



Public Health  
England

Protecting and improving the nation's health

# **Guidance on investigating cases, clusters and outbreaks of Legionnaires' disease**

**For Public Health England health  
protection teams**

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Guidance on investigating cases, clusters and outbreaks of Legionnaires' disease.  
Version 1.3



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# Executive summary

This document has been produced to provide practical and comprehensive guidance for health protection teams undertaking public health investigation of cases, clusters and outbreaks of Legionnaires' disease.

The guidance brings together information on Legionnaires' disease from Public Health England and other organisations, sets out roles and responsibilities for public health investigation and enforcement and highlights specific considerations for investigation of potential sources of infection in healthcare, travel and community settings, both for single cases and clusters/outbreaks. Furthermore, the guidance provides a framework for a standardised approach to an investigation which can be adapted to the wide range of individual scenarios typically found in public health incidents.

Supplementary material and background information is provided in appendices to this document.

## Major changes from version 1.2

- minor changes to healthcare-associated case definitions and types and associated text
- changes to reporting of travel-associated LD cases following EU exit

# 1. Introduction

## 1.1 Aim of this guidance

1.1.1 This guidance provides a framework for a standardised approach to the investigation of Legionnaires' disease (LD) cases, clusters and outbreaks in England. Although this document refers to LD, the principles of public health investigation apply to all forms of legionellosis, for example, Pontiac fever (PF) and non-pneumonic legionellosis (NPL).

1.1.2 It is important to note that the incubation period for PF may differ from LD and users will need to interpret the public health guidance given in this document accordingly. Information regarding actions required in the investigation of PF and NPL, such as epidemiological investigation, can be sought from the Public Health England (PHE) national legionella surveillance team (NLST).

1.1.3 This guidance is primarily designed for PHE local health protection teams (HPTs) but is also applicable to all PHE staff with health protection responsibilities.

1.1.4 This document provides guidance on actions to be taken during investigations and those who need to be notified but is not prescriptive about which organisation should undertake particular actions. Section 1.2 outlines the roles and responsibilities of teams within PHE and other organisations who may be involved with an investigation. Legislation covering the responsibilities and legal duties of the individuals and organisations involved in the investigation should be consulted when allocating responsibilities for each action. See [Appendix 1: Legislation and guidance references](#). General information about LD is given in [Appendix 2](#).

## 1.2 Roles and responsibilities

Investigating cases, clusters and outbreaks of LD requires collaborative effort from specialist teams:

### PHE Health Protection Team

The HPT is responsible for the local surveillance, data collection and for co-ordinating investigation of cases, clusters and outbreaks of LD. The HPT is responsible for receiving notifications, ensuring completion of the national surveillance form, notifying the national legionella surveillance team and providing support to environmental health colleagues for risk assessment and management.

## PHE national legionella surveillance team (NLST)

The national surveillance team receives surveillance forms ([Appendix 3](#)), scrutinises the information for consistency and completeness and queries inaccuracies before processing case information. The NLST identifies clusters and outbreaks using the national database to determine associations between cases and/or locations, conducts postcode analyses and provides assistance with investigations. The NLST co-ordinates activities relating to the notification of travel associated cases to the national health authorities in the country of travel in accordance with World Health Organization (WHO) procedures.

## PHE Food, Water and Environmental (FW&E) microbiology laboratories

The FWE microbiology laboratories provide expert advice and testing of water and environmental samples along with support and training around sampling to environmental health officers (EHOs) and other professionals.

## National Legionella Reference Laboratory (NLRL), Respiratory and Vaccine Preventable Bacteria Reference Unit (RVPBRU)

The NLRL, based in Colindale and part of the RVPBRU, provides a range of specialist and reference services, including routine and additional services during outbreaks. They provide confirmatory and diagnostic testing on clinical specimens taken from suspected cases of LD, undertake specialist molecular typing and provide microbiological advice on interpretation of results.

## PHE Specialist Microbiology Services (SMS) Regional Laboratories and Primary Diagnostic Laboratories

These laboratories provide initial testing and clinical expertise to support the diagnosis of legionella infections. The PHE laboratories provide day-to-day support and guidance relating to the range and availability of clinical testing. SMS regional and primary diagnostic laboratories are responsible for ensuring that relevant samples are referred to the NLRL. They should notify the appropriate HPTs of any provisional positive results.

## Hospital infection control teams

NHS (or independent sector) infection control teams will lead on the investigation of cases arising in their premises. They will work closely with other stakeholders and ensure appropriate representation at any outbreak meeting, including the local PHE

HPT. These meetings will usually be chaired by an infection control doctor or Director of Infection Prevention and Control (DIPC).

### PHE Field Epidemiology Service (FES)

FES has a role in local surveillance of LD and provides epidemiological support to HPTs in clusters and outbreaks.

### Local authority (LA) Environmental Health Department (EHD)

The EHOs have legal powers to undertake inspection of potential LA-enforced places/sources associated with cases, clusters and outbreaks, to review risk assessments, to monitor and enforce legislation relating to the control of legionella, and to undertake sampling as appropriate.

### Health and Safety Executive (HSE)

HSE is responsible for enforcing legislation relating to the management of legionella risk at sites where they are the enforcing authority.

### Care Quality Commission (CQC)

CQC is the lead enforcement body under the Health and Social Care Act 2008 for safety and quality of treatment of patients and service users in premises where the provider is registered with the CQC. This activity is clarified further in the Memorandum of Understanding between the CQC, HSE and LAs in England.

## 2. Notification and reporting

### 2.1 Statutory notification

2.1.1 LD is a notifiable disease and *Legionella spp.* is a notifiable causative agent under the Health Protection (Notification) Regulations 2010. All cases (including suspected) of LD must be notified by the clinician to the Proper Officer of the relevant LA (usually the Consultant in Communicable Disease Control) verbally as soon as reasonably practicable and then in writing within 3 days. All diagnosing laboratories must notify the local HPT when *Legionella spp.* has been identified in a human sample, verbally as soon as reasonably practicable and then in writing within 7 days:

<http://www.legislation.gov.uk/ksi/2010/659/contents/made>.

2.1.2 Reporting procedures for notifiable diseases, and the relevant forms, can be found at: <https://www.gov.uk/notifiable-diseases-and-causative-organisms-how-to-report#registered-medical-practitioners-report-notifiable-diseases>

### 2.2 National enhanced Legionnaires' disease surveillance scheme reporting

2.2.1 PHE co-ordinates the national enhanced surveillance scheme (NELSS) for LD in residents of England and Wales. Enhanced surveillance is carried out on every case of LD and a national surveillance scheme reporting form must be completed and submitted to the NLST at Colindale. Reporting timely and accurate details on cases is important as the NLST is able to support identification of potential outbreaks or clusters across HPTs, assist in the identification of potential sources and to liaise with international public health authorities as appropriate for reporting of travel associated cases.

Further details on completing the national surveillance scheme reporting form are available in [section 3.3](#).

Copies of the form are available online, via HPZone, and in [Appendix 3](#) of this document.

Please refer to section 1.1.2 in relation to other forms of Legionella infection.

## 3. Investigation and management of single cases

### 3.1 Establishing the diagnosis

3.1.1 Sections 3.1 to 3.4 contain guidance that is attributable to every case of LD. Sections 3.5 onwards give further detail for cases in specific settings. Refer to the summary in figure 1 on page 19.

3.1.2 Following notification of a case, the diagnosis should be reviewed to ensure that it meets the case definition for LD (Box 1).

#### **Box 1. Legionnaires' disease: PHE case definitions for public health action in England and Wales**

##### **Confirmed Case**

A clinical or radiological diagnosis of pneumonia with laboratory evidence of one or more of the following:

- isolation (culture) of *Legionella* species from a respiratory specimen
- the presence of *Legionella pneumophila* antigen in urine specimen
- detection of *Legionella spp.* nucleic acid (eg, by PCR) in a lower respiratory tract specimen (eg, sputum, bronchoalveolar lavage (BAL))

##### **Probable case (following declaration of an outbreak only)**

A case with a clinical diagnosis of pneumonia but no microbiological evidence for confirmed LD infection (above) can be considered a probable LD case where the location and onset date(s) meet the outbreak case definition for the exposure category (Box 3).

3.1.3 It is not necessary to wait for reference laboratory results before undertaking public health action. If a case is later tested at the NLRL and the findings do not support the diagnosis of legionella infection, then the case will be excluded from further public health action.

3.1.4 Antigens for *Legionella pneumophila* in urine may not be detected in all LD cases and, therefore, other diagnostic methods may need to be considered on an individual case basis.

### 3.2 Collecting clinical samples

3.2.1 Urine specimens found to be positive for *L. pneumophila* antigens by the local hospital laboratory should be sent to the NLRL for confirmatory testing.

3.2.2 For all confirmed LD cases, a lower respiratory tract specimen (for example, sputum, BAL or post mortem lung tissue) should be obtained from the individual as soon as possible and the specimen sent to the NLRL for reference culture and typing. While culture might be undertaken in local hospitals, laboratories should be requested to send at least a portion of available respiratory samples direct to NLRL to prevent any delay obtaining typing data.

3.2.3 Further information on the microbiological diagnosis of LD is available in [Appendix 5](#). For appropriate specimens refer to the [bacteriology reference department user manual](#) and [instructions for referral of specimens](#).

3.2.4 Legionella infections where the diagnosis is made using only serological methods or direct immunofluorescence no longer meet the case definitions for the purposes of public health action or surveillance.

### 3.3 Completing the national surveillance form

3.3.1 If a case meets the confirmed or probable definition for public health action, the individual must be interviewed promptly, where possible, and the [national legionella surveillance form](#) completed.

3.3.2 The national surveillance form aims to capture details of activities and places visited in the 10 days prior to the onset of symptoms (herein referred to as the 10 day history) and form the basis of investigations to identify a potential source of infection. The case history information recorded on the form should be as detailed as possible and include names, addresses, postcodes and, where appropriate, room numbers of sites stayed at or visited during the incubation period, along with dates.

3.3.3 The WHO has defined the incubation period for LD as 2 to 10 days prior to onset of symptoms (1), and evidence from outbreaks supports a median incubation period of 6 to 7 days (2). However, [longer incubation periods have been documented](#) in specific circumstances such as immunosuppression and if it is considered that information on case activity needs to be obtained for longer than 10 days prior to onset of symptoms, such information should be added to the surveillance form

3.3.4 It is recommended that a skilled and experienced interviewer undertakes the case interview and completes the surveillance form to achieve optimal history. If the patient is too unwell to be interviewed, details should be obtained from the next of kin as far as is possible, within the requirements of patient confidentiality. Follow-up interviews may be necessary if information cannot be obtained from the case in the first instance, or to

verify previous information as the investigation progresses. Self-completion of the surveillance form by the patient or family member (without an interviewer) may yield less detailed information and should be avoided as far as possible. If the surveillance form is routinely completed by a professional outside the HPT, then it is strongly suggested that clinical and microbiological details are completed by the HPT using information obtained at initial notification.

