation of the cause of illness. The investigating officers from the local authority/authorities may take samples, or require them to be taken;

c. provide staff records to discern whether there are any further undiagnosed cases of illness, and to help prepare case histories of the people affected;

d. cooperate fully in an investigation of any plant that may be involved in the cause of the outbreak. This may involve, for example:

(i) tracing of all pipework runs;

(ii) detailed scrutiny of all operational records;

(iii) statements from plant operatives and managers;

(iv) statements from water treatment contractors or consultants.

**Emergency cleaning and disinfection of water systems**

6. If a water system, other than a cooling system, is implicated in an outbreak of legionnaires’ disease, emergency treatment of that system should be carried out as soon as possible. This will involve disinfection as set out in Chapter 17 of Part A.
Appendix C Exemplar temperature test sheets

A unique identification is required for each mixing device as well as identification of its type. Hot and cold water pressures also need to be measured and recorded for each mixing device together with all the test parameters from the in-service tests in Model Engineering Specification D08.

Note

The Health and Safety Commission's (2000) Approved Code of Practice L8 permits a period of 1 minute to achieve an equilibrium temperature of 50°C. A minimum of 55°C may be required for the operation of suitable mixing devices required to provide “safe” hot water at the upper limit of the recommended range. Hot water at 55°C is required in many cases for reasons of food hygiene or decontamination requirements, for example in kitchens and sluice rooms etc. In a properly balanced hot water circulating system, with the circulation taken close to the draw-off point, achieving temperature should be virtually instantaneous. (At a typical flow to a hand-wash basin of 4.5 L/m, 1 minute to achieve temperature would indicate a 25 m dead-leg of 15 mm pipe.)
Note

The Health and Safety Commission's (2000) Approved Code of Practice L8 permits a period of 2 minutes to achieve an equilibrium temperature below 20°C. Achieving this minimum requirement would be indicative of an exceptionally under-utilised water system. (At a typical flow to a hand-wash basin of 4.5 L/m, 2 minutes to achieve temperature would indicate a 50 m dead-leg of 15 mm pipe.)

<table>
<thead>
<tr>
<th>Room</th>
<th>Room name</th>
<th>Mixin</th>
<th>Mix</th>
<th>Hot</th>
<th>Cold</th>
<th>Comments</th>
<th>Date</th>
<th>Initial</th>
</tr>
</thead>
<tbody>
<tr>
<td>120</td>
<td>Ward 4</td>
<td></td>
<td></td>
<td>4</td>
<td>5</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Shower</td>
<td></td>
<td></td>
<td>4</td>
<td>5</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>124</td>
<td>Kitchen</td>
<td></td>
<td></td>
<td>5</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>– Sink</td>
<td></td>
<td></td>
<td>5</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

A unique identification is required for each mixing device as well as identification of its type. Hot and cold water pressures also need to be measured and recorded for each mixing device together with all the test parameters from the in-service tests in Model Engineering Specification D08.
Appendix D Testing for P. aeruginosa

Note:
Experience to date has shown no meaningful correlation between the presence and count of P. aeruginosa and total viable counts (TVC) of bacteria. Consequently, the determination of TVC need not be done routinely in parallel with testing for P. aeruginosa.

P. aeruginosa may be present within the water storage, distribution and delivery systems and also in the water supplied to the hospital.

The sampling protocol (Appendix E) is intended to help healthcare providers establish whether the water in augmented care units is contaminated with P. aeruginosa and, if it is, to help locate its origin and to monitor the efficacy of remedial measures.

Biofilms exist on plumbing materials throughout the water system. Where present, most P. aeruginosa will be found within two metres of the point of water delivery at the outlet monitoris, after the water has left the circulation system.

While most bacteria are trapped within a biofilm, the biofilm will constantly generate bacteria that are released as free-floating individual cells (planktonic forms), and parts of the biofilm may slough off in clumps. The concentration of these planktonic bacteria will build up over time in the water adjacent to a biofilm when the water is of a low flow rate or stagnant, but will be diluted as water is used and flows through the pipework or tap containing the biofilm.

It is essential to maximise the recovery of these free-floating planktonic bacteria that cause infection; therefore, water samples should be taken:

a. during a period of, preferably, no use (at least 2 hours or preferably longer); or

b. low use.

The same water outlet can give very different results if sampled at times of normal use and may be negative if water from the tap has been used before a sample is collected.

The first water to be delivered from the outlet (pre-flush sample) should be collected to assess the microbial contamination in the outlet.

If water flows over a biofilm containing P. aeruginosa located at or near the outlet, planktonic bacteria arising from that biofilm will be diluted and a subsequent sample will give low bacterial counts. If contamination is upstream in the system, this will not affect bacterial counts.

The sample obtained after allowing water to flow from an outlet is referred to as a “post-flush” sample (see paragraphs 12 and 13 in Appendix E). Comparison of counts from pre- and post-flush samples can help locate the source of the P. aeruginosa. If a pre-flush sample gives a high count, subsequent paired pre- and post-flush samples should be tested to help locate the source of the contamination.

In order to be able to carry out the appropriate microbiological examinations on a sample and provide a meaningful interpretation of test results, it is essential that samples are collected in the
correct manner using the correct equipment and that the sampling protocol in Appendix E is adhered to.

Protocols for microbiological examination of samples are provided in Appendix F.

**Where to sample water outlets**

The water outlets to be sampled should be those that supply water which:

- has direct contact with patients;
- is used to wash staff hands; or
- used to clean equipment that will have contact with patients as determined by risk assessment.

**When and how to sample water outlets**

The outlets identified above should be sampled to provide an initial assessment of contamination levels. There is no need to sample all taps that are due to be sampled on the same occasion; samples can be taken in batches on separate occasions. It may assist the receiving laboratory if the sampling schedule is agreed beforehand (see Figure 2 and also Appendix F).

**Interpretation of P. aeruginosa test results**

If test results are satisfactory (not detected), there is no need to repeat sampling for a period of six months unless there are changes in the water distribution and delivery systems components or system configuration (for example, refurbishments that could lead to the creation of dead-legs) or occupancy.

Water sampling could be undertaken within six months if there are clinical evidence-based suspicions that the water may be a source of patient colonisation or infection (that is, with *P. aeruginosa* or another potentially water-associated pathogen).

If tests show counts of 1 to 10 cfu/100 mL, refer to the WSG, who should risk-assess the use of water in the unit. Simultaneously, retesting of the water outlet should be undertaken (see Figure 2 and Note below).

If test results are not satisfactory (>10 cfu/100 mL), further sampling along with an engineering survey of the water system could be used to identify problem areas and modifications that may be implemented to improve water quality.

After such interventions, the water should be resampled (see Figure 2 for suggested frequencies).

**Note:**

Figure 2 gives an example of sampling frequencies. Sampling may be undertaken more frequently according to the risk assessment. It is important that samples are taken as described in Appendix E to avoid false negative results.
Interpretation of pre- and post-flush counts

High counts in pre-flush samples but with low counts or none detected at post-flush could indicate that areas/fittings at or near the outlets are the source outlet of contamination (see Table 1).

