



Public Health  
England

# **Responding to the detection of legionella in healthcare premises**

## **Guidance for PHE Health Protection Teams**

Guidance for the PHE response to positive counts of legionella in healthcare premises, in the absence of associated cases of Legionnaires' disease

## About Public Health England

Public Health England exists to protect and improve the nation's health and wellbeing, and reduce health inequalities. It does this through world-class science, knowledge and intelligence, advocacy, partnerships and the delivery of specialist public health services. PHE is an operationally autonomous executive agency of the Department of Health.

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# 1. Background and purpose

A survey was carried out across all Health Protection Teams (HPT) in England to assess their involvement and engagement with local healthcare premises in relation to legionella control. In some areas, the local HPT is informed by those responsible for healthcare premises when relatively low levels of legionella are detected, or when there are significantly elevated levels of legionella, and there are a small number of instances where the HPT is only contacted when there are clinical cases. There is also considerable variation in the level of involvement that premises request of HPTs.

This document for Public Health England HPTs aims to provide:

- public health guidance for HPTs when approached by infection, prevention and control teams and estate departments with enquiries in relation to their water systems (in conjunction with L8<sup>1</sup>, HTM 04-01<sup>2</sup> and HSG274<sup>3</sup>) to ensure there is a consistent and appropriate response from PHE;
- information and practical guidance for HPT staff who are participating in incident control teams, or a water safety group.

This document describes situations where HPTs should be contacted, and the extent of involvement that can be expected of HPTs where legionella counts are detected in the hot and cold water systems (excludes cooling towers) of healthcare premises. **This is not a technical guidance document for water management contractors or estates departments.** For technical guidance on management of water systems, please refer to L8, HTM 04-01 and HSG274.

The guidance and accompanying algorithm (Figure 1, p.9) applies to situations where there are **no associated nosocomial cases**, although it is possible that cases may subsequently be identified.

Expert advice on environmental legionella management can be obtained from the relevant Food, Water and Environmental Microbiology laboratory (FWEM)

**Click** here for the contact details of the PHE FWEM services.

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<sup>1</sup> L8: Legionnaires' disease. The control of Legionella bacteria in water systems: Approved Code of Practice and guidance - 4<sup>th</sup> Edition. HSE 2013. <http://www.hse.gov.uk/pubns/books/l8.htm>

<sup>2</sup> Health Technical Memorandum 04-01: The control of Legionella, hygiene, "safe" hot water, cold water and drinking water systems. [https://www.gov.uk/government/uploads/system/uploads/attachment\\_data/file/144147/HTM\\_04-01\\_Part\\_A.pdf](https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/144147/HTM_04-01_Part_A.pdf)

<sup>3</sup> HSG274 Legionnaires disease: Technical Guidance, Health Service Executive, 2014.

Part 1: The control of legionella bacteria in evaporative cooling systems

Part 2: The control of legionella bacteria in hot and cold water systems

Part 3: The control of legionella bacteria in other risk systems

<http://www.hse.gov.uk/pubns/books/hsg274.htm>

## 2. Routine water management

The vast majority of legionella outbreaks occur due to the incorrect management of water systems. The day to day management of water systems in healthcare premises is the responsibility of the organisation and is usually undertaken by Estate Departments, often in conjunction with infection control teams. There should be an established Water Safety Group that meets regularly to review management strategies, incidents, any sampling results and actions to be taken.

### Composition of the Water safety Group

The water safety group should include:

- a named **responsible person** (legionella) and their deputy.
- an infection control doctor or nurse.
- consultant medical microbiologist.

A member of the local HPT staff can be nominated as a standing member of the group and invited if there are relevant issues to discuss. Regular attendance is not mandatory but may be useful to understand what frameworks are in place for the maintenance, control and monitoring of water systems in line with Approved Code of Practice (L8) and HTM 04-01, and if management issues arise.

The purpose of this '*check assurance*' is to gain an overall insight of what management systems for the control of water systems / legionella are in place. If these rudimentary measures are not in place, then this will heighten concern that the system is not being managed appropriately.