3.3.5 The completed surveillance form should be submitted to the NLST from the investigating PHE Centre as soon as possible via secure encrypted email or secure fax. PHE and/or local protocols regarding security, transfer and storage of personal identifiable information must be followed at all times. If there is a delay in obtaining all of the case information, preliminary information (as highlighted on the surveillance form) should be reported to the national surveillance scheme by the next working day after the case is detected, with detailed information to follow on an updated form when available.

3.3.6 The NLST must also be notified of any new/updated information on exposures and/or investigations after submission of the surveillance form. The NLST request that they are informed of the outcome of the case (survival or death) at 30 days from onset of symptoms (this can be via email or by submission of an updated surveillance form).

### 3.4 Investigations for potential source(s)

3.4.1 The 10 day exposure history from the completed surveillance form should be used to identify and investigate potential sources of infection. Most cases will have multiple potential sources and each should be considered individually on their likely risk to the public.

3.4.2 The decision to investigate a potential source should be based on the risk to those who are exposed to it, in conjunction with local protocols and resources. Investigations should be initiated simultaneously on those sources considered to be of high risk.

3.4.3 Cases are typically categorised by their most likely potential source of infection (as identified by exposure history) as either healthcare associated, travel associated or community acquired and this is confirmed if and when a link is established between the case and potential source. These categories are not mutually exclusive and any exposures should be investigated if thought to be a risk.

### 3.5 Investigation and management of healthcare settings associated with single cases of LD

3.5.1 Definition: Healthcare-associated LD (defined as an LD case where the presumptive source is a healthcare setting) can occur in individuals who have had significant exposure to healthcare associated premises; including hospitals and hospices for some or all of the 2 to 10 days prior to onset of symptoms (see **Table 1**).

This section specifically relates to investigations following the identification of healthcare associated LD cases. This section does not relate to registered care or nursing homes – please refer to section 3.6 for community acquired cases.

**3.5.2 Rationale for action:** Outbreaks in healthcare settings have high mortality rates, due to the presence of vulnerable groups such as elderly and/or immunocompromised. Rapid investigation of a case associated with a healthcare setting and prompt institution of remedial measures where necessary is essential to minimise the likelihood of an outbreak occurring.

**3.5.3 Alert the healthcare facility or managing trust:** Where a healthcare associated case is identified, the HPT should contact the relevant lead in the healthcare facility to consider the evidence and to agree how to proceed with investigations. The HPT should also inform the NLST who will be able to provide advice to HPTs on the response to individual cases and provide historical context through analysis of the national database to identify previous cases and/or incidents associated with the healthcare facility.

**3.5.4 Alerting other relevant agencies:** The Consultant in Communicable Disease Control (CCDC) or Consultant in Health Protection (CHP) should consider informing the CQC of confirmed cases of LD with Type A and Type B exposures to healthcare premises (see **Table 1**) if this has not already been completed by the Trust. Enforcement actions may be undertaken by CQC.

**3.5.5 ICT arrangements:** Often, an incident control team (ICT) is convened to co-ordinate rapid and effective investigations. The acute trust or infection control team will usually manage the incident and lead the ICT with input and advice from PHE. Several groups and agencies may need to be involved in the investigation, including, but not limited to: the DIPC, microbiologist, healthcare facility estates/contractors, relevant clinicians, the local HPT, CQC and the PHE NLST, NLRL, SMS and FW&E laboratory. If an ICT is not convened, then it is recommended that direct liaison is established with the premises' water safety group (refer to 3.5.9).

**3.5.6 Risk assessment of case in relation to healthcare associated exposure:** Following alerting of a healthcare-associated case, the ICT (or HPT and the incident lead at the healthcare premises if ICT is not convened) may wish to consider the type of exposure the case had to the healthcare premises. For convenience, Table 1 provides a framework for considering different types of exposures as part of the risk assessment. This includes both the individual's time spent within the premises, and the premises' previous associations with LD cases. Consideration should be given to results of most recent routine legionella testing and any known water safety issues in the healthcare premises.

**Table 1. Types of exposures related to a single case of healthcare associated legionellosis**

<b>Types of Healthcare associated exposure</b>	<b>Types of exposures related to a healthcare associated case</b>
Type A	The case stayed overnight in healthcare associated premises for the entire 2 to 10 day incubation period
Type B	The case stayed overnight in healthcare associated premises for any of the 2 to 10 day incubation period (or worked as a regular employee in the premises during the 10 day incubation period) AND the premises have been associated with a case of LD with onset more than 2 years* previously
Type C	The case stayed overnight in healthcare associated premises for any of the 2 to 10 day incubation period (or worked as a regular employee in the premises during the 10 day incubation period) AND the premises have not been associated with any previous cases of LD
Type D	The case visited healthcare associated premises during the 2 to 10 day incubation period, including as an occasional, transient worker but did not stay overnight and did not work at the premises as a regular employee; and a risk assessment indicates investigation of the case as healthcare associated due to, for example, frequency of visits, nature of treatment, underlying illness/susceptibility to LD, documented exposure to a source known to be contaminated, risk to other patients. Refer to section 3.5.13.

\*If the previous case(s) occurred less than 2 years previously, refer to section 4 and investigate as a cluster.

**3.5.7 Identification and assessment of potential sources of infection within the healthcare premises:** Using the 10 day history of the case, identify any potential sources of exposure within the premises; more specifically the hot and cold water systems and other associated equipment such as assisted baths and showers, cooling towers, nebulisers and respiratory equipment, water features and humidifiers. As a priority, potential sources within the healthcare premises should be risk assessed to establish the potential for legionella colonisation and infection.

The risk assessment should:

- consider the nature and condition of the water system
- determine whether control measures are in place and effective

- identify any areas of high risk, for example, where systems with stored or recirculated water have the capacity to produce aerosols
- review the susceptibility of any person(s) exposed to these aerosols
- identify areas not in consistent use, and no regular flushing regime is in place

If no ICT has been convened, then the water safety group (refer to 3.5.9) should consider the risk related to these potential sources as soon as possible.

**3.5.8 Prospective case finding:** Based on the risk assessment of the case, clinicians within the facility may be alerted to cases of LD associated with the hospital or healthcare premises; this may be considered particularly in relation to cases with Type A and B exposures. As pneumonia is a common clinical diagnosis and legionella testing is not always undertaken in such patients, raising awareness among clinicians is likely to assist in early diagnosis and improved patient outcomes.

**3.5.9** All healthcare facilities should have an established Water Safety Group that meets regularly to review management strategies, written scheme, incidents, any sampling or monitoring results and actions to be taken (refer to [HTM 04-01](#)).

The Water Safety Group is not limited to but should include:

- a named Responsible Person (legionella) and their deputy
- an infection control doctor or nurse
- consultant medical microbiologist
- estates Department representative
- other persons where identified

If an incident team is not convened, a member of the local HPT staff may liaise with the water safety group during case investigations to discuss relevant issues.

The existing water safety plan, building schematics and maintenance records should be reviewed and considered as part of the risk assessment, as should any results of previous legionella sampling.

**3.5.10 Environmental microbiological investigations:** For type A cases, environmental samples should be taken from each of the potential sources identified without delay, prior to implementation of control measures such as disinfection. For type B and C cases, a decision to take samples should be taken according to the risk assessment. This could be discussed with a PHE FW&E microbiology laboratory.

**3.5.11 Implementation of control measures:** It is not necessary to await the results of sampling before undertaking control measures, particularly if inadequacies have been found in the management of water systems, medical equipment or cooling towers (including maintenance records). Assurance should be sought that the hospital/facility

has implemented the necessary control measures promptly and that their effectiveness is being monitored. Furthermore, assurance should be sought that ongoing control measures and remedial actions are ongoing and that a sampling schedule is in place to monitor and verify the parameters, including legionella counts, identified in the water safety plan.

**N.B: It is not the role of PHE to provide operational management advice on legionella control in water systems.** The management or owner of the healthcare premises should seek this advice from their contracted water management company.

**3.5.12 Communications:** A single case of healthcare-associated LD may attract media attention, so early consideration should be given to the development of an appropriate media handling strategy, jointly by the healthcare facility management and the local HPT.

**3.5.13 Other scenarios (type D healthcare exposure):** There may be a reported hospital visit by a case with no overnight stay (eg an occasional worker, a person attending or being treated as an outpatient or a patient visitor). In such situations the decision to investigate the healthcare premises should be made on the basis of an individual risk assessment by the HPT and the healthcare premises' infection prevention team, taking into account the likelihood and frequency of aerosol exposure during the incubation period, and the potential susceptibility of the case. If there is any history of previous cases associated with the healthcare premises, the situation should be reviewed to determine if this meets the criteria for a healthcare associated cluster as described in Section 4. Unless a microbiological and epidemiological link is established between the case and the healthcare premises, potential community exposures should still be considered and the case investigated as community acquired.

**3.5.14 Investigating other potential sources:** In addition to investigating the presence of legionella in water associated with the healthcare facility, other sources should be considered for type B, C and D cases, such as a risk assessment of the case's home (refer to section 3.6, below). The local FW&E Microbiology Laboratory can be contacted for advice (refer to [Appendix 6](#)). As healthcare associated legionella infection is a significant potential risk to patient safety, it is essential that actions within the premises are not delayed while other exposures are investigated.

**3.5.15 Follow-up:** Refer to [paragraph 3.3.6](#).

**3.5.16 Situations where legionellae have been identified in water systems in healthcare facilities without any known cases,** that is, where routine sampling has identified high legionella counts, should be managed by the healthcare facility in accordance with their policies. Advice for HPTs is available in the PHE guidance document '[Responding to](#)

the detection of Legionella in healthcare premises: guidance for PHE Health Protection Teams'.

### 3.6 Investigation and management of community-based settings associated with single cases of LD

3.6.1 Definition: A community-acquired case is defined as an LD case where the potential source is in the community or where there is no evidence for a healthcare or travel associated source. A community exposure should be considered for all cases with the exception of those that have been in a healthcare facility or abroad for the entire incubation.