- A few positive outlets, where the majority of outlets are negative, would also indicate that the source of contamination is at or close to the outlet.

- If both pre- and post-flush samples from a particular outlet are >100 cfu/100 mL and other nearby outlets have no or low counts, this shows that the single outlet is heavily contaminated, despite the high post-flush count. This could be explored by...
testing dilutions of pre- and post-flush water samples from this outlet or by using an extended flush such as for 5 minutes prior to post-flush sampling or by taking a post flush sample after disinfection of the outlet as occurs with *Legionella* post flush sampling.

### Table 1 Interpretation of pre- and post-flush counts

| High *P. aeruginosa* count pre-flush (>10 cfu/100 mL) and low post-flush count (<10 cfu/100 mL) | Suggestive of a local water outlet problem |
| High *P. aeruginosa* count pre-flush (>10 cfu/100 mL) and high post-flush count (>10 cfu/100 mL) | Suggestive of a problem not related to a local water outlet but to a wider problem within the water supply system |

**Note:**

Overlaying sample results onto schematic drawings of the system may help to identify the source of contamination and locations for additional sampling.

If the sampling indicates that the water services are the problem, then most outlets would possibly be positive and other points in the water system could then be sampled to assess the extent of the problem (see Table 1).

Figure 3 provides a summary of the sampling procedure and interpretation of results for *P. aeruginosa*.
Appendix E Water sampling

Click here for an online video showing methods for obtaining water samples.

1. Sampling should be undertaken by staff trained in the appropriate technique for taking water samples including the use of aseptic technique to minimise extraneous contamination. The method used in this guidance may differ from the collection of water samples for other purposes (for example, for sampling *Legionella*).

2. Carefully label samples such that the outlet can be clearly identified; system schematics indicating each numbered outlet to be sampled can be helpful in this respect.

3. The main strategy for sampling is to take the first sample of water (pre-flush) delivered from a tap at a time of no use (at least 2 hours or preferably longer) or, if that is not possible, during a time of its lowest usage. This will normally mean sampling in the early morning, although a variety of use patterns may need to be taken into account.

4. Disinfectants in the water, such as chlorine or chlorine dioxide, will have residual activity after taking the sample and may inactivate bacteria in the sample prior to its processing. To preserve the microbial content of the sample, neutralise oxidising biocides by dosing the sample bottle with 18 mg of sodium thiosulphate (equating to 18 mg/L in the final sample, which will neutralise up to 50 ppm hypochlorite). Sterile bottles are normally purchased containing the neutraliser. EDTA (ethylenediaminetetraacetic acid) may be used as a neutraliser for systems treated with copper and silver ions (BS 7592). Where disinfectants are being applied to the water system, take advice on the appropriate neutralisers to use.

5. The tap should not be disinfected by heat or chemicals before pre-flush sampling (see paragraph 12), nor should it be cleaned or disinfected immediately before sampling.

6. Label a sterile collection vessel (200–1000 mL volume) containing a suitable neutraliser for any biocide the water may contain. The labelling information should contain details of the tap location, sender’s reference, pre- or post-flush (see paragraph 12), person sampling, date and time of sampling.

7. If *P. aeruginosa* has been found in a pre-flush sample, take a second paired set of samples. The first would be a pre-flush sample as before. Run the tap for two minutes and take a second identical post-flush sample. Bacteria in this second sample (termed post-flush) are more likely to originate further back in the water system. A substantially higher bacterial count in the pre-flush sample, compared with the post-flush, should direct remedial measures towards the tap and associated pipework and fittings near to that outlet. A similar bacterial count in pre-flush and post-flush samples indicates that attention should focus on the whole water supply, storage and distribution system. A more extensive sampling regimen should be considered throughout the water distribution system, particularly if that result is obtained from a number of outlets.

8. Although water sampling is the principal means of sampling, there may be occasions when water samples cannot be obtained immediately for analysis. In the event of a suspected outbreak,
swabbing water outlets (as per section 5.4 of the Standing Committee of Analysts’ (SCA) 2010 guidance) to obtain strains for typing may provide a means of assessing a water outlet, but this does not replace water sampling (see paragraph 15 on swabbing).

**Procedure for obtaining the samples**

9. Pre-flush sample: Aseptically (that is, without touching the screw thread, inside of the cap or inside of the collection vessel) collect at least 200 mL water in a sterile collection vessel containing neutraliser. Replace the cap and invert or shake to mix the neutraliser with the collected water.

10. Dependent upon the water distribution system design, and the type of water outlet, the water feed to the outlet may be provided by:

   - a separate cold-water supply and hot-water supply to separate outlets;
   - a separate cold-water supply and hot-water supply, which may have its final temperature controlled by the use of an integral TMV within the outlet; or
   - a separate cold-water and a pre-blended hot-water supply that has had its temperature reduced by a TMV prior to delivery to the outlet.
11. For separate hot- and cold-water outlets, each outlet is individually tested with its own collection vessel and outlet identifier. For blended outlets (that is, where both hot and cold water come out of the same outlet):

- sample water with the mixing tap set to the fully cold position using an individual collection vessel and outlet identifier, and note the temperature setting;
- sample the blended outlet set to the maximum available hot-water temperature using an individual collection vessel and outlet identifier, and note the temperature setting.

12. Post-flush sample: where this is required, allow the water to flow from the tap for 2 minutes (see above) before collecting at least 200 mL water in a sterile collection vessel with neutraliser. Replace the cap and invert or shake to mix the neutraliser with the collected water. This sample, when taken together with the pre-flush sample, will indicate whether the tap outlet and its associated components is contaminated or if the contamination is remote from the point of delivery (see Table 1).

13. If a sample from a shower is required, then place a sterile bag over the outlet. Using sterile scissors, cut a small section off the corner and collect the sample in a sampling container (see PHE’s (2013) ‘Guidelines for the collection, microbiological examination and interpretation of results from food, water and environmental samples taken from the healthcare environment’ (forthcoming)). Appropriate precautions should be taken to minimise aerosol production as described in BS 7592.

14. The collected water should be processed within 2 hours. If that is not possible, then it should be refrigerated within 2 hours and kept at 2-8°C and processed within 24 hours.

15. To take a swab sample, remove a sterile swab from its container and insert the tip into the nozzle of the tap. Care should be taken to ensure no other surfaces come into contact with the tip of the swab. Rub the swab around – that is, move it backwards and forwards and up and down, as much as possible, on the inside surface of the tap outlet or flow straightener (see photograph). Replace the swab carefully in its container, again ensuring no other surfaces come into contact with the tip of the swab. Place the swab in a transport medium or maximum recovery diluent (MRD) and send to the laboratory.
A sterile swab should be rubbed on the inside surface of the tap outlet or flow straightener.
Appendix F Microbiological examination of water samples for P. aeruginosa

Notes:

This appendix has been developed to provide technical guidance for a range of laboratories (including NHS, PHE and commercial laboratories) that have the capability and capacity to undertake water sampling and testing.