The checklist (appendix 2) can be used as a detailed assessment tool to work with the Trust on ensuring that they are aware of, and are addressing as necessary, legionella control issues on the premises.

### The Water Safety Plan

The Approved Code of Practice<sup>1</sup> (ACOP) for the control of *Legionella* (L8) applies to any undertaking where there is a reasonably foreseeable risk of exposure to legionella bacteria. The ACOP requires a risk assessment to be carried out for the premises and plans to be developed to monitor and prevent exposure, or control the risk from exposure, to legionella.

The risk assessment allows a written scheme of controls and precautions to be created (a water safety plan) that is implemented and properly managed, and should specify the measures to be taken to ensure that it remains effective. Every healthcare setting should have a water safety plan for the management of their hot and cold (including drinking) water systems and any cooling towers.

## Routine documentation

As part of the ongoing routine management of the water systems the following documentation should be available and regularly reviewed (and updated) by the Group:

- risk assessment.
- written scheme for control of risks identified.
- clear and up to date schematics of water system on site.
- schedules for flushing and descaling (sites and frequency).
- schedules for legionella sampling (sites and frequency).
- temperature control regimen.
- chemical dosing and monitoring (where appropriate).
- records of temperature monitoring data, flushing, legionella sampling and test reports.
- planned or recent building works and schedules.
- schedule and records of maintenance to chemical dosing equipment (where appropriate).
- inspection, cleaning and disinfection of water storage vessels (including tanks and calorifiers).
- organogram of management system.
- out of hour contact list/details.

### 3. Elevated legionella counts

Routine sampling results are the starting point of the algorithm in Figure 1; the frequency and sites for routine environmental sampling and culture for legionella in healthcare facilities should be based on a comprehensive risk assessment and should be part of an overall management strategy.

The purpose of this algorithm is to help in ascertaining the level of response required by HPTs when an elevated legionella count is reported and principally consists of two parts:

1. To assess that the trust is checking assurance.
2. Obtain further information to ascertain the degree of contamination and the risk to health; and agree with the trust infection control team on an appropriate response.

Further information outlining the two points above can be found in Appendix 1, which accompanies the algorithm.

The algorithm in this guidance begins where legionella counts are **greater than 100 cfu/l** (colony forming units per litre). It does not distinguish between different species of legionella and serogroups of *Legionella pneumophila* (e.g. sg 1 and sg 2-14) because where one is found; others are as likely to be present.

In most instances, the HPT should only be informed (and advice sought) when critical points are reached, for example, where there is a lack of legionella control after application of routine measures, an augmented care area is affected, or a suspected nosocomial case linked to the premises is identified.

### 4. Local health protection response

The following outlines the role of PHE HPTs in responding to enquiries related to elevated counts of legionella in healthcare premises. Expert advice is available within PHE should local teams not have sufficient expertise, and the Directory of Legionella Services provides guidance on what support is available, and who to contact. See the 'PHE Duty Doctors Pack' on the intranet for a copy of the directory.

In general, HPTs can be expected to (as part of a trust led incident team):

- review risk assessment and control procedures – the estates team/IPCT should already have undertaken (or contributed to) a risk assessment. This can be reviewed off-site by HPT staff with expert support as required
- provide advice on further sampling, continued monitoring and clearance results
- signpost trusts regarding laboratory support for testing and (where appropriate) typing samples and, where necessary, to coordinate typing of isolates at Respiratory and Vaccine Preventable Bacteria Reference Unit, Public Health England - Microbiology Reference Services, Colindale
- discuss emergency remedial control measures eg. pasteurisation, chlorination, and fitting filters on outlets, again with expert support as required (see below)
- support the review of the risks to vulnerable individuals on site by the IPCT
- assist with case finding among current in-patients, out-patients and staff over the previous two years using hospital and PHE case records
- if there is confirmation of a nosocomial case at the trust, to contribute to the incident team
- provide advice on defining an end point at which the initial remedial work can be judged successful eg two or three consecutive sets of samples where legionella is not detected
- support trust led public facing communications as appropriate