3.6.2 Identifying potential sources: The local HPT in conjunction with the EHOs should identify potential sources and exposures from the case's 10 day history as reported on the surveillance form. A public health risk assessment is useful to prioritise investigation of the potential sources. A public health risk assessment differs from a risk assessment of a water system or potential source, as it considers the possibility of exposure and risks to public health. For example, a poorly maintained cooling tower may be considered to pose a greater public health risk than a contaminated household water system, as it is likely to expose more individuals. However, investigations into a domestic water system may still be appropriate, to exclude it as a potential source of infection.

3.6.3 Care facilities: If the case is linked to a residential care/nursing home, the HPT should notify the enforcing authority (CQC or EHO), the care home management/owner and the LA. The regulator may request the care/nursing home to provide paperwork relating to the institution's legionella control protocol (written scheme), risk assessments, and system monitoring records including microbiological results for review. If there are concerns about water safety, further investigations such as site visit and environmental sampling may be necessary.

3.6.4 Case finding: A search should be made by the HPT for any linked cases previously reported in the last 6 months to the HPT/PHE Centre to rule out a cluster/outbreak. It is suggested that a possible cluster should be considered where reported cases are resident or work within 6 kilometres of each other, with onset within a 6-month period (3). Upon receiving the completed national enhanced surveillance form, the NLST will conduct a search for cases that are clustered in time and location and will notify local teams where any such clusters are identified. This will capture any cases that are in close proximity to each other, but may reside across local borough or PHE centre borders.

3.6.5 Work place: Where a suspected source is identified at a case's workplace, enquiries may be made about the incidence of any respiratory symptoms amongst other

employees at the workplace within one month prior to case onset, with due consideration to patient confidentiality.

3.6.6 Risk assessment of potential source: Following identification of potential sources and their priority for investigation by the public health risk assessment, a risk assessment review and inspection of the condition of suspected source(s) should be carried out by the investigating officer, EHO and/or HSE, including checks of maintenance records and any previous sampling results. **Box 2** provides further information on investigating cooling towers, spa pools and domestic water systems.

3.6.7 Microbiological investigations of potential sources: Appropriate sampling of suspected sources should be undertaken based on the risk assessment. Advice on sampling can be sought from the local FW&E Microbiology Laboratory, who must be informed before samples have been taken and sent to them. Further information is provided in [Appendix 6](#). Domestic sampling may be warranted if no other sources are identified, to exclude other high-risk settings as potential sources or to eliminate cases from possible clusters; it should be noted, however, that domestic environmental sampling in relation to sporadic *L. longbeachae* (refer to [Appendix 2](#)) cases is not routinely required. PHE has published [information for HPTs on when to consider domestic sampling](#).

3.6.8 NLST request that HPTs submit results of any environmental sampling linked to investigation of cases to [legionella@phe.gov.uk](mailto:legionella@phe.gov.uk).

3.6.9 Instigate control measures: EHOs should seek assurance that emergency control measures for suspected/confirmed sources are effectively applied.

3.6.10 Follow-up: Refer to [paragraph 3.3.6](#).

### 3.7 Investigation and management of travel settings (UK and abroad) associated with single cases of LD

3.7.1 Definition: A travel associated LD case is defined as an LD case where travel (or associated) accommodation is the possible source and the case stayed there overnight or visited at any time during the 2 to 10 days prior to onset of symptoms. Staying in travel accommodation is a risk factor for LD. Hotels, cruise ships, campsites and other accommodation sites can pose a high risk for legionella as they often have complex water systems and premises may be unoccupied for long periods.

3.7.2 For all travel associated cases (UK or abroad): As required in the national surveillance form, a detailed history of all travel, including the travel dates, full names and addresses of accommodation, room numbers, use of facilities such as showers, swimming pools, spa pools, any activities/excursions and day visits, and any exposure

to other potential sources such as ornamental fountains and car washes should be obtained.

3.7.3 Full details of the travel history should be sent to the NLST which will report the case to international public health authorities for the country of travel, as appropriate.

3.7.4 Where the case has not been abroad for their entire 2 to 10-day incubation period, exposure to other, more local, sources should also be considered and where necessary investigated. If a case has made single or repeated daytime visits (with no overnight stay) to a location with a potential source, investigation of this site should be considered and, if required, discussed with the NLST.

3.7.5 If the case is associated with travel to an accommodation site within England, a public health risk assessment needs to be undertaken to determine if an investigation of the site may be warranted. Where the case has visited an accommodation site outside of their area of residence, the HPT should inform the team/s that are local to the accommodation site/s visited by the case. HPTs receiving this information should alert the relevant local enforcement agencies. Other potential community sources the case was exposed to during their stay should be investigated in the same way as a community-acquired case.

3.7.6 If a single case is associated with an accommodation site in England, the NLST will remind the HPT responsible for that location to arrange for the relevant enforcing agency, normally the LA, to issue the accommodation site management with a copy of the PHE document '[Information about Legionnaires' disease for managers of commercial accommodation sites](#)', which includes a checklist for reducing the risk from LD.

3.7.7 Follow-up of travel-associated cases: Refer to [paragraph 3.3.6](#).

## **Box 2: Notes on investigating specific water systems as potential sources in community cases, clusters and outbreaks**

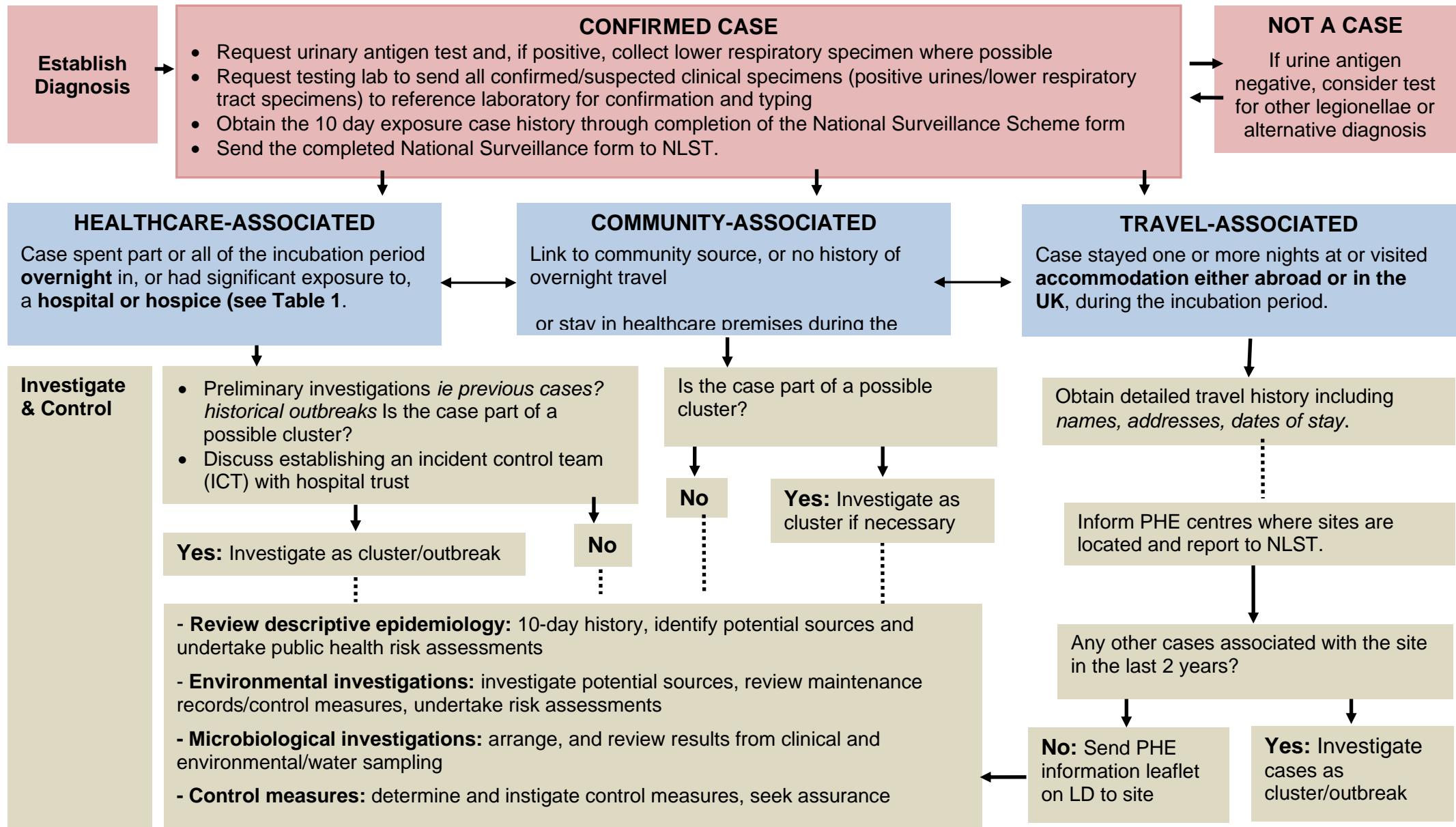
**Cooling towers:** Cooling towers are potentially a high risk source of Legionella, with the capability to disperse aerosols over a wide area (up to 6 kilometres has been reported in some outbreaks). Under the Notification of Cooling Towers and Evaporative Condensers Regulations 1992, owners and operators of cooling towers are obliged to register a cooling tower or evaporative condenser with the relevant LA. Both LAs and the HSE may periodically inspect cooling towers, and operators should maintain detailed records of the maintenance and treatment regimes, and records of any legionella sampling results. When investigating a case, cluster or outbreak it is useful for the HPT to liaise with the LA to obtain a list of local cooling towers within a 6 kilometre radius of case(s) and records of any recent inspections to assist with the investigation and prioritise sampling. If there is no previous information, cooling towers should be visited by the local EHOs or HSE to inspect maintenance records and assess the water system. Where feasible, environmental samples should be taken prior to shock-dosing of towers. If control measures have been taken before sampling, it may still be worthwhile taking post-disinfection samples as PCR analysis may detect dead organisms, which could indicate that the water system contained legionellae prior to disinfection. During cluster/outbreak investigations, Geographical Information Systems (GIS) and spatial analysis tools can be used to model and assess the risk of cooling towers, eg by modelling the plumes produced using meteorological data. [Appendix 7](#) provides further information on spatial analysis methods. [The HSE Technical Guidance document Part 1: Evaporative cooling systems](#), provides further information on the prevention of legionella in cooling towers.

**Spa pools:** Spa pools are a high risk source of exposure to legionella. It is important to note that spa pools have been linked to cases when on display in public areas, as well as through conventional use. The [HSE guidance](#) on reducing the risk of infection in spa pools provides further information.