Alternative water-testing methods other than filtration that can show equivalence and/or improvement on the sensitivity and enumeration of P. aeruginosa are also acceptable.

An oxidase test alone is not sufficiently specific to identify P. aeruginosa.

See also the Standing Committee of Analysts' (2002) 'The microbiology of drinking water Part 8'.

Definition

1. P. aeruginosa are Gram-negative, oxidase-positive bacteria that, in the context of this method, grow on selective media containing cetrimide (cetyl trimethylammonium bromide), usually produce pyocyanin, fluoresce under ultraviolet light 360 ± 20 nm, and hydrolyse casein. P. aeruginosa needs to be identified by the following methods – identification by a positive oxidase test alone is insufficient.

Testing principle

2. A measured volume of the sample or a dilution of the sample is filtered through a membrane filter (≤0.45 microns) to retain bacteria and the filter is then placed on a solid selective and differential medium.

3. CN agar contains cetyl trimethylammonium bromide and nalidixic acid at concentrations that will inhibit the growth of bacteria other than P. aeruginosa. Other selective and differential agars are available and acceptable if validated.

4. The membrane is incubated on a selective/ differential agar and characteristic colonies are counted. Confirmatory tests are carried out where necessary (see paragraph 15) and the result is calculated as the colony count per 100 mL of water.

5. P. aeruginosa usually produces characteristic blue- green or brown colonies when incubated at 37°C for up to 48 hours. Confirmation of isolates is by subculture to milk agar supplemented with cetyl trimethylammonium bromide (commercially available) to demonstrate hydrolysis of casein.
Sample preparation and dilutions

6. Water samples should be received and handled as described in the SCAs’ 2002 guidance (currently under review). For example, samples should be examined as soon as is practicable on the day of collection. In exceptional circumstances, if there is a delay, store at 2–8°C and do not exceed 24 hours before the commencement of analysis.

Filtration and incubation

7. Aseptically measure and dispense 100 mL of water sample into the sterile filter-holder funnel. If the funnel is graduated to indicate volume, this can also serve to measure the volume.

8. If high bacterial numbers are present in water samples, it may be impossible to count individual colonies accurately on the filter membrane. Therefore, if high counts are expected, a range of dilutions made in sterile diluent (water, MRD or similar) can be processed in parallel with the undiluted sample. An example of this would be a 1-in-10 and a 1-in-100 dilution processed as well as an undiluted sample. Filtration of 10 mL rather than 100 mL is an alternative to filtering 100 mL of a 1-in10 solution.

9. Draw the water sample through the filter.

10. Aseptically place the membrane onto the pseudomonas selective and differential agar (see paragraph 3) and incubate aerobically at 37°C.

Counting of colonies

11. Examine plates after 22 hours ± 4 hours and 44 hours ± 4 hours of incubation

12. Count all colonies that produce a green/blue (demonstrating pyocyanin production), or reddish-brown pigment and those which fluoresce under ultraviolet light (optional). Exposure of colonies to daylight for 2–4 hours enhances pigment production. When there is a moderately heavy growth of *P. aeruginosa* and other organisms on the membrane, colonies adjacent to pyocyanin-producing colonies of *P. aeruginosa* can also appear green after 44 hours ± 4 hours of incubation, making the interpretation of the count difficult. Observing the plates after 22 hours ± 4 hours assists in the interpretation in these instances.
Plate showing high counts of pyocyanin-producing colonies of *P. aeruginosa*

**Processing of swabs**

13. Swabs can show presence of *P. aeruginosa* but will not provide equivalent quantitative results as water sampling. They can be used to show the presence or absence of *P. aeruginosa* at the outlet.

14. In the laboratory, use the swab to inoculate a portion of an agar plate that is selective and differential for *P. aeruginosa* (see paragraphs 2 and 3). Streak the inoculum on the plate as for a clinical sample. Incubate as described for filter samples above. Alternatively, after sampling, place the swab in 10 mL MRD, vortex, then plate out (using serial dilution) on the appropriate media and incubate as above.

**Confirmatory tests**

15. Colonies that clearly produce pyocyanin (green/ blue pigmented) on the membrane are considered to be *P. aeruginosa* and require no further testing. Other colonies which fluoresce or are red/brown require confirmation. If more than one volume or dilution has been filtered, proceed if possible with the membrane yielding 20–80 colonies to enable optimum identification and accurate enumeration of colonies. Where there is doubt, perform additional tests to yield reliable species identification.

16. To confirm other colonies, subculture from the membrane onto a milk cetrimide agar (MCA) plate and incubate at 37°C for 22 hours ± 4 hours. Examine the plates for growth, pigment, fluorescence and casein hydrolysis (clearing medium’s opacity around the colonies). If pigment production is poor, expose the MCA to daylight at room temperature for 2–4 hours to enhance pigment production and re-examine.

17. *P. aeruginosa* is oxidase-positive, hydrolyses casein and produces pyocyanin and/or fluorescence. Occasionally atypical non-pigmented variants of *P. aeruginosa* occur. A pyocyanin-negative, casein-hydrolysis-positive, fluorescence-positive culture should be regarded as *P. aeruginosa*. Additional tests may be necessary to differentiate non-pigmented *P. aeruginosa* from *P. fluorescens* (such as growth at 42°C or resistance to C-390, 9-chloro-9-(4diethylaminophenyl)-10-phenylacridan or phenanthroline or more extensive biochemical tests).
### Table A1

<table>
<thead>
<tr>
<th>Colony on CN agar</th>
<th>Oxidase test</th>
<th>Fluorescing on MCA</th>
<th>Caseinolytic on MCA</th>
<th>Confirmed P. aeruginosa</th>
</tr>
</thead>
<tbody>
<tr>
<td>Blue or green</td>
<td>+</td>
<td>NT</td>
<td>NT</td>
<td>Yes</td>
</tr>
<tr>
<td>Fluorescing and not pigmented</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>Yes</td>
</tr>
<tr>
<td>Reddish brown non-fluorescing</td>
<td>+</td>
<td>+/-</td>
<td>+</td>
<td>Yes</td>
</tr>
</tbody>
</table>

### Retention of P. aeruginosa isolates

18. Where an investigation into clinical infections is underway, inform the testing laboratory that the isolates of *P. aeruginosa* and associated sampling location information should be retained for a minimum of three months as they may be required for typing at a later date.

19. It will then be the responsibility of the testing laboratory to ensure that these isolates are supplied to the typing laboratory (for example, PHE at Colindale) when requested, and this should be written into the contract for testing.

### Calculation of results

20. Express the results as colonies of *P. aeruginosa* per 100 mL of the undiluted sample, for example:

- for 100 mL sample – the count on the membrane;
- for 10 mL of sample – the count on the membrane multiplied by 10;
for 1 mL of sample – the count on the membrane multiplied by 100.

