

Guideline on Management of *Legionella* Incidents, Outbreaks and Clusters in the Community

Health Protection Network
Scottish Guidance

March 2009

The Health Protection Network (HPN) is a network of existing professional organisations and networks in the health protection community across Scotland. It aims to promote, sustain, and coordinate good practice. The HPN supports a systematic approach to development, appraisal and adaptation of guidelines, seeking excellence in health protection practice.

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Foreword

Dear Colleague,

In 2005, following the publication of the report on the investigation of the *Legionella* outbreak in Rosyth, Fife, I responded by asking Health Protection Scotland (HPS) to convene an inter-agency forum to consider available expertise in Scotland and, where applicable, to provide practical advice and guidance on the investigation and management of incidents and outbreaks in Scotland.

The forum initially met under the auspices of HPS, but during 2006 became an operational Guideline Development Group under the auspices of the Health Protection Network (HPN), which was at that time becoming the driver for evidence-based health protection advice and practice in Scotland. The Group undertook a systematic approach to identify and evaluate the evidence and to integrate this with tacit knowledge embedded in our community of professionals across Scotland while acknowledging existing legislation and Approved Codes of Practice.

The group, throughout its work, drew on the expertise of practitioners within NHS Boards, Local Authorities, Health and Safety Executive and laboratories and in addition to examining current evidence also considered capacity to respond to an incident, especially with available accredited laboratory capacity. Following initial drafting of the guideline, consultation was extended not only to stakeholders in Scotland, but also included the HPA in England and colleagues from Europe (EWGLINET and the Spanish Society of Environmental Health).

In support of the guideline, HPS is developing training packages including electronic formats to support fellow practitioners and provide added value.

In conclusion, I commend this guideline to you and I trust it will provide assistance in future investigations across Scotland.

Yours sincerely,

Dr Harry Burns

Chief Medical Officer

Acknowledgments

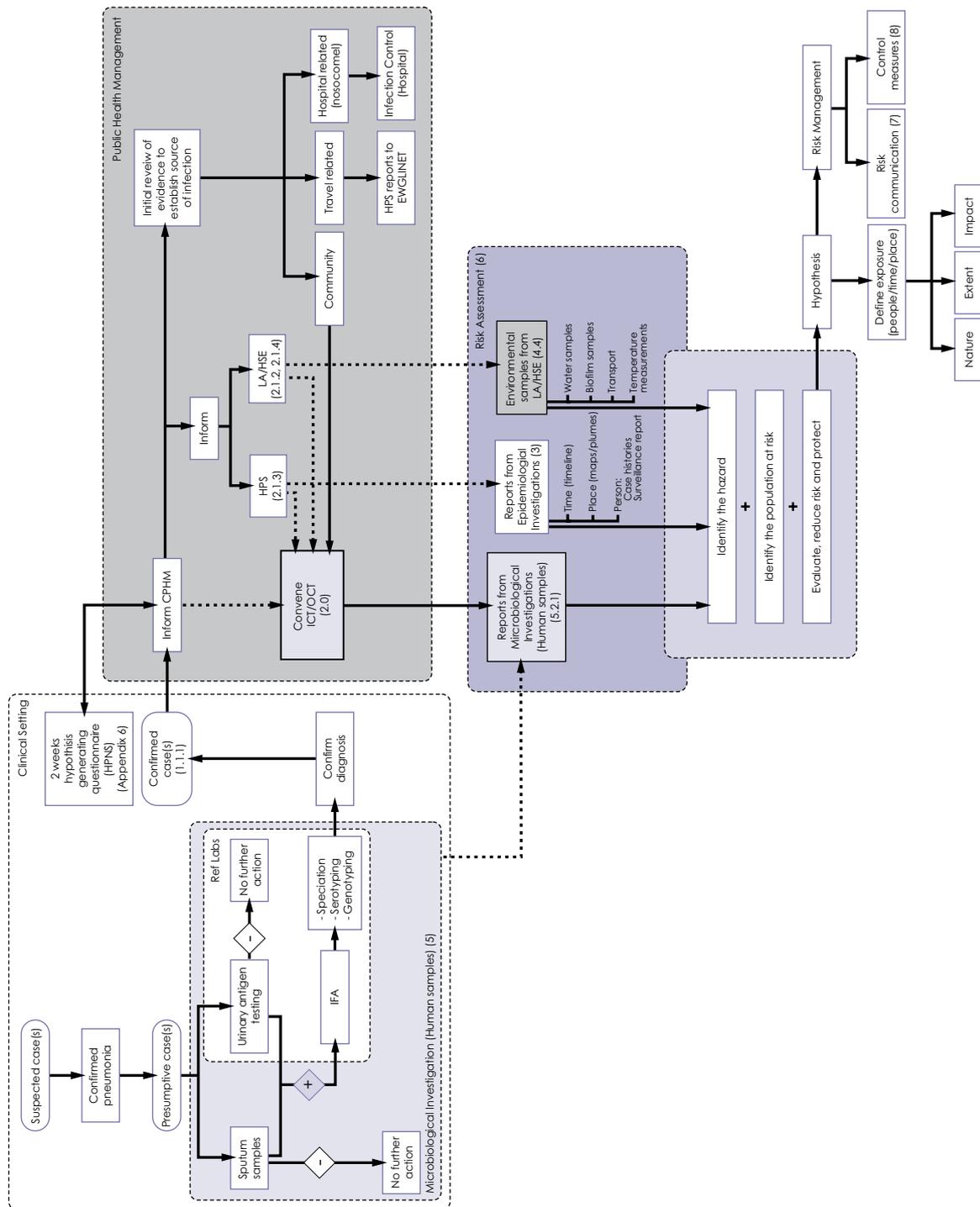
Health Protection Scotland (HPS) and the Health Protection Network (HPN) wish to express their appreciation to all whose efforts made this guidance possible. In particular, to the members of the Guidelines Development Group (GDG) convened in 2006 and their constituencies, to the Scottish Intercollegiate Guidelines Network (SIGN), HPS Graphics, stakeholders and external reviewers, who contributed and reviewed the content of this guidance.