**Domestic water systems:** The term 'domestic' water systems is not restricted to within the case's home, but includes any domestic type water system that the case may have had contact with socially, at work, or in any other public building eg a leisure centre. Taps, showers and toilets are common outlets that produce aerosols, but there may be water features or other equipment that may result in the dispersal of aerosols. Sampling of water systems that are within the cases' home is not always a priority as it has limited public health benefit. However, sampling of the cases' home can be useful to exclude cases from a cluster or an outbreak, and may be advisable in certain circumstances. PHE has published [guidance for HPTs on investigation of domestic premises](#).

**Figure 1: Investigating single cases of Legionnaires' disease, an overview.**

### Initial case notification to HPT: Review against case definitions



## 4. Investigating clusters and outbreaks

### 4.1 Clusters and outbreaks

4.1.1 Every individual case has the potential of being the first case in a cluster or outbreak of LD. Outbreaks can evolve rapidly so urgent investigation is necessary.

4.1.2 This section of the document is consistent with the **PHE communicable disease outbreak management operating guidance**. The following principles are relevant to outbreaks of LD.

### 4.2 Defining a cluster

4.2.1 A cluster is defined as 2 or more cases with onsets of symptoms that are close in time, within days or months depending on the category of exposure (**Box 3**), close in space and/or share an epidemiological link according to the exposure-specific definitions (**Box 3**). Following investigations, a cluster may be found to be sporadic, coincidental cases that are close in time and space. Conversely, further evidence may point towards a common source, suggesting an outbreak.

4.2.2 If, following the initial identification of the cluster, further cases arise, the cluster definition should be reviewed to determine whether the developing situation still fulfils the definition or reaches the criteria for an outbreak (refer to section 4.3, below).

4.2.3 A case may be excluded from a cluster if there is strong epidemiological or microbiological evidence of a link to an alternative source (a domestic exposure). It is suggested that local HPTs contact the NLST to discuss if such exclusion is applicable for specific cases.

4.2.4 The 10 day history must be reviewed as a whole as exposures identified from this period may determine that a case is included in more than one exposure-specific cluster category (**Box 3**). For example, a case may be included in both a community cluster and a healthcare associated cluster.

### 4.3 Defining an outbreak

4.3.1 An outbreak is declared when 2 or more cases meet the criteria for a cluster (depending on category of exposure) and are close in time (onset of illness within 28 days from the onset date of the previous case) and have strong epidemiological and/or microbiological evidence of a common source of infection. Examples for the use of these definitions are shown in **Appendix 8**.

**Box 3: Exposure-specific definitions for detection of clusters and outbreaks of LD.**  
**For PF or NPL, please contact the NLST for further advice**

Healthcare associated cluster	Two or more cases of LD who stayed, visited or worked in the same hospital or healthcare premises within 2 to 10 days prior to onset dates of symptoms, within 2 years of each other. If there is a period of more than 2 years between cases, the first 'new' case should be considered a 'single' case and any further cases thereafter would form a new cluster.
Travel associated cluster (including foreign and UK travel)	Two or more cases of LD who stayed at or visited in the same accommodation site(s) during the 2 to 10 days prior to onset dates of symptoms, within 2 years of each other. If there is a period of more than 2 years between cases, the first 'new' case should be considered a 'single' case and any further cases thereafter would form a new cluster.
Community cluster	Two or more cases of LD that are geographically linked within 6 kilometres, by places of residence, work, or other type of community setting, and with onset of symptoms within 6 months of each other. It should be noted that UK travel cases are also exposed to potential sources of legionella in the community and so should be considered for inclusion in any potential community clusters. If there is a period of more than 6 months between cases, the first 'new' case should be considered a 'single' case and any further cases thereafter would form a new cluster.
Outbreak	<p>Two or more cases of LD meeting the criteria for any type of cluster (as above), with an interval of no more than 28 days between onset dates of consecutive cases and one or more of the following:</p> <ul style="list-style-type: none"> <li>- isolates from clinical AND environmental specimens are indistinguishable using a highly-discriminatory microbiological method (eg sequence-based typing) for at least 2 cases</li> </ul> <p>OR</p> <ul style="list-style-type: none"> <li>- isolates from respiratory specimens from at least 2 cases are indistinguishable using a highly-discriminatory microbiological method (eg sequence-based typing)</li> </ul> <p>OR</p> <ul style="list-style-type: none"> <li>- strong epidemiological evidence for link(s) between all cases (eg, a common workplace)</li> </ul> <p>For the end of an outbreak, please refer to <b>paragraph 4.12</b>.</p>

4.3.2 It should be noted that, unless otherwise specified in the guidance below, the process for investigating clusters and outbreaks is broadly similar. The main differences will exist in the urgency, commitment of appropriate resource and communication of the investigation. These will be determined by the team managing the investigation whether it is the ICT who will investigate a cluster or the outbreak control team (OCT) who will convene once an outbreak is declared.

4.3.3 For the purposes of this section, the investigation and management of an outbreak is described. Similar principles may be used for the investigation and management of clusters depending on the situation at hand.

#### 4.4 Outbreak recognition

4.4.1 As soon as an outbreak is suspected, the HPT should inform relevant organisations immediately. Usually this will include the team within the relevant enforcing authority (LA/HSE/CQC), PHE FW&E microbiology laboratory, NLST, NLRL, FES and, where relevant, public health microbiologist, NHS England, CCG, DPH and Acute Trust Microbiologist(s).

4.4.2 Following suspicion of an outbreak, investigations should begin immediately. Information on cases and exposures should be reviewed to consider and generate an initial hypothesis.

4.4.3 An initial public health risk assessment should be performed in order to make a decision on declaring an outbreak.

#### 4.5 Outbreak declaration

4.5.1 An outbreak will usually be declared by the local CCDC or CHP, often in discussion with the relevant local authority and colleagues in NLST. Wider outbreaks, eg those that cross PHE centre borders, may be declared by a Consultant Epidemiologist at a national or regional centre. Within a hospital, an outbreak may be declared by a DIPC or, for care homes, a CCDC/CHP.

4.5.2 NLST must be informed prior to an outbreak declaration so that national communications, such as briefing notes, can be co-ordinated.

4.5.3 A decision to convene an OCT will be at the discretion of the incident lead. However, the majority of LD clusters and outbreaks are likely to require an OCT to coordinate potentially complex investigations and control measures and to communicate effectively to stakeholders as well as the wider public.

## 4.6 Outbreak control team

4.6.1 For LD outbreaks, the OCT should meet as soon as possible, and within 24 hours of the outbreak being declared.

4.6.2 The composition of the OCT will depend on the nature of the outbreak, but should include all the key agencies and people that will be investigating the outbreak including communications. It will usually be led by PHE with the exception of healthcare-associated outbreaks in which the hospital trust would take the lead. An OCT will need a chairperson and terms of reference. [Appendix 9](#) provides suggestions for the composition of OCTs and their functions, but HPTs may have locally agreed outbreak plans to follow.

4.6.3 The OCT should decide which organisation will lead the management of the outbreak and agree/co-ordinate communications.

## 4.7 Outbreak investigation and control

4.7.1 Case definitions: A case definition, specific to the outbreak being investigated, should be developed to include or exclude cases from the investigation. For example, if a common *L. pneumophila* subtype is identified amongst cases, this may be incorporated into the case definition. Each case should be reviewed against this case definition. Cases that are close, but do not quite meet the case definition, should be recorded in case they become relevant at a later stage of the investigation. A template case definition for an outbreak of LD is below:

### Outbreak specific case definition template:

Cases of probable or confirmed Legionnaires' disease, with a history of association with **(TOWN/REGION/BUILDING/PLACE)** within the 2 to 10 days prior to symptom onset, where the date of symptom onset was between **(DATE)** and **(DATE)** since ddmmmyy

4.7.2 Case Finding: The OCT should outline measures for identifying individuals who meet the outbreak case definition. This may include providing information to local health care professionals about the outbreak and appropriate clinical testing. The outbreak specific case definition should be reviewed and updated by the OCT at regular intervals, and whenever new information comes to light.

4.7.3 Collect and review descriptive epidemiology: Gather as much information as possible on the cases to generate a hypothesis and identify potential sources, eg a specific cooling tower being the source of infection. This may involve re-interviewing

cases with a trawling questionnaire tailored to the area of interest to narrow down potential sources and to identify new potential sources that may previously have been overlooked. Spatial analysis methods may be able to provide further descriptive epidemiology (See [Appendix 7](#)).

**4.7.4 Environmental investigations and sampling:** A dynamic risk assessment of possible sources should be undertaken. The condition of suspected sources should be checked, and maintenance records and previous sampling results reviewed. The public health impact of various sources should be considered within the risk assessment, and used to prioritise investigations. [Box 2](#) provides further information on investigating some of the specific water systems that are commonly implicated in community cases.

**4.7.5 Collect and review microbiological information:** It is important that both clinical and environmental isolates are obtained for epidemiological typing to provide evidence to confirm (or exclude) any links between cases and putative sources. Urine specimens should be collected from suspected cases for urinary antigen testing and respiratory samples collected for legionella culture and/or PCR to enable sequence based strain typing. From an environmental perspective samples should be collected from sampling points indicated by the risk assessments of potential sources; the local [FW&E microbiology laboratory](#) should be consulted and culture analysis carried out as a minimum. The FW&E laboratory should be informed that samples have been sent to them.

**4.7.6 Review hypotheses:** Use available information collected during the investigation to assess support for a specific hypothesis, eg a specific cooling tower being the source of infection.

**4.7.7 Analytical studies:** The OCT should consider the need for an analytical study to confirm or refute the hypothesis relating to source(s) and transmission.

**4.7.8 Control measures:** Emergency control measures should be determined by the OCT and implemented, and a record should be made of actions taken and the subsequent results. Information on control measures for specific suspected sources can be found in the HSE L8. Alternatively, advice can be sought from the local [FW&E microbiology laboratory](#). While protection of public health remains the highest priority, every effort should be made to undertake environmental sampling prior to control measures being taken.

## **4.8 Additional considerations for investigating healthcare-associated clusters and outbreaks**

**4.8.1** As with the investigation of single healthcare associated cases, the acute trust will usually lead the OCT. Risk assessments, investigations, case finding and emergency

control measures should be undertaken with urgency in order to protect the vulnerable population housed within the healthcare premises.

4.8.2 Healthcare-associated outbreaks are particularly likely to attract media interest, and a communications officer should be included in an OCT. It is important that communication statements are prepared and reviewed regularly as the situation develops and the investigation proceeds and single a multi-agency statement should be agreed upon where possible. NLST and the communications team at NIS Colindale should be made aware of progress of the outbreak and investigations.