**Reporting**

21. If *P. aeruginosa* is not detected, report as “Not detected in 100 mL”.

22. If the test organism is present, report as the number of *P. aeruginosa* per 100 mL. Reports should be specific to *P. aeruginosa*, and not generic Pseudomonas species.

23. The sample reference originally submitted should be reported with each result.

**Microbiological typing**

24. Water and/or tap-swab isolates being sent to PHE Water and/or tap-swab isolates being sent Associated Infections (AMRHAI) Reference Unit for molecular analysis of *P. aeruginosa* should only be referred if the isolates have been confirmed to be *P. aeruginosa* and if there is a possible link to the outbreak strain under investigation.

25. Referrals of *P. aeruginosa* isolates for typing should only be sent after consultation with the typing laboratory.

26. Where many taps are positive for *P. aeruginosa*, send one colony of the *P. aeruginosa* from each water sample. Save the primary isolation plate for possible further examination once the results of typing are known and have been discussed with the typing laboratory. Analysis of results to date has consistently shown that multiple picks have been representatives of the same strain; since multiple taps are being sampled, an idea of the extent of homogeneity or otherwise will still be gained where only one colony is sent from each water sample.

27. If only two or three taps are positive for *P. aeruginosa*, then send two separate colony picks of confirmed *P. aeruginosa* from the primary plate per water sample to AMRHAI (taking the stipulations in paragraph 25 into account). Label these clearly as being from the same water sample (so that AMRHAI can accumulate data on how common mixed strains are seen in the same tap water).

28. It is important that the request forms have information about the links between tap water and cases as illustrated in the following examples:

   a. water from tap in room e request forms have
   
   b. water from tap in sluice room;

   C. tap water from room “C” with no cases.

29. It is important to recognise that there are some types of *P. aeruginosa* that are relatively commonly found in the environment and among patient samples globally. These include the PA14 clone and clone C; a match between patient and water samples with these strains is not necessarily evidence of transmission between the two.

**What to do if a contamination problem is identified**
Should risk assessment or water testing identify contamination with *P. aeruginosa*, the following risk reduction and preventive measures should be considered.

a. If a water outlet has been taken out of service because of contamination with *P. aeruginosa*, continue daily flushing while the outlet is out of normal use to prevent water stagnation and exacerbation of the contamination.

b. Where practical, consider removal of flow straighteners. However, the removal of flow straighteners may result in splashing and therefore additional remedial action may need to be taken. If they are seen to be needed, periodically remove them and either clean/disinfect or replace them. Replacement frequency should be verified by sampling/swabbing.
c. Splashing can promote dissemination of organisms, resulting in basin outlets becoming heavily contaminated. If splashing is found to be a problem, investigate the causes. Example causes include:

(i) the tap’s designed flow profile is incompatible with the basin;
(ii) the tap discharges directly into the waste aperture;
(iii) incorrect height between tap outlet and surface of the basin;
(iv) excess water pressure;
(v) a blocked or malfunctioning flow straightener.

d. Hand-washing should be supplemented with the use of antimicrobial hand-rub.

e. To prevent water stagnation, check for underused outlets – assess frequency of usage and if necessary remove underused outlet(s). For example, the provision of showers in areas where patients are predominantly confined to bed, and the resultant lack of use, could lead to stagnation.

f. Check connections to mixing taps to ensure that the supply to the hot connection is not supplied from an upstream TMV. In a hot-water service, a dead-leg will exist between the circulating pipework and hot connection of a fitting such as a mixing tap. In the case of cold-water services, sometimes there will be no draw-off from any part of the system and the entire service is in effect a dead-leg. To minimise the stagnation of water in a cold-water system, it can be beneficial to arrange the pipework run so that it ends at a frequently used outlet. A dead-leg may also exist when a TMV is installed upstream of a mixing tap (see Figure 4). Depending on the activities of the room in which the tap is located, cold water may never be drawn through the pipe between the cold-water connections of the mixing valve and mixing tap.

g. Assess the water system for blind ends and dead-legs (for example, where water is supplied to both the cold-water outlet and a TMV supplying an adjacent blended water outlet, as such cold-water outlets in augmented care units may be commonly underused). When removing outlets, the branch hot- and cold-water pipes should also be cut back to the main distribution pipework in order to eliminate blind ends.
Figure 4 Dead-leg formed by the cold pipework when a TMV is installed upstream of a mixing tap

h. Assess the water distribution system for non metallic materials that may be used in items such as inline valves, test points and flexible hoses. They should be replaced according to the guidance in safety alert (DH (2010) 03: H (2010) 03) http://www.dh.gov. All materials must be WRAS-approved and must not leach chemicals that provide nutrients that support microbiological growth. Materials should also be compatible with the physical and chemical characteristics of water supplied to the building. Flexible pipes should only be used in exceptional circumstances (for example, where height adjustment is necessary as in installations such as rise-and-fall baths and hand-held showers).

i. POU filters, where they can be fitted, may be used to provide water free of \textit{P. aeruginosa}. Where fitted, regard filters primarily as a temporary measure until a permanent safe engineering solution is developed, although long-term use of such filters may be required in some cases. Where POU filters are fitted to taps, follow the manufacturer’s recommendations for renewal and replacement and note that the outer casing of a POU filter and the inner surface can become contaminated (see Health Technical Memorandum 04-01 Part B).
k. In certain circumstances, the WSG may decide it is necessary to carry out a disinfection of the hot- and cold-water distribution systems that supply the unit to ensure that contaminated outlets are treated. See Chapter 16 in HTM 04-01 Part A for guidance on how to carry out the disinfection procedure. Note that with respect to \textit{P. aeruginosa}, hyperchlorination is not effective against established biofilms. Consider replacing contaminated taps with new taps; however, there is currently a lack of scientific evidence to suggest that this will provide a long-term solution. When replacing taps, consider fitting:

(i) removable taps;

(ii) taps that are easy to use;

(iii) taps that can be readily dismantled for cleaning and disinfection;

(iv) taps to which a filter can be attached to the spout outlet. Note: Such taps can be used for supplying water for cleaning incubators and other clinical equipment.

\textbf{Note:}

In the event of an outbreak or incident, further advice on the management of \textit{P. aeruginosa} contamination in water systems can be sought from PHE.
Appendix G Maintenance, cleaning and disinfecting operations for water distribution installations

The following tables have been taken from the French Ministry of Health's document *L'eau de santé dans les établissements*.

**Required skills used in the tables**

According to the nature and scope of maintenance operations, these are carried out by operators having the required skills. These include:

Level 1: operator with no specific skills, for simple operations only, and with no power of decision;

Level 2: operator with general skills for a specific operating level (e.g. plumbing) and with a limited power of decision within his own work; these skills may be obtained with a specific training;

Level 3: operator with specific skills for a given well-defined task, who is empowered to carry out this task and with a well-defined power of decision-making as defined by the scope of this empowerment. These skills are obtained with specialised training;

Level 4: operator with expertise level skills.