Abbreviations

ACoP	Agreed Codes of Practice
CD/EH	Communicable Disease/Environmental Health
CMO	Chief Medical Officer
COSHH	Control of Substances Hazardous to Health
CPHM	Consultant in Public Health Medicine
DFA	Direct Fluorescent Antibody
ECDC	European Centre for Disease Control
EHO	Environmental Health Officer
ELISA	Enzyme- Linked Immunosorbant Assay
EWGLINET	European Working Group for <i>Legionella</i> Infections
GDG	Guideline Development Group
GMC	General Medical Council
HASAWA	Health and Safety at Work Act 1974
HBCP	Health Board Competent Person
H&S	Health & Safety
HPA	Health Protection Agency (England and Wales)
HPS	Health Protection Scotland
HSE	Health & Safety Executive
ICT	Incident Control Team
IFA	Immunofluorescent Antibody
LA	Local Authority
LACP	Local Authority Competent Person
LD	Legionnaires' Disease
OCT	Outbreak Control Team
OSD	Offshore Division (of HSE)
PCR	Polymerase Chain Reaction
PHLS	Public Health Laboratory Service
PPE	Personal Protective Equipment
RPE	Respiratory Protective Equipment
SIGN	Scottish Intercollegiate Guidelines Network
SGHD	Scottish Government Health Directorate
SLRL	Scottish <i>Legionella</i> Reference Laboratories
UKAS	United Kingdom Accreditation Service
WHO	World Health Organization

Algorithm

Investigation and management in the event of an incident, clusters and/or an outbreak of Legionellosis in the community



1. Introduction

The purpose of this document is to provide interagency guidelines to aid investigation and management in the event of an incident, clusters and/or an outbreak of Legionellosis in the community.

1.0. Aim and Scope of the Guideline

This document aims to provide a user-friendly, evidence-informed guideline for Scotland that:

- Offers best practice advice/guidance for investigation and management of incidents, clusters and outbreaks of *Legionella* in the community.

This document is based on current legislation, best published evidence and expert consensus. It indicates areas suitable for training and continuing professional development, and details areas of uncertainty requiring further research.

Details on guidelines development process in line with the methodology established by the Health Protection Network, audience, out of scope, and disclaimer are considered in Appendix 1.

1.1. Background Information

A brief description of the causative microorganism, transmission and infection of the disease, as well as public health interest, is outlined in Appendix 2. A brief outline of epidemiology of *Legionella* in Scotland is considered in Appendix 3.

1.1.1. Definitions

The following list provides – in line with the *European Guidelines for Control and Prevention of Travel Associated Legionnaires' Disease* (EWGLINET, 2005) and the *HPA Guidelines for investigating single cases of Legionnaires' disease* (Lee JV, Joseph C, 2002) – some useful definitions for epidemiological monitoring, used throughout this document:

- **PRESUMPTIVE CASE:** An acute lower respiratory infection with focal signs of pneumonia on clinical examination and/or radiological evidence of pneumonia and one or more of the following:
 - A fourfold or greater rise in specific serum antibody titre to *L. pneumophila* other serogroups or other *Legionella* species.
 - A single high titre in specific serum antibody to *L. pneumophila* sg1 or other serogroups or other *Legionella* species.
 - The detection of specific *Legionella* antigen in respiratory secretion or direct fluorescent antibody (DFA) staining of the organism in respiratory secretion or lung tissue using evaluated monoclonal reagents.
 - The detection of *Legionella* specific DNA by polymerase chain reaction (PCR).
- **CONFIRMED CASES:** An acute lower respiratory infection with focal signs of pneumonia on clinical examination and/or radiological evidence of pneumonia and one or more of the following:
 - Isolation of any *Legionella* organism from respiratory secretion, lung tissue or blood.
 - A fourfold or greater rise in specific serum antibody titre to *L. pneumophila* sg1.
 - The detection of specific *Legionella* antigen in urine using validated reagents and methods recommended by EWGLI in 1998 (Joseph CA, Ricketts KD, 2007).
- **INCIDENT:** a (first) single case – presumptive or confirmed – where, based on the evidence available, there are concerns about actual or suspected threats to the safety or quality of water systems that could require intervention to protect public's interests (FSA, 2007).
- **SPORADIC CASE:** a single case not associated with any other case (Lee JV, Joseph C, 2002). No other case may be linked to the probable source of exposure in the last 2 years.
- **CLUSTERS or COMMUNITY CLUSTERS:** two or more cases linked by area of residence or work, or places visited, and sufficient closeness in dates of onset of illness (within six months of each other).
- **OUTBREAK:** Two or more confirmed cases in the same locality for which there is strong epidemiological evidence of a common source of infection, with or without microbiological evidence, occurring within a six-month period of the onset of illness from first case confirmed.

- **LINKED CASES:** two or more cases associated with a single source with dates of onset more than six months apart but less than two years apart.
- **Definite NOSOCOMIAL:** Legionnaires' disease in a person who was in hospital for all ten days before the onset of symptoms (Lee JV, Joseph C, 2002).
 - **Probable nosocomial** – Legionnaires' disease in a person who was in hospital for between one and nine of the ten days before the onset of symptoms and either became ill in a hospital associated with one or more previous cases of legionnaires' disease, or yielded an isolate that was indistinguishable (by monoclonal antibody [mAb] subgrouping or by molecular typing methods) from isolates obtained from the hospital water system at about the same time.
 - **Possible nosocomial** – Legionnaires' disease in a person who was in hospital for between one and nine of the ten days before the onset of symptoms in a hospital not previously known to be associated with any case of Legionnaires' disease and where no microbiological link has been established between the infection and the hospital.
- **TRAVEL ASSOCIATED SINGLE CASES:** Cases who in the two to ten days before onset of illness stayed at or visited an accommodation site that has not been associated with any other cases of Legionnaires' disease, or cases who stayed at an accommodation site linked to other cases of legionnaires' disease but more than two years previously.
- **TRAVEL ASSOCIATED CLUSTERS:** Two or more cases who stayed at or visited the same accommodation site in the two to ten days before onset of illness and whose onset is within the same two year period.

2. Initial Response

2.0. Activating an Incident Control Team

NHS Boards and Local Authorities have jointly established **incident plans** to investigate incidents and/or major outbreaks of infectious diseases, including Legionellosis.

- A **Consultant in Public Health Medicine (CPHM)**, employed by the NHS Board, should consider evidence – from presumptive and/or confirmed cases (see 5.1) – where there appears to be an incident, clusters or linked cases. Consider preliminary investigation (epidemiological and environmental risk assessment).
- The CPHM **confirms that an incident, clusters or an outbreak exist** (see case definition in section 3.1). This is the first stage of any investigation through local or national surveillance schemes.
- Then a full **Incident Control Team (ICT) or an Outbreak Control Team (OCT) should be convened**. The CPHM **activates an Incident Control Team (ICT)** to manage the incident, with the overall purpose of protecting public health and preventing further infection.