#### 4.9 Additional considerations for investigating community clusters

4.9.1 Community clusters can be challenging to investigate as the only link may be proximity of the cases in time and space. It is possible that further investigations into clusters of cases, such as the use of trawling questionnaires, may identify epidemiological links that were not initially identified. **Box 2** provides further information on investigating cooling towers, spa pools and domestic water systems.

4.9.2 If cluster investigations fail to identify evidence of a common source despite investigations, the ICT may decide to suspend investigations based on an assessment of ongoing risks to public health.

4.9.3 HPTs are requested to notify HSE of community clusters. In the absence of an established contact, the HPT should inform the LA and request that notification is passed to the relevant HSE inspector via their liaison contact.

4.9.4 It is very important that lower respiratory samples are obtained wherever possible from the cases as the typing data is a key evidence-based method by which a case can be linked to a potential source or to other cases, thus indicating that an outbreak exists, or if it is a cluster of sporadic cases.

4.9.5 Spatial analysis tools and methods may be useful to help identify if an outbreak is occurring (refer to [Appendix 7](#)).

#### 4.10 Additional considerations for investigating travel associated clusters and outbreaks

4.10.1 The definition of a travel-associated cluster is where 2 or more cases have stayed overnight in or visited the same accommodation site within a 2-year period. The extended 2-year period (as opposed to the 6 months for community cases) is used to account for the seasonal nature of popular travel destinations during the holiday season and consequently the seasonal occupancy of accommodation sites.

4.10.2 Clusters associated with travel abroad should be managed in the same way as single case investigations. Full details should be collected from cases regarding their movements and accommodation during their time abroad. It is important to remember that the information recorded must be detailed enough to enable colleagues in the country of travel to identify the accommodation in which the case stayed. This information must be sent to NLST so that it can be provided to colleagues in the country of travel.

4.10.3 Where an accommodation site in England is associated with a cluster or outbreak, the HPT local to the accommodation site should be informed and an investigation initiated. In order to support the process of investigation, risk assessments and ongoing control measures of the accommodation site, the local HPTs can arrange for the completion of the [Legionella Accommodation Site Investigation Report form](#) by the relevant enforcing authority (usually the LA). Completed forms should then be retained by the local HPT as a record of recommendations by the enforcing agency and resulting actions taken by the site operators that may be called upon for individual case reports or future investigations.

Please note that completion of this report is not mandatory and the following suggested timescales for completion and return of parts 1 and 2 of the report to the HPT are advisory only:

- Investigation Report Form part 1 – this can be used to indicate whether a risk assessment and initial investigations have been carried out and control measures implemented and is typically completed within 2 weeks of the cluster being identified.
- Investigation Report Form part 2 – this can be used to indicate whether control measures were satisfactory, remedial actions undertaken and the result of any sampling and is typically completed within 6 weeks of the cluster being identified.

There is further guidance in [Appendix 4](#) on completing and retaining each part of the Legionella Accommodation Site Investigation Report and NLST can be approached for advice in this situation.

## 4.11 Communications

4.11.1 In most situations PHE should lead communication but in close collaboration with the other agencies involved in the outbreak investigation, for example, the LA; the only exceptions are healthcare associated outbreaks where the hospital will usually lead.

4.11.2 The NLST will be responsible for alerting of outbreaks and clusters to other national organisations as appropriate (for example, Department of Health for large scale outbreaks).

4.11.3 Outbreaks of LD often attract significant media and/or public interest. The OCT should develop a communications strategy that covers:

- communication within the OCT, NHS and participating agencies
- communication to the media, both re-active and pro-active if required
- communication to the public

Further advice and guidance on communication can be found in [Appendix 8](#) and in the [PHE Communicable Disease Outbreak Management: Operational Guidance](#).

4.11.4 The NLST is responsible for communication at an international level. Information on travel-related cases is shared with public health authorities in the country of travel, and on rare occasions limited (non-patient identifiable) information may be shared with tour operators or the National Travel Health Network and Centre (NaTHNac) to notify and alert travel companies or to provide travellers with additional advice.

4.11.5 Any incident that meets the WHO criteria for a serious public health impact must be notified under the International Health Regulations (IHR) (4). The NLST will take responsibility for this notification.

## 4.12 End of outbreak

4.12.1 The OCT will decide on the end point of an outbreak, and should issue a statement to that effect.

4.12.2 An end point may be determined when:

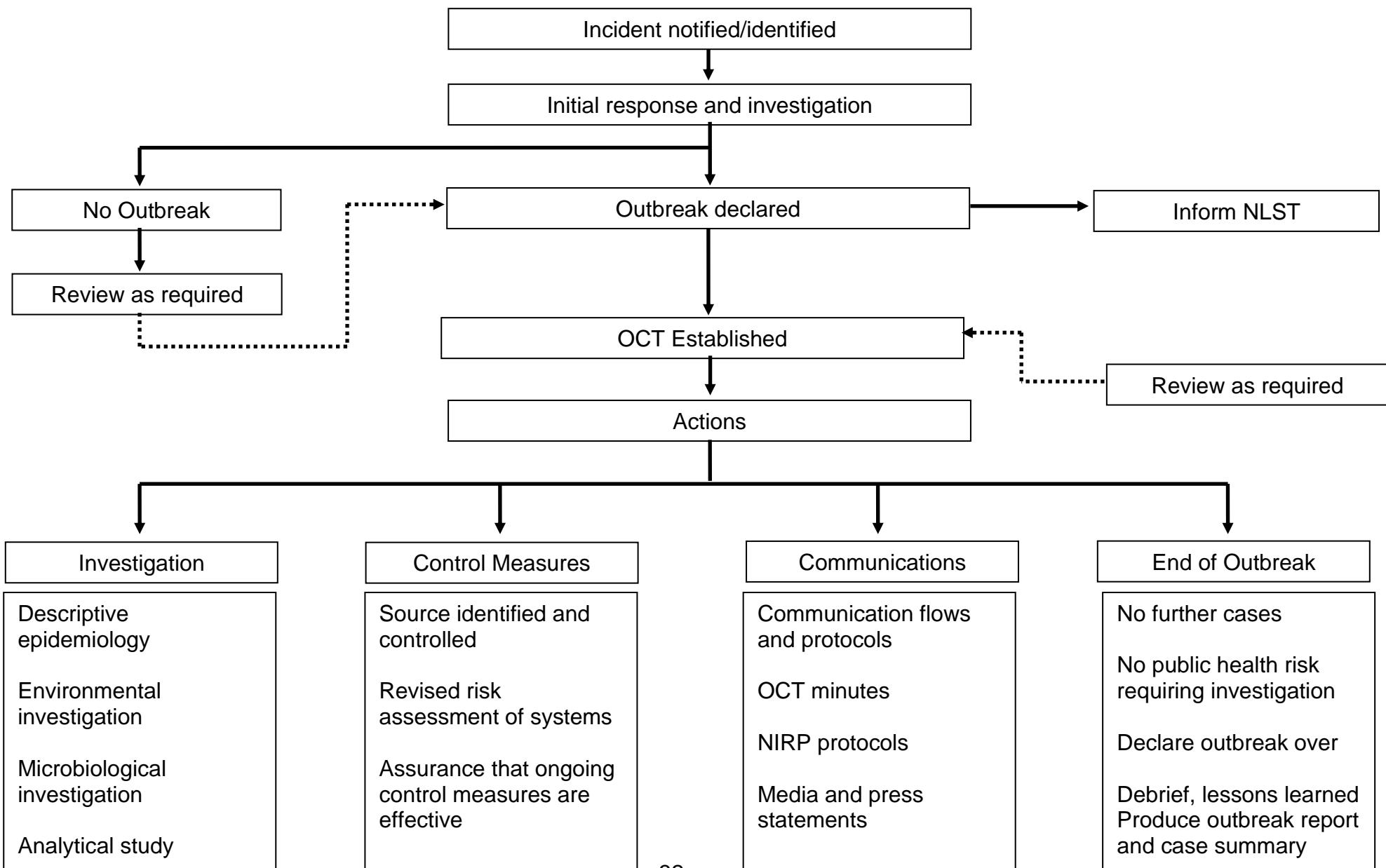
- the probable source has been identified and remedial action has been taken to control and prevent further exposure
- there have been no further cases within a specified time period (eg no cases within 28 days after the onset date of the last reported case or since control measures were taken)

4.12.3 A summary of the incident should be submitted to NLST to ensure that all cases associated with the incidents have been reported and linked to the cluster or outbreak and logged on the national database. The information supplied should be sufficient to allow NLST to describe observed associations with potential source(s) in accordance with Table 2 below:

**Table 2: Strength of evidence for common source of LD clusters or outbreaks**

<b>Level</b>	<b>Definition</b>
<b>A</b>	An epidemiological link in time and place with microbiological evidence of indistinguishable strains in at least one patient and/or environment.
<b>B</b>	An epidemiological link in time and place meeting criteria for level C with additional evidence such as environmental risk assessment or microbiological evidence (clinical and/or environmental) which does not meet Level A.
<b>C</b>	An epidemiological link in time and place according to cluster detection definitions in Section 4
<b>D</b>	An epidemiological link with locations, but outside of the time limits specified in the cluster detection definitions in Section 4

**Figure 2: Management of Legionnaires' disease outbreaks, an overview (adapted from PHE Communicable disease outbreak management: operational guidelines)**



## 5. Appendices

### Appendix 1: Legislation and guidance references

#### 1.1 Key legislation on the notification of infectious diseases

1.1.1 LD has been a notifiable disease in the UK since April 2010.

1.1.2 Medical practitioners have a legal duty to notify the 'proper officer' designated by their local authority or local health protection team of confirmed and suspected cases of certain infectious diseases under the Public Health (Control of Disease) Act 1984 and the Health Protection (Notification) Regulations 2010. Legionella spp. is also a causative agent in the Health Protection (Notification) Regulations 2010 which must be reported by human diagnostic laboratories.

Web link: <http://www.legislation.gov.uk/ksi/2010/659/contents/made>

#### 1.2 Key legislation and guidance references on legionella control

1.2.1 The Health and Safety at Work Act (1974) places a duty on employers to ensure the health, safety and welfare of employees so far as is reasonably practicable and requires employers to ensure that non-employees who may be affected by work activities are not exposed to risks to their health and safety.

Web link: <http://www.hse.gov.uk/legislation/hswa.htm>

1.2.2 The Health and Social Care Act 2008 (Regulated Activities) (Amendment) Regulations 2015 grants enforcement powers to the CQC for health and adult social care in England.