PHE HPTs should not:

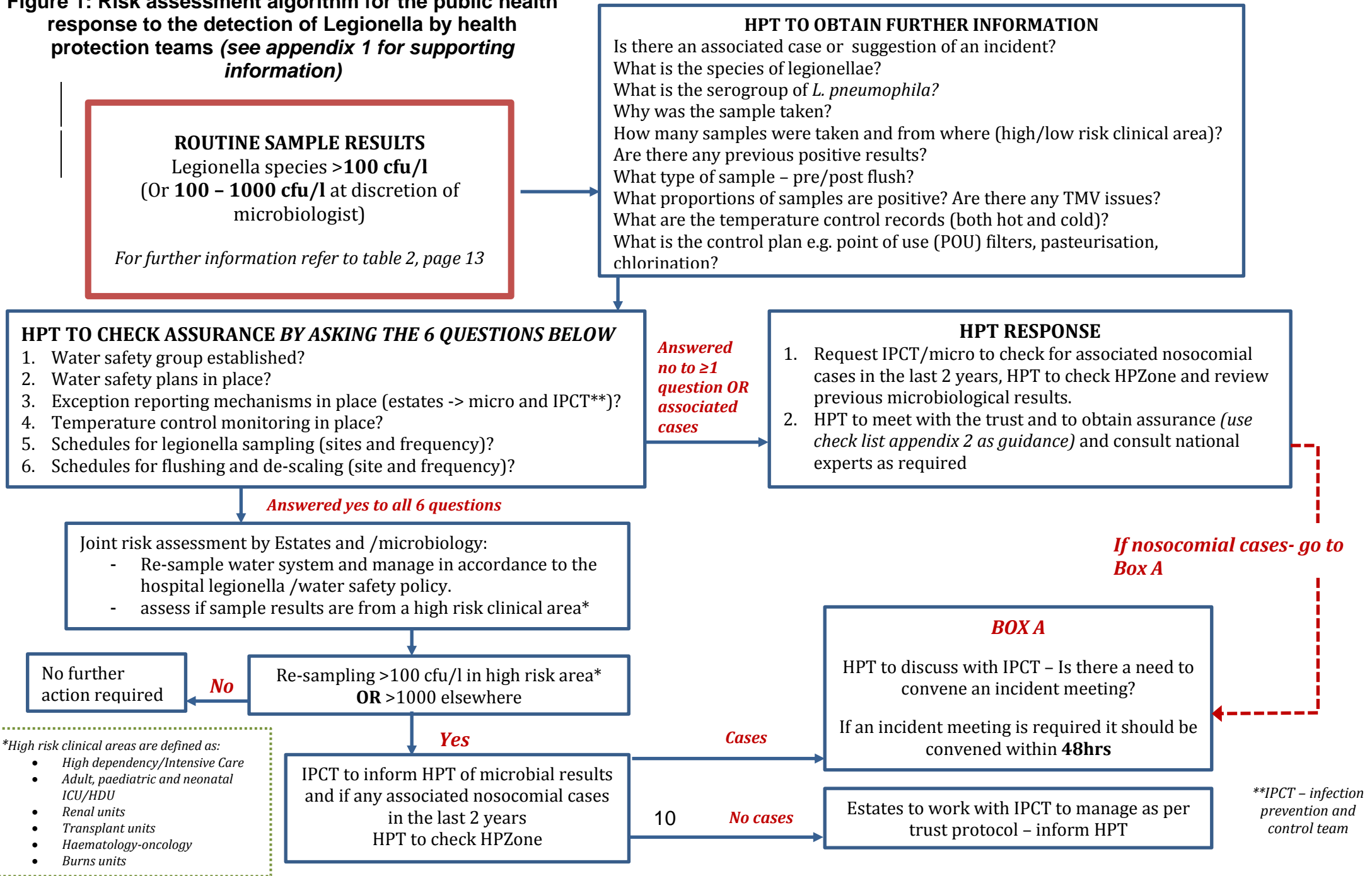
- make recommendations for long term legionella control, operational management and water treatment processes
- advise on engineering aspects of management of the water system