Question to consultees: Are the tables on the following pages useful, and do you think they should be reproduced/adapted in the final draft?
The following tables show all possible operations. Carrying out these operations and specifying their frequency should be adapted to the context of the installation and to its constituents.

Table 14: Hot and cold water distribution – General networks

<table>
<thead>
<tr>
<th>Nature of operations</th>
<th>Objectives</th>
<th>Minimum skill level required</th>
<th>Frequency</th>
<th>Principles</th>
</tr>
</thead>
<tbody>
<tr>
<td>Watertightness check</td>
<td>Get rid of leaks</td>
<td>1</td>
<td>Six monthly to annually</td>
<td>Inspect the overall condition of joins (external corrosion…). Ensure there are not any leaks at pipework seals and fittings.</td>
</tr>
<tr>
<td>Manual flushes of network</td>
<td>Get rid of non-adhering deposits</td>
<td>1</td>
<td>Six monthly to annually</td>
<td>Carry out flushes at ends of the horizontal distribution system as well as at every low point and in every low output zone.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>- Carry out flushes at foot of water column.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>- For the hot water distribution network, conduct an inspection, when carrying out this process, of the temperature of the loop backflow so as to check that the water is circulating properly in the hot water columns.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>- According to manufacturer’s instructions.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>- Carry out a test of the operation of the automatic flushing mechanisms. Inspect energy supply for systems running on batteries etc.</td>
</tr>
<tr>
<td>Check of automatic network flushing systems</td>
<td>Check systems operation</td>
<td>2</td>
<td>According to manufacturer’s recommendations and at least annually</td>
<td>- Carry out successive purges until no air comes out.</td>
</tr>
<tr>
<td>Operating manual drain valves and gas vents</td>
<td>Get rid of gases causing surges and corrosion phenomena</td>
<td>1</td>
<td>Six monthly to annually for cold water distribution - Bi-monthly to quarterly for hot water distribution</td>
<td>- According to fittings and any recommendations from the manufacturer. - Clean internal components and carry out an operation test.</td>
</tr>
<tr>
<td>Maintenance and checking of automatic drain valves and gas vents</td>
<td>Check and ensure operation</td>
<td>1</td>
<td>In line with manufacturer’s recommendations and at least annually</td>
<td>- According to fittings and any recommendations from the manufacturer. - Clean internal components and carry out an operation test.</td>
</tr>
<tr>
<td>Checking and maintaining systems for protection against backflows</td>
<td>Check appropriateness with regard to risk and the effectiveness of components (watertightness and operation)</td>
<td>3</td>
<td>Six monthly at level N₁ and as often as necessary at level N₂ and at level N₃</td>
<td>- Examine the elements which may have an effect on operation, its ability to function or its maintenance (general installation conditions and immediate environment). - Check the appropriateness with regard to risk for which it was initially specified. - Assess the efficiency of its safety controls using specific tests. - Detect breakdowns and operational anomalies and specify repairs to be carried out. (…)</td>
</tr>
</tbody>
</table>
Table 14 (continued): Cold and hot water distribution – General networks