1.2.3 Legislation and guidance for the control of legionella in water systems is covered by the HSE approved code of practice – Legionnaires' disease: The control of legionella bacteria in water systems (otherwise known as L8 Approved Code of Practice (2013)). The L8 Approved Code of Practice (ACOP) describes the responsibilities on duty holders and provides guidance on compliance for duty holders including employers, those in control of premises and those with health and safety responsibilities for others, to help them comply with their legal duties in relation to legionella.

1.2.4 HSE Technical Guidance HSG274 is a 3-part technical guidance document that supports L8 and provides guidance on legionella control in the following specific settings:

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

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

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

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

1.2.5 HSE guidance: HSG 282 - Control of legionella and other infectious agents in spa-pool systems. <http://www.hse.gov.uk/pubns/books/hsg282.htm>.

1.2.6 Department of Health, Health Technical Memorandum 04-01 (HTM 04-01) (2016): Safe Water in Healthcare Premises.

Part A: Design, installation and commissioning

Part B: Operational management

Part C: *Pseudomonas aeruginosa* – advice for augmented care units

HTM 04-01 supplement: performance specification D 08 – thermostatic mixing valves (healthcare premises)

1.2.7 In conjunction with L8 and HTM 04-01 advice and guidance specific to primary care dental practices is outlined in the Department of Health, Health Technical Memorandum 01-05 (HTM 01-05) (2013): Decontamination in primary care dental practices.

<https://www.gov.uk/government/publications/decontamination-in-primary-care-dental-practices>

1.2.8 Under the Notification of Cooling Towers and Evaporative Condensers (1992) regulations, duty holders are required to register any cooling tower or evaporative condenser with the LA. If the registered apparatus is later changed or ceases to be the LA must also be notified. The cooling tower register allows health and safety enforcing authorities to proactively audit and inspect premises, and is a useful tool for the investigation of cases, clusters or outbreaks.

<http://www.legislation.gov.uk/ksi/1992/2225/contents/made>

PHE provides a tool kit of guidance documents to assist with the control and management of LD.

1.2.9 Examining food, water and environmental samples from healthcare environments: Microbiological Guidelines

[https://www.gov.uk/government/uploads/system/uploads/attachment\\_data/file/446981/Hospital\\_F\\_W\\_E\\_Microbiology\\_Guidelines\\_PHE\\_format\\_June\\_2013.pdf](https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/446981/Hospital_F_W_E_Microbiology_Guidelines_PHE_format_June_2013.pdf)

1.2.10 The investigation of household water systems in cases of Legionnaires' disease: guidance for health protection teams

<https://www.gov.uk/government/publications/legionnaires-disease-investigation-of-household-water-systems>

1.2.11 Responding to the detection of Legionella in healthcare premises-guidance for PHE Health Protection Teams

<https://www.gov.uk/government/publications/legionella-detection-in-healthcare-premises>

## Appendix 2: General information on Legionnaires' disease

### 2.1 Natural history of legionella

2.1.1 Legionnaires' disease is a potentially fatal form of pneumonia, caused by infection with bacteria from the genus *Legionella*. The species *Legionella pneumophila*, and in particular *L. pneumophila* serogroup 1, is responsible for most cases of human infection and all major documented outbreaks although other species of *Legionella* can cause infection in those at risk, including for example, an immunosuppressed individual.

2.1.2 Legionella species are ubiquitous in the natural environment, where they rarely pose a threat to public health.

2.1.3 Legionellae can also inhabit manmade water systems and reproduce quickly when:

- water is between 25°C and 45°C
- there is a high concentration of nutrients and impurities such as other microorganisms or corrosion in the water system which will either act as a nutrient source or will provide a protective haven for these waterborne pathogens
- water is stagnant within the system, where biofilm can develop and provide a protective environment from chemical and physical treatment of the water system

The above conditions are usually created in badly designed or poorly maintained water systems but may even be found in water systems that are well designed and maintained; legionellae found in such conditions can quickly proliferate, spreading throughout the water system.

### 2.2 Legionnaires' disease – transmission and clinical features

2.2.1 LD is generally not considered to be transmissible from person-to-person. Infection occurs through direct exposure to, and subsequent inhalation of, aerosols (small droplets < 5µm able to penetrate the lower regions of the lungs) from a source of water containing legionellae. More rarely, LD may be caused by aspiration of larger volumes of contaminated water directly into the lungs.

2.2.2 Sources of legionella infection are usually man-made due to the propensity of for example, cooling towers, water systems or spa pools, to generate aerosols. The majority of cases appear sporadic, but clusters and outbreaks are frequently detected (5). Depending on the source, an outbreak can develop quickly resulting in hundreds of cases. However, prompt investigation of potential sources may help to minimise public health risks.

2.2.3 Horticultural growth media such as compost and topsoil have also been shown to contain high numbers of *Legionella longbeachae*. Cases of LD caused by *L. longbeachae* have been identified particularly in gardeners and have been linked with exposure to compost and top soils. The exact route of transmission is currently unknown, but is hypothesised to be through inhalation or aspiration of dust generated when handling horticultural growth media.

2.2.4 Analysis of the limited quantitative evidence found to date supports a median incubation period of 6 to 7 days, with the majority of cases experiencing a 2 to 10 day incubation period (2).

2.2.5 Although few people who are exposed to legionellae will develop LD, anyone can become infected (6). However, cases occur more frequently among individuals from the following risk groups:

- people aged over 50 years
- men
- smokers
- people with underlying medical conditions (eg heart disease, COPD, diabetes)
- people who are immunocompromised

2.2.6 The initial symptoms of Legionnaires' disease are flu-like with high-fever, and a dry or slightly productive cough, progressing to pneumonia. Diarrhoea and vomiting are also reported by some patients. Confusion or memory problems may also occur.

## 2.3 Epidemiology of Legionnaires' disease

2.3.1 Approximately 300 to 500 cases of LD are reported to the NELSS each year among residents of England and Wales, and approximately 10% of cases are fatal. Cases occur throughout the year but a seasonal pattern is observed with many more cases reported with onset of symptoms over the summer months (June to October).

2.3.2 Each year PHE publishes a report on the epidemiology of LD in England and Wales. The most recent report can be found at:

<https://www.gov.uk/government/collections/legionnaires-disease-guidance-data-and-analysis>

## Appendix 3: National Enhanced Legionnaires' disease surveillance form (England and Wales)

The reporting form for the national LD surveillance scheme can be found on the following webpage:

[National Legionella surveillance forms](#)

## Appendix 4: National and international reporting of travel-associated Legionnaires' disease

Travel-associated LD is identified by information provided for the 10-day history on the LD surveillance form. In order to report the relevant authorities or initiate an effective local investigation, it is important that as much detail as possible about an accommodation site visited by a case is included on the surveillance form.

Accommodation sites such as hotel chains, can often have similar names, or have multiple sites within the same town or city, and it is essential that the precise location can be identified.

### Travel sites within England

Every commercial accommodation site in England associated with a single case of LD (that is, a site that has no other associated cases within 2 years of the current case) should be investigated in the same way as for a community-acquired case. A PHE information leaflet entitled '**Information about Legionnaires' disease for managers of commercial accommodation sites**', which includes a checklist for reducing the risk from LD, should be issued to the site by the local HPT where the site is located.

Where there are 2 or more cases associated with the same commercial accommodation site in England within 2 years, a cluster is formed and it is strongly advised that the accommodation site is investigated in the same way as a community-acquired cluster.

A form, 'Legionella Accommodation Site Investigation Report', is available to support local documentation of investigations. It is suggested that HPTs send this form to the local enforcement agency and request completion of part 1 of the form within 2 weeks of being notified, and part 2 with 6 weeks of being notified of the cluster. The completed form can then be retained by the HPT as a record of investigations carried out at the site for future reference. Please note that use of the report form is not mandatory as HPTs may have alternative systems to record this information.

The Legionella Accommodation Site Investigation Report form can be found at the following URL: <https://www.gov.uk/government/publications/report-a-site-investigation-for-travel-associated-legionnaires-disease>

### Travel accommodation sites outside England

Where travel-associated cases and clusters are identified in residents of England who have travelled outside their country of residence, the NLST will liaise with authorities in the country of travel to report the case(s) to enable the initiation of any investigations deemed necessary by authorities in the country of travel in accordance with their local protocol.

Please note that any actions undertaken by a country of travel to investigate an accommodation site in response to notification of the case(s) is entirely at the discretion of the country to which a case travelled and will vary from country to country. The involvement of the NLST ends at the point of notification, no further involvement or feedback from the country of travel is expected.

## Appendix 5: Microbiological diagnosis of Legionnaires' disease and identification of legionella in clinical samples

The NLRL undertakes confirmatory testing of locally legionella antigen positive urines and exclusion of false-positive results; real-time PCR (qPCR) testing of lower respiratory tract specimens and confirmation and identification of locally positive legionella isolates including serogrouping of *L. pneumophila*. Sequence-based typing (SBT) of clinical and linked environmental *L. pneumophila* isolates is undertaken to assist in investigations, and SBT may also be performed directly on clinical (lower respiratory) and environmental specimens (7).

Laboratory confirmation together with phenotypic and genotypic typing data is used to support or refute epidemiological links in the investigation of suspected environmental sources. Although local laboratories may undertake legionella urine antigen testing, PCR and culture, the NLRL at the RVPBRU requests that all urine specimens testing positive with the legionella urinary antigen test (UAT) are referred for confirmation, and that lower respiratory specimens from any patient found to be legionella UAT positive and/or legionella PCR positive and/or legionella culture positive are referred to enable qPCR detection/confirmation of *L. pneumophila* and *L. pneumophila* serogroup 1 and sequence based typing, and also to enable culture for *Legionella* spp. Lower respiratory tract specimens are essential in order to attempt isolation of legionella and/or qPCR testing and in order to obtain sequence based typing data. Clinical isolates of legionella for identification/confirmation are also accepted for identification and typing.

Please note that lower respiratory tract specimens (sputum and bronchoalveolar lavage (BAL) taken within 2 days of admission from UAT positive patients are more likely to yield both positive culture and qPCR results (8) and therefore typing data. However, it is not always possible to obtain lower respiratory tract specimens, in which cases urine samples should still be referred. Post-mortem lung tissue is also a suitable specimen.

Please refer to the **Bacteriology reference department user manual** and **instructions for referral** for details of appropriate specimens and to ensure all referred clinical and environmental isolates and specimens are appropriately packaged.