## 5. Key documents

1. L8 Legionnaires' disease. The control of legionella bacteria in water systems. Approved Code of Practice), Health Service Executive, 2013.  
<http://www.hse.gov.uk/pubns/priced/l8.pdf>
2. HSG274 Legionnaires disease: Technical Guidance, Health Service Executive, 2014.  
Part 1: The control of legionella bacteria in evaporative cooling systems  
Part 2: The control of legionella bacteria in hot and cold water systems  
Part 3: The control of legionella bacteria in other risk systems  
  
<http://www.hse.gov.uk/pubns/books/hsg274.htm>
3. HTM 04-01 Part A (design, Installation and testing):  
[https://www.gov.uk/government/uploads/system/uploads/attachment\\_data/file/144147/HTM\\_04-01\\_Part\\_A.pdf](https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/144147/HTM_04-01_Part_A.pdf)
4. HTM 04-01 Part B (operational management):  
<http://www.whtlimited.com/doc/lib/98/htm-04-01-part-b-20061009113435.pdf>
5. HTM 04-01 Addendum (Pseudomonas aeruginosa – advice for augmented care units):  
[https://www.gov.uk/government/uploads/system/uploads/attachment\\_data/file/140105/Health\\_Technical\\_Memorandum\\_04-01\\_Addendum.pdf](https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/140105/Health_Technical_Memorandum_04-01_Addendum.pdf)
6. Legionella and the prevention of Legionellosis. WHO, 2007.  
[http://www.who.int/water\\_sanitation\\_health/emerging/legionella.pdf](http://www.who.int/water_sanitation_health/emerging/legionella.pdf)

**Figure 1: Risk assessment algorithm for the public health response to the detection of Legionella by health protection teams (see appendix 1 for supporting information)**



## Appendix 1 – Information to support the algorithm

**Assess risk** - Hospitals should have a framework for the maintenance, control and monitoring of water systems in line with L8 and HTM 04-01. The vast majority of legionella outbreaks occur because the water system is not managed correctly. The purpose of the assurance check is to get an insight, albeit superficial, of what management systems for the control of water systems / legionella exist. If these rudimentary measures are not in place then this will heighten the concern that the system is not being managed appropriately.

### Further information:

#### 1. Trying to ascertain the degree of contamination and risk to health

**Temperature control not achieved of contaminated system**- the principal means of controlling legionella is to maintain water temperatures above 55°C for hot water and below 20°C for cold water.

**Location of the contamination** - A degree of contamination at the periphery of a water system with legionella is almost inevitable. Presence of legionella may represent poor use of an outlet or the presence of materials that promote biofilm formation. In addition, sampling through a thermostatic mixer valve (TMV) will also have an impact on the microbiological results and their interpretation. The results from pre-and post-flush samples will help identify whether the colonisation is local to the outlet or system-wide.

**Table 1: Location of contamination using pre and post-flush samples\***

	<b><i>Presence of legionella bacteria (cfu/l) in pre-flush samples</i></b>	<b><i>Presence of legionella bacteria (cfu/l) in post flush samples</i></b>	<b><i>Comments on legionella positive outlets</i></b>
<b><i>Contamination of water system</i></b>	Levels (cfu/l) are similar to post flush	Usually levels (cfu/l) are similar to pre flush	A high proportion of outlets may be positive but this will be dependent upon the local water system and other risk factors e.g. temperature control, flushing regimes and presence of dead legs
<b><i>Contamination at the outlet</i></b>	Usually higher than post flush	Usually low or absent	May be interspersed with positive and negative outlets, but this will be dependent upon the local water system and other risk factors e.g. temperature control, flushing regimes and presence of dead legs

**\*Local interpretation must take in to account other risks e.g. temperature control, flushing regimes and presence of dead legs; and the variations in local water systems such as usage and plumbing.**

Sample results, both positive and negative, should be plotted on the water schematics in order to understand their relationship and where the contamination may be located.