<table>
<thead>
<tr>
<th>Nature of operations</th>
<th>Objectives</th>
<th>Minimum skill level required</th>
<th>Frequency</th>
<th>Principles</th>
</tr>
</thead>
<tbody>
<tr>
<td>Check corrosion indicators</td>
<td>Assess the seriousness of corrosion phenomena and anticipate their consequences</td>
<td>2</td>
<td>Six monthly to annually</td>
<td>Dismantle the reference packings so as to note: - the presence of blisters (approximate size, number, colour); - the diameter of the section where the water passes in the packing. If major deterioration is noted, it is advisable to look for the cause(s) (a complete study – metallographic analysis, network survey, checking injection positions… - may prove necessary).</td>
</tr>
<tr>
<td>Bypass rinsing</td>
<td>Get rid of stagnant water and deposits</td>
<td>1</td>
<td>Before commissioning and every 2 months</td>
<td>Drain then circulate a large flow of clean water, which is directly to a wastewater network every 2 months (Isolate the installations bypass situated downstream during the operation)</td>
</tr>
<tr>
<td>Check pressure surge controls</td>
<td>Check systems operation</td>
<td>2</td>
<td>In line with manufacturer’s recommendations and at least once annually</td>
<td>Check: - that the joint at the top of the riser column is in good condition; - the ratings of the springs for the systems which have them; - the inflation pressure for systems with bladders; - the watertightness of membranes separating gas/water. Replace devices if abnormal vibrations are observed on the columns when opening and closing taps.</td>
</tr>
<tr>
<td>Draw-off in the unoccupied chambers or at water points which have not been used for over 48 hours</td>
<td>Renew water to avoid contamination through stagnation</td>
<td>If a chamber remains unoccupied or a water point remains unused for more than 48 hours</td>
<td>- Draw off cold water for 2 to 3 minutes at points of use, especially before re-activation. - Draw off hot water for 2 to 3 minutes at points of use, especially before re-activation.</td>
<td></td>
</tr>
<tr>
<td>Temperature inspections for cold water distribution</td>
<td>Check that the temperature of the cold water is lower than the limit required</td>
<td>1</td>
<td>Weekly or continuously</td>
<td>Raise the temperatures and check that requirements are met. Inspection points are to be specified according to the network configuration and operation.</td>
</tr>
<tr>
<td>Temperature inspection for hot water distribution (cf. annex 3)</td>
<td>Check that the temperature of the hot water is always above 50°C, at all points of the network up to immediately upstream of the point of use</td>
<td>Preferably on a continuous basis or daily</td>
<td>Inspect the water temperature at the tank exit point, of the plate heat exchanger and loop backflow. Inspect the temperature: - at the least-used points of use (usually the loop backflows which are the furthest away); - at 2 or 3 of the most representative points of use; - at representative points of use which are located in high-risk areas. Note the arrival time at the point of use. Recording temperatures can be done continuously using sensors or automatic cyclical reading systems.</td>
<td>9</td>
</tr>
<tr>
<td>Nature of operations</td>
<td>Objectives</td>
<td>Minimum skill level required</td>
<td>Frequency</td>
<td>Principles</td>
</tr>
<tr>
<td>----------------------</td>
<td>------------</td>
<td>-----------------------------</td>
<td>-----------</td>
<td>------------</td>
</tr>
<tr>
<td>Descaling networks</td>
<td>Get rid of adhering scale deposits</td>
<td>4</td>
<td>In the event of major scaling or advanced deoxidation of networks</td>
<td>Descaling and deoxidation operations must be carried out after a feasibility study, which is carried out, among other things, for: - analysing the compatibility of treatment products with materials making up the networks; - checking the feasibility of operations; - determining the methods and processes used; - specifying precautions to be taken. Given the complex nature of the operations, it is recommended that specialist service providers are used.</td>
</tr>
<tr>
<td>Deoxidising networks</td>
<td>Get rid of adhering deposits caused by products of corrosion</td>
<td>4</td>
<td>In the event of major scaling or advanced deoxidation of networks</td>
<td></td>
</tr>
</tbody>
</table>
| Disinfecting networks | Getting rid of undesirable micro-organisms which are responsible for contamination | 4 | In the event of major contamination or after major work has been done | Thermal disinfection:  
- First ensure that hot water installations are able to stand up to the treatment and that the hot water production installations have sufficient thermal power.  
- Prior descaling is important, as the scale protects the biofilm by limiting heat diffusion.  
- Water flow must be kept at a minimum rate during the operation.  
- Operating mode:  
  - Isolate the network for disinfection.  
  - Disconnect the loop backflow (if the thermal power is sufficient) and connect it directly to a water outlet.  
  - Dismantle, descale and disinfect the distribution peripherals (shower heads, anti-splash nozzles…)  
    (Replace after disinfection), dismantle the mixing tap cartridges and neutralise the temperature restrictors.  
  - Descale and rinse the hot water production elements (tank, exchanger…)  
    Followed by disinfection and rinsing (cf. hot water production).  
  - Point out the operational danger with regard to the drawing-off points (risk of burns).  
  - Heat up the hot water production installation to a temperature of around 85°C.  
  - When the required temperature is reached, turn on each tap and outlet, moving from the closest pipes to the furthest ones (upstream to downstream).  
  - At each position, maintain a low flow rate at a temperature of 70°C for 30 minutes.  
  - Turn off the taps as you go along.  
  - When finished, turn down the required temperature for hot water production to its normal operating level.  
  - Replace the mixing tap cartridges and the temperature restrictors. Check at the draw-off points that the temperature is below 55°C. Check the balancing of the loop  
    (see table 16). Replace all distribution peripherals. As you go along, systematically change the seals and parts which require replacement. |
<table>
<thead>
<tr>
<th>Nature of operations</th>
<th>Objectives</th>
<th>Minimum skill level required</th>
<th>Frequency</th>
<th>Principles</th>
</tr>
</thead>
<tbody>
<tr>
<td>Network disinfection</td>
<td>Getting rid of undesirable microorganisms which are responsible for contamination</td>
<td>4</td>
<td>In the event of major contamination or after major work has been done</td>
<td><strong>Chemical disinfection:</strong> Water flow must be kept at a minimum rate during the operation.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Recommended operating mode:</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>- Isolate the network for disinfection (valve and check valve) and connect the injection pump to an introduction tap located downstream of the valve.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>- If the section for disinfection is connected to user positions, disassemble, descale and disinfect the supply peripherals (shower heads, ventilators…).</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Replace them after disinfection.</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>- Rinse networks thoroughly for 2 hours (between 5 and 10 times the installation volume).</td>
</tr>
<tr>
<td></td>
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<td></td>
<td>- Open the taps slightly located at the ends of all the branch mains.</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>- Inject the disinfecting solution regularly using a metering pump (flow regulated according to the division of concentration/time of contact required).</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>- Open each tap and outlet moving from the closest pipes to the furthest ones.</td>
</tr>
<tr>
<td></td>
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<td></td>
<td></td>
<td>- Close when the desired concentration has been obtained (check by using a colourimetric test, for example, which indicates the presence of disinfectant), then isolate by closing the stop valves.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>- Ensure there is enough residual disinfectant at all points of the disinfected supply network.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>- Empty the disinfecting solution through all the low points of the installation (emptying).</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>- Rinse for around 2 hours through all taps and outlets.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>- Open all taps and outlets to get rid of all traces of disinfectant.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>- Make sure there is no residual disinfectant (beyond the “normal” concentration of water in the public network).</td>
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<tr>
<td></td>
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<td></td>
<td>- After 12 hours, take bacteriological samples, having previously inspected the amount of residual disinfectant.</td>
</tr>
<tr>
<td>Nature of operations</td>
<td>Objectives</td>
<td>Minimum skill level required</td>
<td>Frequency</td>
<td>Principles</td>
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<tr>
<td>----------------------</td>
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</tr>
<tr>
<td>Checking safety mechanisms (valves and safety assemblies)</td>
<td>Ensure normal operation</td>
<td>1</td>
<td>In line with manufacturer’s recommendations and at least once a month</td>
<td>Operate the valves and safety assemblies.</td>
</tr>
<tr>
<td>Checking drain valves</td>
<td>See table 14</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tank flushes</td>
<td>Get rid of deposits</td>
<td>1</td>
<td>Weekly</td>
<td>Carry out successive flushes at low point (emptying valve or safety assembly) by opening quickly and closing slowly. N.B. For tanks fitted with treatment systems using soluble anodes, follow supplier’s instructions (frequency)</td>
</tr>
<tr>
<td>Descaling and disinfection production devices (exchangers and tanks)</td>
<td>Avoid and prevent contamination</td>
<td>3</td>
<td>Annual descaling Disinfection after every operation which may cause contamination of the water in the tanks - at least once a year for tanks open to atmospheric pressure</td>
<td></td>
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<tr>
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<td></td>
<td>Tanks:</td>
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<td>- Empty fully.</td>
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<td></td>
<td>- Examine internal walls: if these show signs of corrosion, make provision for repair (deoxidation and application of new coating) or replace, otherwise descale and disinfect.</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td>- Collective tank: clean the tank using plenty of water and, if possible, brush the interior walls by hand.</td>
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<td></td>
<td>- Individual tank: clean the tank with plenty of water.</td>
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<tr>
<td></td>
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<td></td>
<td>- Rinse the tank by filling with water while flushing at low points until all traces of deposits have gone from the drained water.</td>
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<tr>
<td></td>
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<td></td>
<td>- Descale using authorised commercial solutions (follow supplier’s instructions) or using a sulphamic or citric acid solution. For individual tanks, inject the solution in a closed circuit (use tapping in the cold water supply of the tank and on the hot water outlet, connect these to a circuit which allows reagent injection).</td>
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</tr>
<tr>
<td></td>
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<td></td>
<td>- Rinse with plenty of water (use a volume of water equal to 2.5 times the volume of the tank).</td>
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<tr>
<td></td>
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<td></td>
<td>- To ensure effective disinfection, use commercial solutions according to the required concentrations and according to the contact time between the disinfectant product and the water. For bleach, for example, 1 chlorometric degree = 3.17 g of free chlorine per litre. To obtain 150 mg/L, you need around 1/4 of a berlingot (small plastic carton) at 36 chlorometric degrees for 50 l of water or 1 berlingot at 36 chlorometric degrees for 200 l of water. For collective tanks, fill the tank to 1/3 of its volume or up to the manhole then inject the disinfectant solution via the manhole or the manual drain valve. For individual tanks, inject the disinfectant solution in a closed circuit (see descaling). Fill the tank fully with water and leave it to stand for the required contact time.</td>
<td></td>
</tr>
<tr>
<td>Nature of operations</td>
<td>Objectives</td>
<td>Minimum skill level required</td>
<td>Frequency</td>
<td>Principles</td>
</tr>
<tr>
<td>----------------------</td>
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</tr>
<tr>
<td>Tanks (continued):</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>- Empty and rinse using plenty of water (use a minimum volume of water equal to 2.5 times the tank volume) before reactivating. NB: seek assurance from the manufacturers that the concentrations of disinfectants used cannot alter the integrity of installations.</td>
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<tr>
<td>Plate heat exchanger:</td>
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<tr>
<td>- Dismantle the exchanger plates and remove the coupling joints.</td>
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<tr>
<td>- Descale the plates in a solution of sulphamic acid or white vinegar.</td>
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<tr>
<td>- Rinse with plenty of water.</td>
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<tr>
<td>- Disinfect the plates by soaking them in an authorised disinfectant solution, using the concentrations required and the contact time required between the disinfectant and the water, for effective disinfection. For bleach, for example, 1 chlorometric degree = 3.17 g of free chlorine per litre. To obtain 150 mg/L for 30 mins, you need around 1/4 of a berlingot at 36 chlorometric degrees for 50 l of water.</td>
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<tr>
<td>- Rinse with plenty of water until you have got rid of the traces of disinfectant (carry out a colourimetric test).</td>
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<tr>
<td>- Replace the plates using new coupling joints.</td>
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<tr>
<td>Tubular exchanger:</td>
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<tr>
<td>- Disconnect the inlets and outlets of the hot and cold water supply exchanger.</td>
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<tr>
<td>- Descale using commercial solutions (follow supplier’s instructions for use) or using a sulphamic or citric acid solution injected in a closed circuit (contact time of 30 mins.), then rinse in an open circuit.</td>
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<tr>
<td>- Disinfect using an authorised disinfection solution, using the concentrations required and the contact time required between the disinfectant and the water for effective disinfection. For bleach, for example, 1 chlorometric degree = 3.17 g of free chlorine per litre. To obtain 150 mg/L for 30 mins, you need around 1/4 of a berlingot at 36 chlorometric degrees for 50 l of water.</td>
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<tr>
<td>Inject the disinfectant solution into a closed circuit, then rinse in an open circuit until you have got rid of traces of disinfectant (carry out a colourimetric test).</td>
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</tbody>
</table>
### Table 16 (2 continued): Hot water production