(An ICT should also be called for a single case of nosocomial Legionellosis.)

- The CPHM becomes the chair of the ICT. Where multiple Boards are involved in the investigation, the chair should be agreed between HPS and the Boards.
- The ICT will involve representatives of all the agencies participating in the investigations (Appendix 4). Roles and responsibilities, leadership functions, and communication structures of members of the ICT/OCT should be clearly defined at the start (Appendix 4).
- **The HSE and the Local Authority EHO will be involved in the investigation of incidents and outbreaks;** their aim being to eliminate the risks to workers and the public and to pursue compliance with health and safety legislation. The Local Authority (LA) Environmental Health Officer (EHO) will also investigate possible environmental sources. **In all incidents/outbreaks the HSE will be invited to the initial ICT irrespective whether a source has been identified.**

2.1. Agency Roles and Key Objectives

Early establishment of the coordination and partnership working in the management and control of *Legionella* outbreaks is essential to ensure that the various roles and responsibilities of the agencies involved are utilised to the best effect from the start of the investigation.

2.1.1. NHS Boards

Section 2 of the Public Health etc. (Scotland) Act 2008 places a duty on NHS Boards to ensure provision is made within their area for the purposes of protecting public health.

NHS Boards – Key Objectives	
Reducing complications, disabilities and mortality in those affected	
	NHS Boards will ensure that primary care arrangements are appropriate to the risk, including support facilities in frontline laboratories for the prompt identification and confirmation of possible cases.
Preventing people being put at risk from further exposure	
	Through management of the ICT/OCT, the NHS Board will ensure that all key agencies clearly understand their respective roles, and carry out their investigative and management tasks promptly and effectively in co-operation with each other as required.

2.1.2. Local Authorities

Section 4 of the Public Health etc. (Scotland) Act 2008 places a duty on Local Authorities to ensure provision is made within their area for the purposes of protecting public health.

On a day-to-day basis, **Environmental Health Officers (EHO) working in Environmental Services Departments constitute the prime Local Authority resource in health protection.** They also have the principal local responsibility for securing the abatement of public health nuisances through advice and enforcement and thereby reducing the risks from many environmental hazards, including *Legionella*. They liaise closely with their NHS colleagues in the investigation and control of incidents and outbreaks of infections, often being the enforcement arm of the teams set up to manage these incidents.

Local Authorities – Key Objectives

Preventing people being put at risk from further exposure

1. The Local Authority pursues compliance with H&S legislation including management systems and performance, and also investigates potential sources of *Legionella*.
2. The Local Authority will take or arrange for samples to be taken to identify potential sources of *Legionella*, including water sampling, swabbing, arranging for the collections of samples and specimens, etc.

Stopping growth of the organism and reducing the risk from *Legionella* growth in water systems

1. The Local Authority provides advice on corrective action to control *Legionella* in affected premises, and the HSE will be consulted where corrective action is considered necessary.
2. The HSE will provide expert advice/support to the Local Authority, if required, on investigation of environmental sources and corrective action to control *Legionella* in affected premises.

2.1.3. Health Protection Scotland

Health Protection Scotland (HPS) is responsible for the national surveillance of communicable diseases and environmental health hazards and the provision of expert operational support on infection and environmental health to NHS Boards and Local Authorities in Scotland.

Its aim is to protect the health of the Scottish population by providing the best possible information and expert support to practitioners, policy-makers and others on infectious and environmental hazards.

HPS duties include the collection, analysis and dissemination of information on laboratory reports and outbreaks and incidents.

As well as its own function, HPS will be responsible for coordinating the tactical health protection response by the NHS Boards (i.e. surveillance, investigation, risk assessment and management and risk communication). NHS Health Boards will remain responsible for the operational health protection response.

Health Protection Scotland – Key Objectives	
Preventing people being put at risk from further exposure	
	HPS will contribute to the ICT/OCT by providing epidemiological investigation and advice on identified cases and potential cases across geographical and organisational boundaries within Scotland, the UK and where applicable Europe.
Stopping growth of the organism and reducing the risk from <i>Legionella</i> growth in water systems	
	HPS will contribute to the ICT/OCT by providing expertise on surveillance, analytical and epidemiological studies, infection and environmental control, and supporting communication. Other expert advice will be provided as required, including location and profile of cooling towers, etc.

2.1.4. Health & Safety Executive

The Health and Safety Executive (HSE) is the enforcing authority, responsible for health and safety regulations in the UK.

Their mission is to protect people's health and safety by ensuring risks in the changing workplace are properly controlled.

HSE looks after health and safety in nuclear installations and mines, factories, farms, hospitals and schools, offshore gas and oil installations, the safety of the gas grid and the movement of dangerous goods and substances, and many other aspects of the protection both of workers and the public throughout various industry sectors.

Companies have a legal requirement to control the risks from *Legionella*. HSE publishes extensive guidance on the control measures which are necessary to minimise the risks and to comply with the legislation (ACoP (L8)). HSE routinely carries out inspections of these companies to ensure that controls for *Legionella* are adequate and that workers and the public are protected.

HSE seeks to ensure that the risks from *Legionella* are being properly managed in workplaces. HSE works with many organisations to reduce risks and will routinely carry out inspections to ensure control is adequate.

Furthermore:

- HSE pursues compliance with H&S legislation including the provision of management systems, and also investigates potential occupational sources of *Legionella* and water systems.
- The Local Authority on behalf of the ICT/OCT will take or arrange for samples to be taken to identify potential sources of *Legionella*, including water samples, swabs, etc. in premises where the HSE are the enforcing authority for health and safety legislation.
- HSE provides advice on corrective action to control *Legionella* in affected premises.
- HPS provides expert advice/support, including epidemiological investigation.

2.1.4.1. In the event of outbreaks

HSE will seek to investigate all relevant premises in the outbreak zone. HSE will make a decision as to which premises to visit, based on a number of factors (registered cooling towers, local knowledge, etc.).

- HSE will seek to ensure that the water systems do not present a risk to workers or the public and that the potential for further cases of infection are minimised.
- HSE will seek to ensure compliance with legislation and that adequate arrangements are put into place for the on-going control of *Legionella* risks. HSE will often specify the necessary corrective actions to decontaminate water systems and to achieve adequate control.

The Local Authority on behalf of the ICT/OCT will take or arrange for samples (including water, swabs, etc.) to be taken at the premises to identify potential sources of *Legionella*.