**Serogroup of *Legionella pneumophila*** – Serogroup 1 accounts for the vast majority of Legionnaires' disease cases. Other serogroups / legionella species may give rise to clinical cases and may require other tests to diagnose, as the urinary antigen test will usually only detect serogroup 1. The finding of legionella irrespective of serogroup or species indicates that conditions exist in the system which will support the growth of legionella.

**Flushing records** – water turnover is a pre-requisite to maintaining temperature control of the system. Water stagnation produces temperatures and conditions which promote biofilm formation and bacterial multiplication. The absence of flushing records or a risk assessment of outlets with regards to water turnover indicates the system is not being managed appropriately.

## **2. Whether an appropriate response has / is going to occur.**

Is an incident meeting being held?

Who will be attending the incident control meeting/water management group – depending on size of problem should include for example: the DIPC; infection control doctor, responsible person for water, estates and infection control; representative from water treatment specialist company (if used); and communications

Are further water samples being tested and from where? Is there a policy detailing collection of water samples and have staff been trained? If not refer to PHE 'Examining food, water and environmental samples from healthcare environments Microbiological Guidelines'. Please click [here](#) for a copy.

What measures are being taken to reduce risk? Further sampling to monitor and validate control measures, such as point of use filters, pasteurisation, use of biocides, enhanced flushing, placing a bleed on the system, water system review and refurbishment?

If a significant risk is thought to be present what communication has occurred to medical staff ie consider in differential diagnosis of hospital acquired pneumonia, what specimens to take, should you include a macrolide in addition to standard therapy? Who else should you tell?

**Table 2: Action levels following legionella sampling in hot and cold water systems in healthcare premises with susceptible patients<sup>4</sup>**

Legionella bacteria (cfu/l)	Recommended actions
Not detected or up to 100 cfu/l	In healthcare, the primary concern is protecting susceptible patients, so any detection of legionella should be investigated and, if necessary, the system resampled to aid interpretation of the results in line with the monitoring strategy and risk assessment.
>100 cfu/l and up to 1000 cfu/l	<p>Either:</p> <ul style="list-style-type: none"> <li>• if the minority of samples are positive, the system should be resampled. If similar results are found again, review the control measures and risk assessment to identify any remedial actions necessary or</li> <li>• 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.</li> </ul>
>1000 cfu/l	The system should be resampled following an immediate review of the control measures and risk assessment carried out to identify any remedial actions, including possible disinfection of the system. Retesting should take place a few days after disinfection and at frequent intervals thereafter until a satisfactory level of control is achieved.

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<sup>4</sup> Legionnaires' disease - Part 2: The control of legionella bacteria in hot and cold water systems, p51  
<http://www.hse.gov.uk/pubns/priced/hsg274part2.pdf>

## Appendix 2 – Assurance checklist

The checklist below provides a detailed checklist to be used as a basis for establishing assurance that a Trust are aware of and are addressing legionella control appropriately. Undertaking these actions is the responsibility of the IPCT and estates department.

This checklist may also be useful for providing:

- guidance to less experienced IPCT and estate departments on investigating their systems (in conjunction with L8 and HTM 04-01)
- information and a practical tool for public health consultants who are participating in incident control teams, or a water management group .

### 1.0 Information about positive samples – this should reflect the sampling results

1.1 Why were the samples taken?

1.2 How many samples were taken, and from where?

1.3 What levels of *Legionella* were found ( $\leq 100$  cfu/l,  $\leq 1000$  cfu/l,  $\leq 10000$  cfu/l,  $\geq 10,000$  cfu/l)?