<table>
<thead>
<tr>
<th>Nature of operations</th>
<th>Objectives</th>
<th>Minimum skill level required</th>
<th>Frequency</th>
<th>Principles</th>
</tr>
</thead>
</table>
| Check balancing of circulation loops | Ensure homogeneous hot water circulation | 4 | Quarterly or in the event of temperature anomaly | Note the temperature differences (DT) between the start and return of each loop:  
- **Guide value:** \( T \leq 5°C \)  
- **Warning level:** \( 5°C < T < 7°C \)  
- **Action level:** \( T > 7°C \)  
If necessary, review the balancing of the loop, the operation of the circulation pumps, and any silting up of networks. **Note:** caution, this involves all the loops. One often sees secondary loops in which water is not circulating, although the manifold meets the above criteria. |
| Maintaining and checking circulation pumps | Ensure pumps are working properly | 2 | In line with manufacturer’s recommendations and at least annually | Check pump operation (no overheating, leaks, etc.) and maintain them in line with manufacturer’s recommendations. |
| Maintaining and checking temperature regulation devices (thermostats, mixing taps…) | Ensure smooth operation and check set points | 3 | In line with manufacturer’s recommendations and at least once every six months or in case of temperature anomaly | |

### Table 17: Peripheral elements and specific fittings

<table>
<thead>
<tr>
<th>Nature of operations</th>
<th>Objectives</th>
<th>Minimum skill level required</th>
<th>Frequency</th>
<th>Principles</th>
</tr>
</thead>
</table>
| Maintaining plumbing | Getting rid of scale deposits and contamination | 2 | Quarterly to annually | Visually examine the condition of internal scaling of plumbing by sampling. If necessary, replace or clean/descaling before disinfecting. If not, disinfect directly. **Descaling:**  
- Remove ventilators, swan necks and shower heads/hoses.  
- Soak these in a descaling solution (white vinegar…).  
- Leave them to soak for 15 minutes, then clean mechanically (brush).  
- Rinse thoroughly.  
**Disinfection:**  
- Soak the parts in a disinfectant bleach solution (40 ml bleach - 1/4 glass - at 9 chlorometric degrees in 10 litres of cold water).  
- Leave them to soak for 15 minutes.  
- Rinse thoroughly before replacing parts. |
Table 17 (continued): Peripheral elements and specific fittings

<table>
<thead>
<tr>
<th>Nature of operations</th>
<th>Objectives</th>
<th>Minimum skill level required</th>
<th>Frequency</th>
<th>Principles</th>
</tr>
</thead>
<tbody>
<tr>
<td>External cleaning of plumbing</td>
<td>Get rid of contamination</td>
<td>1</td>
<td>Daily</td>
<td>Clean plumbing parts with a detergent-disinfectant solution when cleaning chambers (do not use powder detergents). Descale and disinfect.</td>
</tr>
</tbody>
</table>
| **Maintaining drinking water coolers (internal circuits)** | Maintain good hygienic standards | 3 | Six monthly to annually | **Internal cleaning:**  
  - Remove the water from the cooler.  
  - Remove the coil and the flexible hose.  
  - Descale by soaking in a solution of white vinegar then rinse.  
  - Disinfect by soaking in a solution of white vinegar then rinse.  
  - For the coil, see whether it is possible to use direct injection in a closed circuit of descaling and disinfecting solutions.  

**Maintenance:**  
- Change the hose for an opaque, food-quality hose.  
- Change filters in line with supplier’s specifications and at least once annually. |
| Maintaining drinking water coolers (external portion) | Maintain good hygienic standards | 1 | Daily | Clean the walls, the pourers, grates and basins… with a detergent  
  - Descale the pourer by soaking it in white vinegar for 5 minutes then rinse.  
  - Disinfect the pourer by soaking it in a bleach solution for 15 minutes (1 tablespoon of bleach at 9 chromometric degrees in 1 litre of water), then rinse.  
  - Defrost, clean and disinfect with products for use with foodstuffs. Rinse before using again. |
| Maintaining machines for producing ice for human consumption | Maintain good hygienic standards | Monthly to quarterly | Monthly to quarterly | Defrost, clean and disinfect with products for use with foodstuffs. Rinse before using again. |
| Maintaining machines for producing ice which is not for human consumption | Maintain good hygienic standards | Monthly to quarterly | Monthly to quarterly | Defrost, clean and disinfect with products for use with foodstuffs. Rinse before using again. |
Water treatment systems

The aims of the maintenance operations are to maintain the quality of the water produced and to optimise the production cost by limiting the number of production stoppages.

Water treatment system upkeep and checking operation must be carried out in line with the information and recommendations provided by the system suppliers.