Health and Safety Executive – Key Objectives

Preventing people being put at risk from further exposure

1. HSE will take the appropriate action to ensure that the risks from *Legionella* are prevented or controlled in the outbreak zone, and that workers and the public are adequately protected.
2. HSE will seek to ensure compliance with H&S legislation.

Stopping growth of the organism and reducing the risk from *Legionella* growth in water systems

1. HSE will provide advice on corrective action to control *Legionella* in affected premises, and pursues enforcement action where necessary.
2. HSE will ensure appropriate management systems and process are provided by the Occupier to ensure the potential for growth of *Legionella* in water systems is minimised.

2.1.5. Laboratories

Clinical laboratories (NHS) and Public Analysts (Local Authority) play a key role in identifying the causative organism in human cases and in the environment and as required will attend the ICT/OCT meetings.

2.2. Agency Responsibilities

2.2.1. Legislative Framework

Public Health etc. (Scotland) Act 2008

The Public Health etc. (Scotland) Act 2008 received Royal Assent in 2008 and will be subject to a phased introduction starting in 2009 and completed in 2010.

Section 3 of the Act requires NHS Boards to designate sufficient persons on behalf of the Board for the purpose of protecting public health. This person is known by the term "Health Board Competent Person".

Section 5 of the Act requires Local Authorities to designate persons for the purpose of protecting public health. This person is known by the term "Local Authority Competent Person".

Section 6 of the Act places a duty on NHS Boards and Local Authorities to co-operate with each other in order to protect public health.

Under Part 3 of the Act, the NHS Boards are required to investigate Public Health Incidents and carry out Public Health Investigations.

Health and Safety at Work etc. Act 1974 (HSWA 1974)

Both the HSE and Local Authorities enforce the HSWA 1974 and the subordinate regulations and ACoPs in their respective areas of responsibility. The new Health and Safety Executive allocates premises and Industry sectors to each enforcing agency through regulation.

2.2.2. Scottish Government Guidance on Managing Public Health Incidents

The Guidance deals with the generic organisational arrangements and main functions involved in handling incidents or outbreaks involving actual or potential exposures to a range of hazards, and in particular the roles and responsibilities of ICTs. This guidance builds on the principles set out in other specific guidance. This guidance reinforces the need for preparedness to manage incidents and outbreaks and these arrangements should be integrated into NHS Boards overall health protection arrangements. This guidance can be found at

<http://www.scotland.gov.uk/Publications/2003/01/16243/17320>

2.2.3. Health & Safety Executive Approved Code of Practice (L8) on The Control of *Legionella* in Water Systems (Extract)

This Approved Code of Practice (ACoP) gives practical advice on the requirements of the Health and Safety at Work etc. Act 1974 (HSE, HSWA 1974) and, the Control of Substances Hazardous to Health Regulations 2002 (COSHH) (as amended), (HSE, 2005) concerning the risk from exposure to *Legionella* bacteria. In particular, it gives guidance on sections 2, 3, 4 and 6 (as amended by the Consumer Protection Act 1987) of HSWA and regulations 6, 7, 8, 9 and 12 of COSHH (HSE, 2005). The Code also gives guidance on compliance with the relevant parts of the Management of Health and Safety at Work Regulations 1999 (MHSWR).

This Code applies to the risk from *Legionella* bacteria (the causative agent of Legionellosis including Legionnaires' disease) in circumstances where the Health and Safety at Work etc. Act 1974 applies.

2.3. LA and HSE Actions in the Event of an Incident or an Outbreak

2.3.1. Actions Relating to HSE Controlled Premises

1. NHS Board manages the incident through the ICT/OCT.
2. NHS Board investigates clinical evidence and suspected cases.
3. HSE will seek to ensure that *Legionella* risks are eliminated, that workers and the public are adequately protected and that there is compliance with H&S legislation.
4. The Local Authority on behalf of ICT/OCT will take or arrange for samples to be taken to identify potential sources of *Legionella*, including water samples, swabs, etc.
5. HPS provides expert advice/support including epidemiological investigation.
6. HSE provides advice on corrective action to control *Legionella* in affected premises.

2.3.2. Actions Relating to Local Authority Controlled Premises

1. NHS Board manages the incident through the ICT/OCT.
2. NHS Board investigates clinical evidence and suspected cases.
3. Local Authority pursues compliance with H&S legislation to ensure that *Legionella* risks are controlled, including management systems and process and also investigates potential environmental sources.
4. The Local Authority will take or arrange for samples to be taken to identify potential sources of *Legionella*, including water samples, swabs, etc.
5. HPS provides expert advice/support including epidemiological investigation.
6. Local Authority provides advice on corrective action to control *Legionella* in affected premises.
7. HSE provides expert advice/support if required on investigation of environmental sources and corrective action to control *Legionella* in affected premises.

3. Epidemiological Investigation

3.1. Case Detection and Case Definition

- **Every single case of *Legionella* should be fully investigated in a timely fashion.** This might be the first case in an outbreak and prevention of further cases is the priority. It should be noted that there might well be an appreciable delay before cases start to be reported.

A **single case definition** (potentially a preliminary outbreak case) may read as follows:

“Any person with a confirmed or presumptive diagnosis of

Legionnaires' disease and a history of association with
in the 2-10 days before onset of illness

and whose illness started between dd/mm/yyyy and dd/mm/yyyy.”

3.1.1 Cases of *Legionella* Should be Investigated in the Following Manner

Initial Notificationⁱ

Notification to the Public Health Department of a case of Legionnaires' Disease must be supported by, confirmed, or presumptive microbiological evidence of recent *Legionella* infection (unless notified as a suspected case(s) associated with an identified outbreak). Discuss case and initial results with microbiologist (see section 5).

And Initial enquiries

Initial enquiries should identify if the case is:

- Probable or possible nosocomial infection (definitions in 1.1.1). Investigations should be carried out immediately. Use form provided in Appendix 5.
- Suspected in the community or an overseas travel associated infections: In both circumstances, investigations should also be initiated immediately in a timely fashion. Use form in Appendix 5. Also required is any history of previous cases that have occurred within the community in recent weeks to months.

i Public Health etc. (Scotland) Act 2008, Section 12, Part 1 of Schedule 1

- Advise CPHM (CD/EH) and on-call CPHM.
- Follow and complete investigation.