Further information, contact details and relevant referral form are available from the links below:

- <https://www.gov.uk/guidance/rvpbru-reference-and-diagnostic-services>
- [https://www.gov.uk/government/uploads/system/uploads/attachment\\_data/file/405211/R1\\_Respiratory\\_and\\_Systemic\\_Bacteria.pdf](https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/405211/R1_Respiratory_and_Systemic_Bacteria.pdf)

## Appendix 6: Environmental investigations and sampling

PHE Food, Water and Environmental (FW&E) microbiology laboratories provide advice on sampling and testing for legionella bacteria. Further guidance on sampling methodology, consumables, sampling locations and testing arrangements is available from the local PHE FW&E laboratory at London, Porton, or York.

Environmental sampling is recommended whenever possible to assist public health action. The decision to sample is a result of a public health investigation, which considers the following:

- the degree of certainty of the putative source
- the development of the incident
- the urgency of eliminating any potential source

The sampling officer should be appropriately trained and equipped. In some circumstances it may be appropriate for a member of PHE FW&E staff who is suitably trained to assist enforcing authorities. Each sampling exercise must be subject to an individual health and safety risk assessment before commencement. Sampling should be carried out with due consideration of BS7592: Sampling for Legionella Bacteria in Water Systems 2008.

Water and environmental samples taken as part of the investigation of a case of Legionnaires' disease should be submitted to a PHE FW&E microbiology laboratory in line with current procedures and protocols. At all stages, the chain of evidence must be maintained.

PHE FW&E network microbiology laboratories provide expert advice and testing of environmental samples, and can provide support and training around sampling.

### Enforcement

The LA may be assuming 2 roles (public health investigation and enforcement under Health and Safety at Work legislation). LA Environmental Health Officers (EHO) are authorised to carry out sampling of premises where there is a work activity and/or a statutory duty of care owed to the occupiers of a property. There is no prescriptive power of entry and statutory requirement for domestic sampling of LD cases. However, EHOs may undertake domestic sampling as part of their wider public health investigatory powers under the Environmental Protection Act, 1990. Other powers are available where a property is owned by a landlord and statutory interventions are required.

The lead authority for the purposes of health and safety will be determined by the Health and Safety Enforcing Authority Regulations 1998. In the case of a LA controlled premises or site, this will be the Health and Safety Executive (HSE). Where this is the case LA officers may assist the HSE in their investigations, however, relevant decisions must be taken by the HSE, not LA officers. In cases where the HSE is the lead authority for health and safety issues, the LA will always still retain its public health responsibilities. LA officers are authorised under the Environmental Protection Act 1990 to enter certain premises to determine if there is a statutory nuisance and may take samples for this purpose.

While HSE will co-operate with sampling, HSE inspectors are not required to sample as microbiological evidence is not required to support enforcement action. However, if samples are obtained, HSE will be interested in the results. There is therefore no need for HSE to authorise LA officers to accompany them to take samples.

The sampler, if not a LA officer, should obtain samples after consultation with the LA officer to ensure that an appropriate sampling strategy has been adopted.

## Environmental Investigation

Local PHE HPTs may request sampling from a number of different sites during a public health investigation. Appropriate action must be taken to reduce the risk to the public from suspected sources pending any environmental investigation. Information may need to be disseminated over a wide area to ensure systems are shut down but not immediately disinfected (if sampling is to be carried out). Systems which cannot be shut down without severe consequences may have to be disinfected prior to sampling. Disinfection should take place as soon as possible after any sampling. Disinfection is the responsibility of the relevant duty holder.

In a scenario where disinfection or temperature control has been implemented before sampling for legionella test by culture, then a discussion with the PHE FW&E laboratory should be made to consider analysis by PCR.

## Health and safety considerations

Prior to sampling, a health and safety risk assessment of the sampling activity must be carried out. This will include how to take the samples with due consideration of the health, safety and welfare of sampling officers and other persons when sampling is carried out.

Sampling staff must be trained in off-site working and should be familiar with their employer's off-site and dynamic risk assessment arrangements.

## Sample collection consumables

Disposable single use sample consumables such as bottles, swabs and other materials used to facilitate sampling, such as cool boxes and sample bags, should be stored appropriately, in date and without extraneous contamination.

## Sampling

Any water or environmental sample collected provides a snapshot of the microbiological quality of the system at the time of sampling. Sampling should therefore be carried out by experienced persons.

Laboratories should be asked to retain environmental legionella isolates as they may be required for submission to the PHE Legionella reference laboratory (refer to [Appendix 5](#)).

The PHE FW&E microbiology laboratories have a public health remit towards environmental investigations. Therefore the local PHE FW&E microbiology laboratory should be contacted as they can undertake sample analyses free of charge in the event of an incident or outbreak environmental investigation.

## Transport

All water or environmental samples for legionella examination should be stored at an ambient temperature (approximately 20°C), in the dark, and returned to the laboratory for testing as soon as possible (<24h). If samples are not transported by sampling officers, a courier should be pre-arranged through FW&E Microbiology laboratory in advance.

Further details of appropriate sampling points are given in Approved Code of Practice and Guidance: L8 (HSE 2013).

## Laboratory testing and interpretation

Environmental investigation samples may be tested for legionella by culture and/or PCR. All PHE FW&E microbiology laboratories are United Kingdom Accreditation Service (UKAS) accredited to perform detection and enumeration of legionellae by culture.

Examination by quantitative PCR for the detection of Legionella in water and other environmental samples is available as a national service **only** where a need is agreed by the local incident control team. Referral of sample(s) for PCR testing must be discussed and coordinated with the local PHE FW&E microbiology laboratory.

**Please note that the first point of contact for all investigations is the FW&E microbiology laboratory.**

Contact details and further information on services offered can be found at:

<https://www.gov.uk/government/collections/food-water-and-environmental-laboratories>

## Appendix 7: Spatial analysis tools

When investigating a cluster of cases and all initial analyses to identify the potential source are unsuccessful, the OCT should consider spatial analysis.

### Spatio-temporal cluster analysis

Colleagues in the Emergency Response Department Science and Technology (ERD S&T) at PHE, Porton Down are able to carry out spatial analysis using a range of tools devised to facilitate source identification. The output produced by the team can identify areas of space in which the source is likely to be contained based on where and when cases arose, ie, location and date of onset of symptoms.

Type of analysis	Type of data	Minimum number of cases needed	Key assumptions
Basic data visualization	Any data of interest to OCT	1	None, simply visualizing observed data.
Proximity Analysis	Case travel history and potential source locations	Depends on choice of annulus width	No allowance for underlying population at risk
Estimating the timing of an aerosolised release using symptom onset dates.	Date of onset. Recently extended to use date of admission to hospital	Depends on how spaced out the cases are in time. Can be informative on only a few cases if they are within days of each other	Fits uniform and logistic release windows, assuming epidemic curve is 'complete'.  Fits uniform window to data allowing for censoring in epidemic curve.  Assumes constant exposed population.
Case association cluster detection and visualization tool	Home postcode and date of onset	About 5	Models the probability of a legionella case occurring within a given distance and time of an earlier case  Only uses home location, given difficulty incorporating case movements with representative denominator population.

Meteorological analysis – wind-roses	Date of onset Case travel history and potential source (eg, cooling tower) locations Meteorological data	1	An investigation involving cooling towers may benefit from wind-rose being plotted for the cases. This is a visual map of the daily wind direction during the most likely period of exposure using case location date of onset of symptoms and the location of potential sources ie location of cooling towers
Attack ratio analysis using concentric circles	Nearest location of each case to potential source	Depends on number of annuli chosen	Tests if attack ratio is decreasing with distance from potential source.  Assumes estimated denominator population is representative.  Needs provision of potential source locations.
Attack ratio analysis using postcodes	Home and alternative locations for cases	Depends on spatial spread of cases but about 5 needed for district scale, about 10 for sector.	Tests if attack ratio is decreasing with distance from postcode geography with peak attack ratio.  Assumes estimated denominator population is representative.
Source estimation model assuming no dominant wind over time	Home and alternative locations for cases	Unclear at present, method under development	Provided mechanistic justification and extension to ARC tool above.  Assumes estimated denominator population is representative.  No consideration given to censoring issues.
Estimating the source and extent of a short duration release event.	Home and work locations, with dates of onset for each case	About 5	Full reverse epidemiology framework but requires short release duration.  Assumes estimated denominator population is representative and the guinea pig dose response translates to humans.

## Appendix 8: Examples for identifying clusters and outbreaks

### Definitions

#### **Cluster**

A cluster is generally defined as 2 or more cases with onsets of symptoms that are close in time, within days or months and space and/or share an epidemiological link. However, exposure-specific definitions are:

#### **Healthcare-associated cluster**

Two or more cases of LD who stayed, visited or worked in the same hospital or healthcare premises within 2 to 10 days prior to onset dates of symptoms, within 2 years of each other. If there is a period of more than 2 years between cases, the first 'new' case should be considered a 'single' case and any further cases thereafter would form a new cluster.

#### **Travel-associated cluster**

Two or more cases of LD who stayed at or visited the same accommodation site(s) during the 2 to 10 days prior to onset dates of symptoms, within 2 years of each other. If there is a period of more than 2 years between cases, the first 'new' case should be considered a 'single' case and any further cases thereafter would form a new cluster.

#### **Community cluster**

Two or more cases of LD that are geographically linked within 6 kilometres, by places of residence, work, or other type of community setting, and with onset dates of symptoms within 6 months of each other. It should be noted that UK travel cases are also exposed to potential sources of legionella in the community and so should be considered for inclusion in any potential community clusters. If there is a period of more than 6 months between cases, the first 'new' case should be considered a 'single' case and any further cases thereafter would form a new cluster.

#### **Outbreak**

An outbreak is defined as 2 or more cases of LD meeting the criteria for any type of cluster (as above), with an interval of no more than 28 days between onset dates of consecutive cases and one or more of the following:

- isolates from clinical AND environmental specimens are indistinguishable

OR

- isolates from respiratory specimens from at least 2 cases are indistinguishable

OR

- strong epidemiological evidence for link(s) between all cases

## Example A

Surveillance data shows 4 cases, who all live in a 3km area and have tested positive by urinary antigen test. No sequence-based typing results are available. Dates for 'Onset of illness' are as follows:

	Date of Onset
Case 1	01/12/2015
Case 2	20/01/2016
Case 3	05/03/2016
Case 4	30/04/2016

These 4 cases would fit the criteria for a community cluster, as they consist of 4 cases, living within 6km of each other and with onset dates within a 6 month time period. None of these cases fit the criteria of an outbreak as no 2 cases have onset dates within a single 28-day period.