1.4 What type of samples are these (pre-flush, post-flush or post-disinfection)?

1.5 Were any positive samples from a high-risk clinical area?

1.6 What is the proportion of positive samples (number positive/total taken x 100)?

1.7 Was the water temperature recorded (and appropriate) for each sample taken?

1.8 Were samples taken through thermostatic mixer valves (TMV)?

1.9 What serotype of legionella was recorded?

1.10 Have repeat samples been taken?

1.11 Have further areas now been sampled, or are such areas planned to be sampled?

### 2.0 Environmental systems – this should be available from the risk assessment

2.1 Who owns the building?

2.2 Is the building leased out?

2.3 Description of the building? e.g. age, size etc

2.3 How many floors are within the building?

2.4 How many people use, visit, or are resident in the building?
2.5 Are there any people who are vulnerable to legionella, using, visiting or resident within the premises?
2.6 What is the cold water system supply?
2.7 What are the water sources? Eg cold water tanks, mains, borehole.
2.8 What is the cold water entry temperature?
2.9 What type of hot water system is in place?
2.10 How is the water system linked between various buildings/wards/units etc?
2.11 What biocide is being used and are target levels being reached and maintained at outlets?
2.12 Is there continuous biocide dosing?
2.13 Is any other form of water treatment used eg ultraviolet light
2.14 Are there any TMVs? Has a survey of TMVs been undertaken?
2.15 Is an anti-stratification pump fitted to the calorifier? If yes, when does it operate and for how long?
2.16 Is there a water softening system in place? Is there a maintenance contract for this?
2.17 Are there any wet cooling systems present?
2.18 Are there any water features in the premises?
2.19 Are there multiple circuits to the ring main?
2.20 Are there connections between the different water systems?
<b>3.0 Risk assessment, paperwork and maintenance</b>
3.1 Who has the contract for legionella water management on the premises?
3.2 Where is the risk assessment? Ask for a copy.
3.3 Is the risk assessment up to date? Has it been reviewed following changes to the system?
3.4 What does the risk assessment inform the responsible person to do when legionella has been found in the system?

3.5 Do the estates team service/monitor the TMVs?
3.6 Is there a regime for checking the TMVs? Whether it gets scaled up, whether the hot water feed and the cold water feed reaches the appropriate temperature (checked with surface probe).
3.7 Are there up-to-date schematic(s) of the water system?
3.8 Is there a regime for cleaning and descaling shower heads, and are there records to show this?
3.9 What are the historical temperatures at the hot and cold outlets?
3.10 Is there documentation of temperature monitoring, flushing, descaling and disinfection, and are these signed and dated?
3.11 When were the last legionella counts performed? What were they?
3.12 Which laboratory undertakes the testing?
3.13 What is their reporting threshold eg 100 cfu/l?
3.14 Is the laboratory United Kingdom Accreditation Service (UKAS) accredited for legionella testing (they may be accredited for other testing)? What is their UKAS number?
3.15 Do they participate in the EQA scheme?
3.16 Does the responsible person have a copy of the SOP for laboratory testing including sensitivity?
<b>4.0 Diagnostics</b>
4.1 What are the flow temperatures – coming from the boiler? The outgoing water from the calorifier should be at least 60°C.
4.2 What are the return temperatures coming back from the system? The return should be at least 55°C.
4.3 What are the temperatures at the hot outlets – are they satisfactory? The hot water temperature should be at least 55°C within a minute of running the water. Temperatures should be taken from outlets NOT fitted with TMVs, or where this is impractical, from the hot water feed to the TMV by means of a suitably calibrated surface probe thermometer.
4.4 What is the temperature at the cold water tank? Is there more than 2 °C gain from entry temperature?
4.5 Is the cold water tank in good condition? Well insulated, no evidence of biofilm, no significant sediment, no rust, no scum, no hot water flow entering, no dust on surface, should hold no more than 24 hours supply, should have lid to prevent ingress of air-