3.1.1.1 For cases identified in the community

- Obtain details of patient's movements for the 2 weeks prior to onset of illness – use form in Appendix 6, (also provided in the HPS “on call” laptop).
- Obtain details of any cooling towers or aerosol producers in vicinity (up to 6 kilometres) of the patients' home, work place or places visited, from Environmental Health and Local Authority (Nguyen et al, 2006; García-Fulgueiras, 2003; HSE, 2007).
- Request EHO in conjunction with HSE to examine maintenance records, risk assessment documents and sampling regime of identified cooling towers.
- If cooling tower(s) identified at work place, enquire about recent levels of sick leave and respiratory illness in employees.
- If patient has had contact with a spa pool, request EHO to examine that control measures comply with Health and Safety requirements (Nguyen et al, 2006; HSE, 2007) and HPA guidance (Lee JV, Joseph C, 2002).
- If maintenance and risk assessment is deficient, further investigation should be carried out after discussion with the CPHM and EHO.
- If patient lives in a care home, enquire about recent levels of respiratory illness in other residents and care staff.
- Ensure sampling of the household water supply, should be considered where there has been problems relating to maintenance of the water system or the house has not been used for long periods of time.
- Discuss at the ICT/OCT whether a press release is indicated.
- Record all actions and findings.
- Discuss findings with CPHM (CD/EH) or HPS for further advice.

3.1.1.2 For cases identified in the hospital/health care environment

- Obtain details of patient's movements for the 2 weeks prior to onset of illness – use form in Appendix 6, (also provided in the HPS "on call" laptop).
- Call ICT/OCT.
- Review risk assessment documents.
- Review hospital maintenance records.
- Search for other cases associated with the hospital.
- Conduct environmental sampling.
- Institute remedial control measures.
- Record all actions.
- Ask patient permission for press release.

3.1.1.3 For cases identified as travel associated infections

- Obtain details of patient's movements for the 2 weeks prior to onset of illness – use form on Appendix 6 (also provided in the HPS "on call" laptop).
- Obtain name of tour operator/flight
- Mode of travel and destination
- Name(s) of hotel, apartment, caravan park, etc.
- Inform HPS.

Further actions:

- **NHS Board should pass details of suspected or confirmed cases of Legionnaires' disease to the appropriate Environmental Health office, and the Health & Safety Executive, as soon as possible, ideally in working hours.**
- Environmental Health should usually be asked to obtain details of any cooling towers or aerosol producers in vicinity (up to several kilometres (HSE, 2007)) of the patient's home, work place or places visited.

EHOs should:

- Examine maintenance records, risk assessment documents and sampling regime of identified water systems, cooling towers or aerosols producers.
- If cooling tower(s) identified at workplace, enquire about recent levels of sick leave and respiratory illness in employees – and maintain confidentiality.
- If patient has had contact with a spa pool, check that control measures comply with HSE requirements and HPA guidance.
- If maintenance and risk assessment is deficient, further investigation should be carried out after discussion with the CPHM and EHO.
- If patient lives in a care home, enquire about recent levels of respiratory illness in other residents and care staff.
- Ask patient for details and collaboration in case the ICT/OCT decide to take samples of the water supply in the household .
- Complete and return HPS *Legionella* form (Appendix 5).

3.1.2. Enhanced Surveillance

- **Enhanced surveillance** of *Legionella* allows identifying cases most likely to have been acquired recently, and it should be driven both by environmental sampling and a working hypothesis formulated by the ICT.
- **The main objective of such enhanced surveillance** is to promote subsequent outbreak investigation, which will in turn, determine the magnitude of the outbreak, to identify source(s) of transmission and risk factors for acquiring LD.
- Furthermore, control measures should be implemented to prevent further transmission and to evaluate the effectiveness of these control measures.

3.1.3. Hypothesis Generating Questionnaire

- An epidemiological questionnaire to elicit information on clinical aspects, predisposing factors, risk factors, place of residence and recent mobility out with the place of residence, should be issued to suspected cases, and relevant analytical studies such as case-control studies should be considered.

Appendix 6 offers a template of this questionnaire.

3.1.4. Analytical Studies

- Analytical studies are used to test a hypothesis and include case-control and cohort studies. The cohort study is the gold standard of analytic epidemiology as it allows calculation of indicators which have a very clear meaning and the results are immediately understandable. However, it is more realistic in an outbreak situation to use the case-control study and the use of this type of study has been repeatedly demonstrated in the investigation of *Legionella* outbreaks, most notably where cooling towers were found to be the source of transmission (Nguyen et al, 2006; García-Fulgueiras, 2003; HSE, 2007).

3.2. Analysis of Clusters (Spatial Investigations)

- There is a dearth of published information on spatial clustering of cases although the **use of mapping software can be helpful** in plotting cases during outbreaks (Hyland JM *et al*, 2008).
- The report on the West Fife outbreak highlighted the importance of having maps at an early stage of outbreak investigations (Hyland JM *et al*, 2008), and that HPS should be in a position to plot cases via MapInfo software.
- Recommendations drawn from two scientific papers – both case control studies with similar patient profile (Nguyen et al, 2006; García-Fulgueiras, 2003; HSE, 2007) – suggest that **Legionella aerosol transmission from cooling towers can extend for several kilometres.**

3.2.1. Statistical Tools for Cluster Detection

- **Statistical tools such as Spatial and Space-Time Scan (SatScan)** can be used to look at temporal or spatial clusters but there are a number of caveats which should be taken into consideration for such tools. For example, the appropriate statistical model must be utilised as well as sensible limits being set for the model of choice.

There are potential problems if dealing with few events (typical in *Legionella* outbreaks) and/or odd spatial shapes. Many clustering detection techniques have their limitations and it may be prudent to look for consistent results using a combination of epidemiology, mapping and statistics to elucidate clusters of *Legionella* cases.

- **A combined approach** should be used to inform clinical settings regarding clustering i.e. use of **statistical tools, mapping and epidemiology** should be used. There are limitations in which methodologies can be used by individual NHS Boards, HPS and/or HPA should be able to offer expertise in all areas if required.

3.3. Modelling Putative Plumes (Sources)

The literature on plume modelling is sparse for both dispersion and turbulence models. Several case control studies and reviews were appraised but only two scientific papers (both case control studies in 3.2.1) were of relevance (Hyland JM *et al*, 2008; Nguyen *et al*, 2006), as well as the HPS software system used to model plumes (Atlas Vulcan).