Generally speaking, these operations consist of:
- an examination of the overall hygiene conditions which may influence the treatment and checking the presence of consumable products (monthly);
- cleaning and adjusting hydraulic, electric or electronic mechanisms required for systems to operate smoothly (monthly);
- assessing the effectiveness of the treatment, using, among other things, analyses which are representative of the treatment carried out (monthly);
- diagnosis of repair work to be carried out (quarterly).

Information about maintenance operations for water treatment systems using sodium exchange (softeners) are provided by manufacturers.

These maintenance operations depend to a certain extent on what the water is to be used for: water for technical use or for food use.

The inspection and maintenance schedule must include at least the following operations:

<table>
<thead>
<tr>
<th>Elements</th>
<th>Operations</th>
<th>Frequency*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Filter</td>
<td>Inspection (pressure loss)</td>
<td>Quarterly</td>
</tr>
<tr>
<td></td>
<td>Cleaning</td>
<td>Quarterly</td>
</tr>
<tr>
<td>Softener</td>
<td>Operation inspection (work phases)</td>
<td>Monthly to quarterly</td>
</tr>
<tr>
<td></td>
<td>Ensure that the duration of softening and regeneration phases comply with the constructors’ instructions.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Inspect frequency of regeneration</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Inspect supply</td>
<td>Monthly to quarterly</td>
</tr>
<tr>
<td>Salt tank</td>
<td>Cleaning + Disinfection</td>
<td>Weekly</td>
</tr>
<tr>
<td></td>
<td>Rinsing</td>
<td>Annually</td>
</tr>
<tr>
<td>Bypass</td>
<td>Operation inspection</td>
<td>Quarterly</td>
</tr>
<tr>
<td>Counter / clock / automaton</td>
<td>Inspection (connection with flow variation)</td>
<td>Monthly</td>
</tr>
<tr>
<td>Draining</td>
<td>Disinfection</td>
<td>Annually</td>
</tr>
<tr>
<td>Resin</td>
<td>Replacement</td>
<td>Annually</td>
</tr>
<tr>
<td>Quality of softened water</td>
<td>Analyses</td>
<td>According to manufacturer’s recommendations</td>
</tr>
<tr>
<td>(Th, Chlorides, Sodium)</td>
<td></td>
<td>Monthly to quarterly</td>
</tr>
</tbody>
</table>

* Frequencies are given for information purposes only. It will be necessary to follow manufacturers’ instructions and/or to adapt them to the system operating conditions, to the water quality and to different uses (technical, health, medical).

These maintenance operations must be recorded in the health inspection record.

If a maintenance contract is agreed with a company for water treatment devices it is necessary to check that it has all the necessary skills to provide this service (certification, qualified personnel...).
Maintenance operations for cold water storage tanks

> Objectives
- Ensure that water quality is retained.
- Manage the amount of time the water spends in the tank.
- Allow water to flow to the supply network in good conditions.

> General awareness and management rules
- Knowledge about the physical structure and hydraulic operation of tanks.
- Follow the operating instructions of the tanks and of their accessories.
- Knowledge about resources (quality and potential).
- Preparedness for crisis management:
  - knowledge about zones supplied by the installation;
  - knowledge about the options for isolating the contaminated installation and about decontaminating the installation and the zone in which polluted water may have been sent;
  - assessment of possibilities of alternative supplies;
  - prepare a basic structure showing the warnings and reports to be compiled.

> Nature of operations to be carried out
- Clean and disinfect tanks, get rid of deposits (calcium, iron, manganese, biofilm…)
  forming on the walls. Depending on the nature of the organic and/or mineral deposits, several procedures need to be implemented to ensure that the cleaning and disinfecting of the walls respects the integrity of the surfaces for cleaning or disinfecting (details on the following page).
- Treat the walls against any attack that may take place by organic and/or mineral matter contained in the water.
- Inspect, in the tanks, the condition of metallic materials which may come into contact with water for human consumption, so as to avoid direct water/metal contact (cast steel) to fight any possible corrosion phenomena.
- Inspect the condition of the corrosion markers located at the start of the supply pipe, in the control house.
- If the water is aggressive, closely inspect the condition of cement-based materials.
- Inspect the adherence of the watertight coating on the tank.
- Inspect the watertightness and airtightness of the supply upstream of the tank and of the distribution network start point.
- Inspect the condition of the seals of the equipment within the tank and up to within the control house.
- Filling the tank must be preceded by two rinses. Then it is filled for activation.
- Check the tank environment (water flow, air…).
- Check the protection of air inlets (anti-insect mesh…).
- Check the protection against sudden flow variations.
- Check procedures for taking samples.
- Check the air guards.
- Check the condition of siphons.
- Check water circulation within the tank.
- Check the watertightness of covers.

> Procedures
Before any operation takes place in a tank, maintenance operatives must be supplied with specific equipment which has been adapted for use, including safety protective gear.

The tank operative must always supervise the water quality. This means that he must have a health inspection record showing the results of checks carried out.
> Frequencies

The tank is highly prone to sedimentation of deposits and is therefore a high-risk zone for water degradation. It therefore needs to be cleaned often. Article R.1321-59 of the public health code states that "maintenance of storage tanks must be carried out and checked as often as necessary and at least annually". This operation may be accompanied by disinfection before becoming operational (again). Draining also makes it possible to check the standard of coatings, civil engineering work and tank fittings.

Given the possible changes in water quality within a tank, this may be chosen as an inspection point, within the context of the sampling plan for water analyses as set out by the establishment. Checking the water quality must be done as frequent as the modifications made to the tank’s hydraulic operation.

> Cleaning and disinfection phases of a tank

1/ Isolate and empty the tank.

2/ Clean deposits from walls, bottom and accessories:
- cleaning is done using brushing, with sludge and sand being drained by emptying the tank;
- pipes and accessories (hydraulic equipment, ladders, ...) are to be cleaned and scraped if necessary;
- ceilings, arches and domes are to be rinsed with a water jet to get rid of condensed water, which may carry germs.

To get rid of scale of the walls, cleaning may be:
- Mechanical: brushing and scraping by hand using a telescopic pole or using pressurised water;
- Chemical: chemical products can be used to clean tanks. The health ministry has authorised a list of products. The effectiveness of these products depends on the concentration and contact time.

3/ When cleaning with chemical products, their disposal and the pH of the water used for rinsing need to be inspected beforehand. The pH must be between 5.5 and 8.5 inclusive. If this is not the case, the water needs to be neutralised before draining takes place. Rinse using water under medium pressure. Rinse several times (at least twice) until the product has disappeared.

4/ Disinfect and include in the last rinse water a disinfectant solution authorised by the health ministry. The contact times indicated by the supplier or, by default, those shown in table 9 p. 84 of this document must be scrupulously observed. The products currently used are:
- chlorine in the form of sodium hypochlorite;
- hydrogen peroxide based products.

5/ Fill the tank after draining it several times.

6/ Carry out a bacteriological inspection of the water (drinkability analysis).

7/ Produce a report on the final condition of the tank after full examination. This is put into the health inspection record.
References