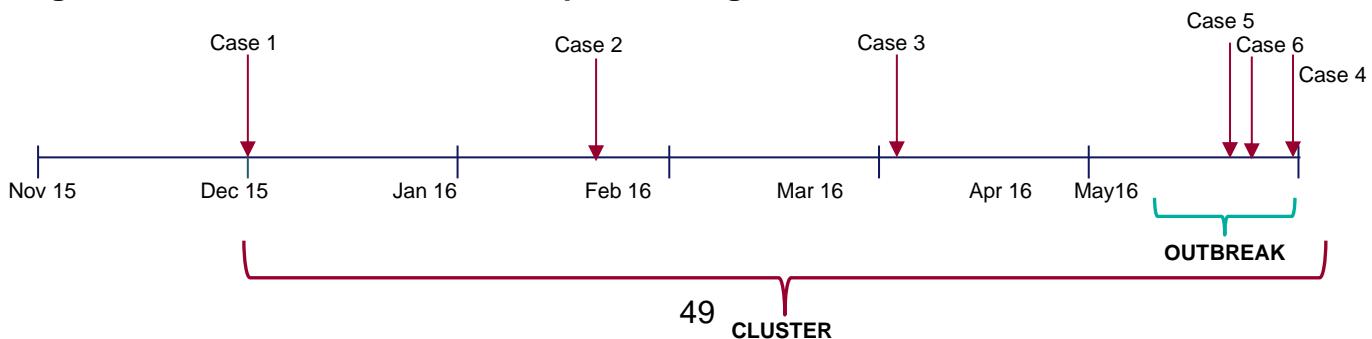
## Example B

An additional 2 cases are notified to the cluster in example A who work within the same 3km area as the original 4 cases. These 2 further cases are also positive by urinary antigen only. Cases 4, 5 and 6 have all visited the same garden centre. The onset dates for all these cases are as follows:

	Date of Onset
Case 1	01/12/2015
Case 2	20/01/2016
Case 3	05/03/2016
Case 4	30/04/2016
Case 5	22/04/2016
Case 6	24/04/2016

All 6 cases meet the criteria for a community cluster; however, cases 4, 5 and 6 constitute an outbreak (figure 1) that is, the intervals between onset dates for consecutive cases is within 28 days and there is strong epidemiological evidence for a link between them (visiting the garden centre).

**Figure 1. Outbreak created within a pre-existing cluster of cases**

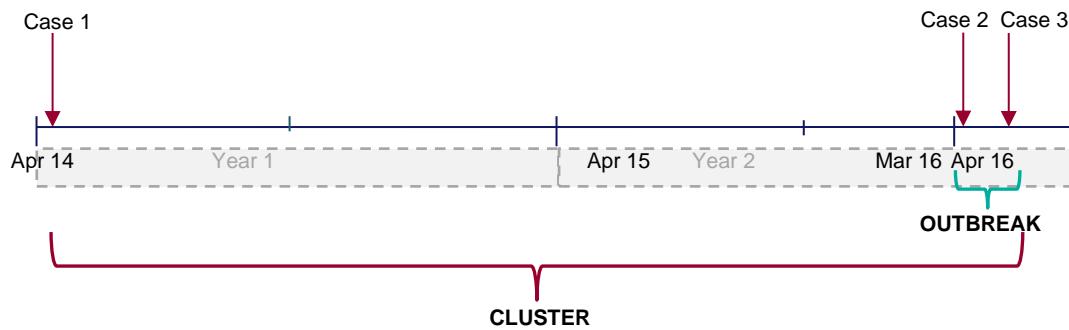


### Example C

A review of surveillance data has identified 3 LD cases who stayed one or more nights during their incubation period at hospital X.

	Date of Onset
Case 1	02/04/2014
Case 2	04/03/2016
Case 3	16/03/2016

All of the cases meet the criteria for a healthcare associated cluster, that is, they each stayed overnight in the same hospital during the 2 to 10 days of their incubation period, within 2 years of each other. Within this cluster, cases 2 and 3 together meet the criteria for an outbreak, that is, 2 cases that stayed at the same hospital during the 2 to 10 days of their incubation period and where the incubation periods are within 28 days of each other. Staying in the same hospital premises can be considered strong epidemiological evidence.

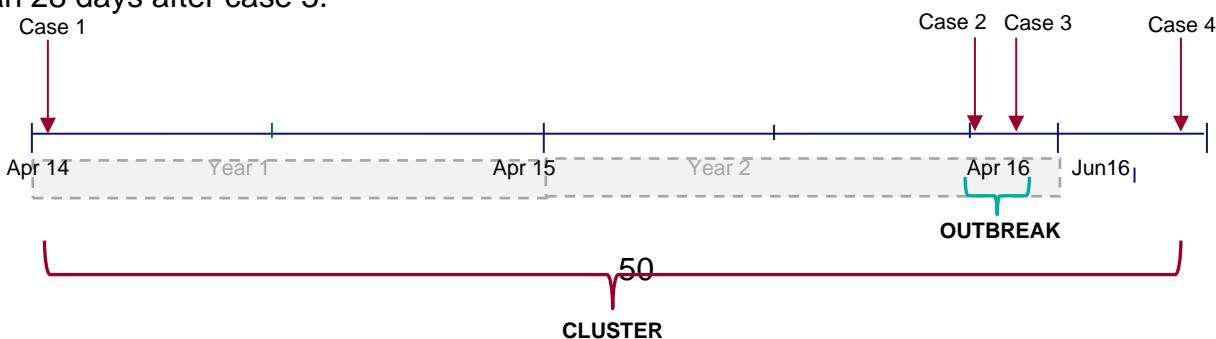


### Example D

A fourth case is reported who also stayed overnight during their incubation period at hospital X mentioned in example C.

	Date of Onset
Case 1	02/04/2014
Case 2	04/03/2016
Case 3	16/03/2016
Case 4	22/05/2016

Case 4 is identified with onset of symptoms on 22/05/2016 and is included in the cluster with cases 1, 2 and 3 as onset is within 2 years of cases 2 and 3. Cases 2 and 3 still remain an outbreak but case 4 is not included in the outbreak as the onset date is more than 28 days after case 3.



### Example E

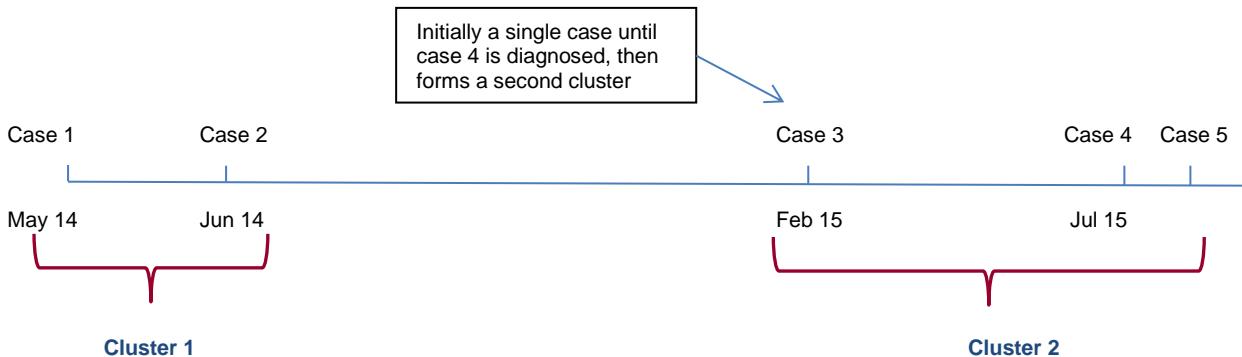
Two cases of community acquired LD are diagnosed and live within 4km of each other; they form a cluster as they occur within 6 months.

	Date of Onset
Case 1	12/05/2014
Case 2	03/06/2014

A further case living within the same 4km area is diagnosed with onset on 23 February 2015. Case 3 occurs more than 6 months after the previous case and is treated as a single case. However, 2 further cases living in the same 4km area are diagnosed.

	Date of Onset
Case 3	23/02/2015
Case 4	01/07/2015
Case 5	31/07/2015

There is a period of more than 6 months between cases 2 and 3; therefore, cases 3, 4 and 5 now form a second cluster associated with this location.



### Implications for management

The above hypothetical situations outline how the case definitions may be applied; this is particularly important so that HPTs can communicate clearly to partner organisations about whether an incident is regarded as a cluster or outbreak. It is important, however, to remember that labelling an incident as a cluster or an outbreak may not necessarily alter specific aspects of an investigation, for instance in the approach to environmental investigations and use of high discriminatory microbiological techniques.

## Appendix 9: Incident/outbreak Control Team

An outbreak control team (OCT) may be comprised of the following members, depending on the situation:

- CCDC - Chair (potentially a Consultant microbiologist (if related to a healthcare setting)
- Medical Microbiologist – (from trust where local clinical specimens processed and/or patients admitted)
- Local PHE Public Health Microbiologist
- NLST, Colindale
- NLRL, RVPBRU
- Local FW&E lab
- EHO/HSE/CQC
- Field Epidemiology Services
- ERD Science and Technology (if spatial analysis considered or required)
- Local authority public health team
- Local NHS services eg CCG
- PHE Communications
- For healthcare associated: DIPC, infection control team, estates
- Port Health Authority (if case was on board a ship which had called at the relevant port)
- Maritime and Coastguard Agency (if case was on board a ship which has been at a UK port)

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## 7. Glossary

BAL	Bronchoalveolar Lavage
CCDC	Consultant in Communicable Disease Control
CCG	Clinical Commissioning Group
CHP	Consultant in Health Protection
CQC	Care Quality Commission
DIPC	Director of Infection Prevention and Control
DPH	Director of Public Health
EHO	Environmental Health Officer
ERD	Emergency Response Department
FES	Field Epidemiology Service
FW&E	Food, Water and Environmental Microbiology Laboratory
GIS	Geographical Information Systems
HPT	Health Protection Team
HSE	Health and Safety Executive
ICT	Incident Control Team
IHR	International Health Regulations
LA	Local Authority
LD	Legionnaires' disease
NaTHNac	National Travel Health Centre and Network
NELSS	National Enhanced Legionnaires' disease surveillance scheme
NIS	National Infections Service
NLRL	National Legionella Reference Laboratory
NLST	National Legionella Surveillance Team
NPL	Non-pneumonic legionellosis
OCT	Outbreak Control Team
(q)PCR	Polymerase Chain Reaction
PF	Pontiac fever
PHE	Public Health England
RVPBRU	Respiratory and Vaccine-Preventable Bacteria Reference Unit
SBT	Sequence-based Typing
UAT	Urinary Antigen Test
WHO	World Health Organization