3.3.1. Use of Atlas Vulcan Software for Plume Modelling

Atlas Vulcan software has been designed specifically to assist incident management professionals or organisations that need to respond to, or train for incidents that may involve toxic/infectious industrial or explosive content.

The software will quickly calculate a downwind hazard template area for devices with infectious, explosive and/or chemical content based upon all known information. If any information is not known, a worst case scenario is automatically generated which may be amended once more accurate information becomes available.

HPS software (Atlas Vulcan) utilises weather conditions and projects an envelope of chemical dispersion – this software assumes worst-case scenario with regards to water and cooling towers. The software does not take buildings into consideration and assumes an uninterrupted line of sight. The system, which analyses weather conditions and dispersion models, should be incorporated into any potential modelling of *Legionella* plumes.

- Plume dispersion of *Legionella* aerosols (e.g. from a cooling tower) may cause infection up to several kilometres away from the source. The best method for modelling plumes is **using the Atlas Vulcan software tool**, which takes dispersion models into consideration. There are no known plume models for turbulence.

3.3.2. What is the Best Source of Meteorological Data?

- **The best source of meteorological data is the Met Office.**

The ability to assess weather records has a massive impact in elucidating the role of a contaminating source such as a cooling tower e.g. bacterial concentrations increase with wind speed and temperature. The Met Office holds data for a number of monitoring stations across Scotland informing the nation's weather and climate. The data is collected hourly and the previous 30 days are available for download. There does not appear to be a viable alternative to the Met Office data and given that Atlas Vulcan software is based on data from the Met Office, it would be best to utilise such data for this software especially for aerosol dispersion.

4. Investigation of “Water Systems”

4.1. Typical and Atypical Putative Sources of *Legionella*

4.1.1. Foreign Travel

On average, 50% of all cases recorded in Scotland each year are associated with foreign travel. It is therefore prudent for an ICT/OCT to consider at the earliest opportunity the likelihood of travel being implicated in the outbreak.

4.1.2. Potential Sources (Extract from ACoP (L8))

- 4.1.2.1. The Approved Code of Practice (ACoP (L8)) applies to the control of *Legionella* bacteria in any undertaking involving a work activity, and to premises controlled in connection with a trade or business, and other undertakings where water is used or stored and where there is a means of creating and transmitting water droplets which may be inhaled. There may be a reasonably foreseeable risk of exposure to *Legionella* bacteria.
- 4.1.2.2. A reasonably foreseeable risk of exposure to *Legionella* bacteria exists in:
 - (a) water systems incorporating a cooling tower
 - (b) water systems incorporating an evaporative condenser
 - (c) hot and cold water systems, and
 - (d) other plant and systems containing water which is likely to exceed 20°C and which may release a spray or aerosol (i.e. a cloud of droplets and/or droplet nuclei) during operation or when being maintained.
- 4.1.2.3. Experience has shown that cooling towers, evaporative condensers and hot and cold water systems in a wide variety of workplaces present a risk of exposure to *Legionella* bacteria. Further guidance on systems that may present a risk can be found in section 4.2. Not all of the systems listed in section 4.1.3. will require elaborate assessment and control measures. A simple **risk assessment** – suggested in the ACoP (L8), paragraph 57 (measuring water temperatures, inspecting for dead legs or intermittent water supplies, etc.) may show that the risks are low and in such case, no further action will be necessary. Examples include small, domestic-type water systems where temperatures and turnover are high, or where instantaneous water heaters are used.

4.1.2.4. A water system includes all plant/equipment and components associated with that system e.g. all associated pipe-work, pumps, feed tanks, valves, showers, heat exchangers, quench tanks, chillers etc. It is important that the system is considered as a whole and not, for example, the cooling tower in isolation. Dead legs and parts of the system used intermittently, e.g. test loops in engineering factories and injection moulding machines, also need to be included as part of the system since they can create particular problems with microbial growth going unnoticed.

4.1.3. Risks Associated with Water Sources

- 4.1.3.1. From experience gained from investigation of previous incidents and outbreaks in Scotland and throughout the UK, from an extensive review of the literature, there is sufficient evidence to identify the main sources likely to be implicated in potential outbreaks and there is sufficient information on the types of water systems that can become contaminated with *Legionella* and therefore be potentially hazardous.
- 4.1.3.2. Each outbreak investigation has specific characteristics. However, consideration of frequent potential sources will be beneficial in the investigation of potential environmental sources. (Please refer to 4.2.1.2 where a list of potential putative sources of *Legionella* are considered against risk criteria.)
- 4.1.3.3. Previous outbreaks and research have identified that many water systems within a variety of environments can be contaminated with *Legionella* species. These can include:
- Cruise ships
 - Hotels
 - Medical and dental equipment (see 4.1.3.4)
 - Construction work (can sometimes lead to contamination of water systems).
- 4.1.3.4. Research papers discussed dental equipment. The evidence suggests that equipment that uses water ("Dental care water lines") can become contaminated, and that staff have an immune response (antibodies detected) (Rice *et al*, 2006). There is however little evidence of infection.

4.1.4. Investigative Approach

In the event of an incident or an outbreak, after excluding travel, all potential sources in the “appropriate” zone will need to be identified (as far as possible). The strategy for the investigation will of course depend on the circumstances (e.g. hospital, workplace, community etc.) but priority should be given to the most likely appropriate source(s) as outlined above.

4.2. Classification of Installations

4.2.1. Risk Associated with Systems

4.2.1.1. There is sufficient evidence from previous outbreaks to identify the “high-risk” sources likely to cause major outbreaks.

The number of water systems that can become contaminated is substantial, but many will present a “low-risk” of causing an outbreak due to limited ability to cause aerosol dispersion.

4.2.1.2. The risk scale proposed here (table 1) is not rigid, and it is based essentially on three factors:

- potential for dissemination of aerosol
- the number of people likely to be affected in an outbreak
- the frequency that these installations are involved in outbreaks.

The following is a “working” or “practical” list based on the information within the published papers and other information. It is recognised however, that virtually any water source can become contaminated with *Legionella* and, if favourable conditions occur for growth and dissemination in the context of inadequate control, then exposure and infection may occur.

A “low-risk” source does not necessarily mean that potential for infection is always low. The risk of exposure/infection may be high and the numbers of people affected are unpredictable.