borne contaminant, insects, vermin etc.
4.6 What are the temperatures at the cold outlets – are they satisfactory? The HSE HSG274 part 2 document recommends that cold water should be below 20°C after running the tap for up to two minutes.
4.7 Were these temperature measurements taken after a period of non-use?
4.8 What is the surface temperature of the hot water going to TMVs? This can be measured using a suitably calibrated surface probe thermometer
4.9 Are flexible hoses used on TMVs or hand wash stations?
4.10 How frequently are the affected areas used, by whom and for what purpose?
4.11 Have any areas been identified with poor insulation of pipes or hot adjoining cold pipes?
4.12 Have any functional dead legs been identified e.g. outlets not used, shower rooms used as store cupboards?
4.13 Have any blind ends (where a facility has been removed and a length of pipe cut back) been identified?
4.14 What is the most likely cause of the problem?
<b>5.0 Further investigation</b>
5.1 What further sampling has been done? As a guide, sampling should be carried out from cold water tanks, hot and cold outlets, sentinel sites (eg, those most distal from the hot and cold supply and those in other 'high risk' areas – should have been identified from schematic). Particularly sample from outlets less likely to be used eg an assisted toilet. Do before chlorination/pasteurisation. Weekly samples if an area is affected.
5.2 Is there an outlet use audit planned? eg to identify functional dead legs
5.3 What further investigations are planned?
<b>6.0 Control measures</b>
6.1 Is the control plan being implemented as described in the risk assessment?
6.2 Have particular areas been shut or vacated? They will need to be sampled, need to consider risk of shutting – does it affect people's care?
6.3 Has a flushing regime been implemented for unused areas or outlets and are there records of this? Daily flushing in affected areas. A risk assessment will be required for the people undertaking the flushing.
6.4 Has the water been pasteurised? Note, this may not help with the cold water system,

does not get beyond the TMVs and carries a risk of scalding
6.5 Has flexible hosing been removed?
6.6 Has the water been chlorinated?
6.7 Have point of use filters been used? These are effective, but may not fit all taps or be suitable for some outlets such as showers, and need replacing every month.
6.8 Have vulnerable patients been moved?
6.9 Have any dead legs been removed?
6.10 Has the use/necessity of TMVs been reviewed? TMVs are generally not needed in kitchens, and staff areas. They are needed in areas where clients may have risk of scalding eg elderly, mental health, childrens' wards. HTM 04-01 Addendum for <i>Pseudomonas aeruginosa</i> suggests TMV outlets are not used in augmented care settings, as patients are unlikely to be using outlets and so the scalding risk is reduced.
6.11 Has case finding been initiated? Eg have staff been advised to be aware of symptoms, and provided information about legionella.
6.12 What other control measures have already been put into place?
<b>7.0 Communications</b>
7. 1 Who is the communications lead?
7.2 Has a press statement been drafted?
7.3 Have any staff been informed?
7.4 Have the residents/clients/users been informed?
7.5 Has the service commissioner been alerted?
7.6 Has the local authority been alerted?
7.7 Has the PHE legionella section, at Colindale, been alerted?
7.8 Has the local PHE food, water and environmental microbiology lab been alerted?
7.9 Do the Health & Safety Executive (HSE) need to be informed?
7.10 Who else knows about this issue?

## Glossary

**aerosol** a suspension in a gaseous medium of solid particles, liquid particles or solid and liquid particles having a negligible falling velocity. In the context of this document, it is a suspension of particles which may contain legionella with a typical droplet size of <math><5\ \mu\text{m}</math> that can be inhaled deep into the lungs.

**algae** a small, usually aquatic, plant that requires light to grow.

**bacteria** (singular bacterium) a microscopic, unicellular (or more rarely multicellular) organism.

**biocide** a substance which kills microorganisms.

**biofilm** a community of bacteria and other microorganisms embedded in a protective layer with entrained debris, attached to a surface.

**calorifier** an apparatus used for the transfer of heat to water in a vessel, the source of heat being contained within a pipe or coil immersed in the water.

**chlorine** an element used as a biocide and for disinfection.

**chlorine dioxide** a compound used as a biocide.

**cold water service** installation of plant, pipes and fitting in which cold water is stored, distributed and subsequently discharged.