Table 1: Risk Scale

Risk Scale for Potential Sources of <i>Legionella</i> in Installations
High-risk sources
<ul style="list-style-type: none"> • Cooling towers/evaporative condensers/air conditioning systems – associated with major environmental/community outbreaks • Hot and cold water systems (particularly in hospitals, hotels – often related to showerheads –, leisure facilities and care homes to a lesser extent) • Whirlpools/spa baths (both “display” and leisure)
Medium-risk sources
<ul style="list-style-type: none"> • High pressure hosing/cleaning • Car wash • Industrial water systems (engineering machine coolants, “closed” water system in plastics) • Fountains
Low-risk sources
<ul style="list-style-type: none"> • Sewage plants • Ship water pump repair • Gardening potting soil (specific <i>Legionella</i> species: <i>L. longbeachae</i>) • Garden sprinkling water systems (both from indoor and outdoor taps) • “Respiratory therapy devices” which generate aerosols (health care related); “Aerosolising” devices • Contaminated hospital equipment • Hot spring bath water • Public bath water • Ice machines • Dental equipment • Food display humidifiers

4.2.2. Focus of the Investigation

In the event of an incident or an outbreak, those premises which have been linked to the incident/outbreak should be investigated on a priority basis. The investigation should be focused on the water systems management and control systems.

4.2.3. Sampling Strategy

Sampling will be discussed in detail in section 4.4. and each outbreak must be considered separately depending on circumstances. However the sampling strategy should, in general, reflect the risks identified in reference to 4.2.1. Sampling at the appropriate "high-risk" source should be given initial priority, unless there is evidence to the contrary.

4.3. Compliance with Legislation

4.3.1. General

The current H&S legislation framework is designed to minimise the risk of *Legionella* developing in water systems and consequently reducing the risk of disease to employees and the community at large.

4.3.2. Duties and Responsibilities

- 4.3.2.1. The actions that duty holders (Local Authorities, other public bodies and voluntary organisations) should take and the information that they should have to control the risks from *Legionella* are required under specific health and safety legislation: *The Control of Substances Hazardous to Health (COSHH) Regulations 2002 (as amended)* (HSE, 2002).
<http://www.opsi.gov.uk/si/si2002/20022677.htm>

The legal duties and practical guidance on how to comply with the Regulations are set out in a single legal document *Legionnaires' Disease (LD), The Control of Legionella Bacteria in Water Systems, Approved Code of Practice and Guidance (ACoP (L8))*, (HSE, 2000).

In addition to H&S legislation the EHO has other powers under the Public Health etc. (Scotland) Act 2008 and Nuisance procedure under Section 79(1) of the Environmental Protection Act 1990. (See section 8.1.5).

The law requires duty holders to:

- Identify and assess the risks from LD associated with their work
- Appoint a person to have managerial oversight
- Prepare a written plan or scheme to ensure that the risks are controlled
- Implement the control regime
- Monitor the performance of the control regime and keep appropriate records.

4.3.2.2. The information that a duty holder should have relating to their duties is as follows:

- A risk assessment document and the “significant findings”
- Details of the appointed person and deputy and other competent persons involved in the control regime
- Communications arrangements and training requirements
- A schematic plan of the water system(s)
- A description of the correct and safe operation of the system
- The precautions to be taken (the control regime)
- A records of checks that have been carried out to ensure the efficacy of the control regime (i.e. monitoring and test results, inspection and checks data)
- Details of the remedial action that should be taken in the event of failure of the control regime.

4.3.2.3. With regards to the control regime, the written precautions should include the following information:

- The chemical or physical (e.g. temperature) water treatment programme
- Water quality/system control data
- Remedial measures to be taken when control parameters are exceeded
- Cleaning and disinfection procedures

Records should be kept for the period for which they remain current and for at least 2 (or in some cases 5) years after that period.

4.3.3. Other Supporting Legislation and HSE Guidance

There is other legislation and HSE guidance which can apply:

- Notification of Cooling Towers and Evaporative Condensers Regulations 1992.
- Legionnaires' Disease, A Guide for Employers" (IAC27 (rev)), Legionnaires' disease, "Essential information for the providers of residential accommodation" (INDG376).
- Legionnaires' Disease, Control of *Legionella* bacteria in water systems Audit Checklists (C200).

4.3.4. Investigative Approach

ACoP (L8) gives clear guidance on how to manage risks from LD in workplace water systems. Duty holders should follow the guidance in the ACoP (L8) including actions to take in the event of an outbreak (Appendix 2 of the ACoP (L8)).

The strategy for the investigation will of course depend on the circumstances (e.g. hospital, workplace, community etc.) but steps should be taken to eliminate risks, ensure that the water systems are cleaned and disinfected and that an adequate control regime is put into place.

4. 4. Water Systems Sampling

- **The type and volume of sampling** that is required during an investigation is directed by the epidemiological information that is available at the outset of the investigation. It is essential to prioritise the sampling to target high risk processes or equipment first, followed by sampling of lower risk processes.
- **The numbers and focus of the sampling** should be continually assessed and redirected as the investigation develops and results and information become available to locate the source of the infection and prevent further infection.
- The samples taken normally comprise of samples of water taken from a water distribution system and swabs of the biofilm or biofilms found on the surfaces of water systems. Sampling should be conducted in accordance with the procedures described in *The determination of Legionella bacteria in waters and other environmental samples (2005)- Part 1 - Rationale of surveying and sampling* (Environment Agency, 2005). See http://www.environment-agency.gov.uk/commondata/acrobat/book_200_1028650.pdf

4.4.1. Water Samples

- **The volume of water sample** required is normally 1 litre; however it maybe appropriate to sample 5-10 litres of an incoming mains water supply or a private water supply. Samples should be collected in sterile polyethylene bottles or similar containers.
- **The sampling container** must contain a suitable agent to neutralise any biocide that may be present in the water. The use of a 1 litre sterile sampling containers containing 180mg of sodium or potassium thiosulphate would be sufficient to neutralise biocides containing chlorine, bromine or chlorine dioxide. If the system to be sampled contains biocides based on the use of Silver or Copper ions then the sampling container should contain 10mg/l of Ethylenediaminetetraacetic Acid (EDTA), (Versteegh GH, 1989).

4.4.2. Biofilm Samples

- Samples of biofilm can be collected from the surfaces of parts of the water distribution system, for example from water tanks or showerheads. The biofilm is sampled using a sterile cotton swab which is wiped and rotated across the test surface. If the surface to be tested is not moist then the swab should be dipped into sterile water, Pages' saline or Ringers 1:40 solution (Environmental Agency, 2005, Section 3.1.12). When moistened, the swab can then be wiped across the test surface.
- When the surface has been swabbed, the head of the swab containing the biofilm can be broken off into a known volume of sterile water, Pages saline or Ringers 1:40 solution.