**contact time** the time a chemical is retained in the system.

**corrosion inhibitors** chemicals which protect metals by: passivating the metal by the promotion of a thin metal oxide film (anodic inhibitors); or physically forming a thin barrier film by controlled deposition (cathodic inhibitors).

**dead end/blind end** a length of pipe closed at one end through which no water passes.

**dead leg** a length of water system pipework leading to a fitting through which water only passes infrequently when there is draw off from the fitting, providing the potential for stagnation.

**disinfection** the reduction of the number of microorganisms to safe levels by either chemical or non-chemical means (eg biocides, heat or radiation).

**distribution circuit** pipework which distributes water from hot or cold water plant to one or more fittings/appliances.

**domestic water** hot and cold water intended for drinking, washing, cooking, food preparation or other domestic purposes.

**fouling** organic growth or other deposits on heat transfer surfaces causing loss in efficiency.

**hot water service** installation of plant, pipes and fittings in which water is heated, distributed and subsequently discharged (not including cold water feed tank or cistern).

**legionnaires' disease** a form of pneumonia caused by bacteria of the genus *Legionella*.

**legionella (plural legionellae)** a bacterium (or bacteria) of the genus *Legionella*.

**legionellosis** any illness caused by exposure to legionella.

**mg/l** (milligrams per litre) a measure of dissolved substances given as the number of parts there are in a million parts of solvent. It is numerically equivalent to ppm (parts per million) with respect to water.

**microorganism** an organism of microscopic size, including bacteria, fungi and viruses.

**neonates** newborn children.

**nutrient** a food source for microorganisms.

**pasteurisation** heat treatment to destroy microorganisms, usually at high temperature.

**pH** the logarithm of the reciprocal of the hydrogen ion concentration in water, expressed as a number between 0 and 14 to indicate how acidic or alkaline the water is. Values below 7 are increasingly acidic, 7 is neutral, and values higher than 7 are progressively alkaline. However, acidity and alkalinity are not proportional to pH.

**planktonic** free-floating microorganisms in an aquatic system.

**point of use (POU) filters** a filter with a maximal pore size of 0.2 µm applied at the outlet, which removes bacteria from the water flow.

**ppm** (parts per million) a measure of dissolved substances given as the number of parts there are in a million parts of solvent. It is numerically equivalent to milligrams per litre (mg/l) with respect to water.

**risk assessment** identifying and assessing the risk from legionellosis from work activities and water sources on premises and determining any necessary precautionary measures.

**scale inhibitors** chemicals used to control scale. They function by holding up the precipitation process and/or distorting the crystal shape, thus preventing the build-up of a hard adherent scale.

**sentinel taps** for hot water services – the first and last taps on a recirculating system. For cold water systems (or non-recirculating HWS), the nearest and furthest taps from the storage tank. The choice of sentinel taps may also include other taps which represent parts of the recirculating system where monitoring can aid control.

**sero-group** a sub-group of the main species.

**sessile** aquatic microorganisms adhering to a surface, normally as part of a biofilm.

**shunt pump** a circulation pump fitted to hot water service/plant to overcome the temperature stratification of the stored water.

**slime** a mucus-like exudate that covers a surface produced by some microorganisms.

**sludge** a general term for soft mud-like deposits found on heat transfer surfaces or other important sections of a cooling system. Also found at the base of calorifiers and cold water storage tanks.

**stagnation** the condition where water ceases to flow and is therefore liable to microbiological growth.

**strainers** coarse filters usually positioned upstream of a sensitive component, such as a pump control valve or heat exchanger, to protect it from debris.

**thermal disinfection** heat treatment to disinfect a system.

**thermostatic mixing valve (TMV)** a mixing valve in which the temperature at the outlet is pre-selected and controlled automatically by the valve.

**total viable counts (TVC)** the total number of culturable bacteria (per volume or area) in a given sample (does not include legionella).

**wholesome water** water supplied for such domestic purposes as cooking, drinking, food preparation or washing; or supplied to premises in which food is produced