4.4.3. Transport of Samples

As soon as the samples have been taken they should be transported to the laboratory without delay to allow the examination to begin, preferably on the same day as the sample was collected. The samples should be kept between 6-20°C and protected from sources of heat and sunlight.

4.4.4. Temperature Measurement

In addition to collecting samples of water and biofilm it is also extremely useful to record the temperature of the water when sampling. The temperature will give an indication of the parts of the system that would support the optimum growth and survival of *Legionella* (see Appendix 2).

4.5. Training and Equipment to Sample Potential Sources

4.5.1. Risk to Investigators

There is potential risk for exposure to *Legionella* bacteria for personnel engaged in investigating work, including sampling.

To control this risk, no officers should undertake an investigation into an outbreak of Legionellosis, including sampling, unless they have received training in accordance with their organisational instructions or are supervised by someone who has undergone such training. Each Local Authority Environmental Services Department should maintain a register of trained officers in order that they can be readily identified during an investigation.

Furthermore, organisational policies should take into account precautions and recommendations given in the Safe Systems of Work, agreed between the Health and Safety Executive and Local Authorities.

- Selection of personnel for certain aspects of the investigation and sampling should take into consideration personal risk factors (e.g. higher risk for immuno-suppressed individuals, individuals greater than 50 years of age and smokers or greater than 50 years of age and recent smokers).
- Water systems under investigation should be turned off 30 minutes before officers approach potential areas of exposure, so ensuring there are no aerosols in the environment while sampling.
- All officers entering areas where exposure to *Legionella* may occur must be aware of the hazards they could face and be provided with the necessary personal protective equipment (PPE). The PPE will vary according to circumstances and may include:
 - Respiratory Protective Equipment (RPE)
 - Hard hat and safety shoes
 - High visibility clothing
 - Disposable overalls
- On any occasion where investigators may be exposed to aerosol they must wear suitable RPE. In most situations, high efficiency disposable masks (i.e. a 3M 8835 respiratorⁱ meeting the requirements of the European EN149:2001 FFP3 standards) will be appropriate. Personnel should check that the RPE fits their face and are trained in the use of the equipment.

i <http://www.surgical-face-masks.co.uk/images/3m-8835.pdf>

- The Local Authority investigating an outbreak should review their risk assessment at the outset to ensure that the risk to all investigators of exposure to *Legionella* bacteria is adequately controlled.

4.5.2. Training

Officers carrying out investigative work on *Legionella* should have appropriate training that should cover the following areas:

- The organism and disease
- Strategy
- Hot and cold water systems
- Cooling towers
- Spa pools
- Other risk systems
- Inspection
- Outbreak investigation
- Sampling.

4.5.3. Sampling

Most of the information on sampling is contained in section 4.4. Equipment required for sampling will include:

- 1 litre sterile polyethylene bottles containing an appropriate neutralising agent
- Cool boxes – in which to store the samples and the samples must be stored at between 6-20°C and protected from sources of heat and sunlight
- Marker pens for sample details on bottles
- Alcohol disinfectant for post-flush samples
- Sterile cotton swabs and containers to put the swabs in
- Sterile diluent to moisten swabs i.e. Ringers solution
- Sterile tube to sample tanks, the tube should be 2-3 metres long
- Plastic bags, food grade
- Scissors, a Calibrated thermometer, and a Camera.

The Local Authorities should maintain a supply of all equipment required for *Legionella* sampling to include PPE and should liaise with their local *Legionella* accredited laboratory to ensure that they also have the requisite equipment available to deal with an outbreak, to include biocide neutralising agents.

For methodology of sampling refer to Section 3 of the Environment Agency publication: *The determination of Legionella bacteria in water and other environmental samples (2005) – Part 1 – Rationale of surveying and sampling*.
http://www.environment-agency.gov.uk/commdata/acrobat/book_200_1028650.pdf

5. Microbiological Investigations

5.1. Indications and Guidance to Human Samples

The clinical presentation of infection with *Legionella* is not distinguishable from that of other causes of pneumonia, and special diagnostic methods are needed to identify *Legionella*. These not only allow timely and appropriate management but also enable the prompt initiation of epidemiological and environmental investigations.

5.1.1. Diagnostic Methods

5.1.1.1. Urinary Antigen Testing

- It is recommended **that all suspected cases – patients in a high-risk category – are investigated promptly by urinary antigen testing.**
- The use of enzyme immunoassays (EIAs) for detecting *L. pneumophila* antigen in urine allows Legionnaires' disease to be diagnosed early in the course of infection. It is a convenient and rapid test (15min–3h) with reasonable specificity (80–85%) and sensitivity (75–99%) for *L. pneumophila* serogroup 1.
- It is detectable in most patients between one and three days after the onset of symptoms, and may persist for some weeks or months.
- **Positive tests should be confirmed by immunofluorescent antibody (IFA) testing at the Scottish *Legionella* Reference Laboratory.**
- Where there is a high level of suspicion then IFA testing should be performed because it detects disease caused by *Legionellae* other than *L. pneumophila* serogroup 1.

5.1.1.2. Sputum Samples – Isolation of the Bacterium by Culture

- **Bacterial isolation should be attempted** whenever possible as strain typing is essential for the demonstration of links between case and between cases and environmental isolates.
- **Sputum should be considered for culture in suspected cases**, even when sputum is not purulent. It is strongly recommended that sputum samples are taken as soon as possible in suspected cases.

- As Legionellosis is often accompanied by a dry cough with little sputum, respiratory specimens, such as lung tissue, pleural fluid or bronchoalveolar lavage (BAL), are often indicated for culture.
- Culture of *Legionella* is often the most sensitive detection method, with high sensitivity (>99%) and the highest specificity, particularly important in: severe pneumonia; immunocompromised patients; nosocomial infections; and cases caused by any *Legionellae* other than *L. pneumophila* serogroup 1.
- Requires 2-4 days, sometimes (rarely) up to 14 days.
- Enrichment culture techniques (used routinely in the Scottish *Legionella* Reference Laboratory) may allow the isolation of *Legionellae* even when the patient has been on appropriate antibiotics for several days. Available respiratory secretions should be normally sent to the Reference Laboratory as soon as a diagnosis is made by urinary antigen and when a serological diagnosis is made early in the course of an infection.

5.1.1.3. Other Methods for Laboratory Diagnosis of Legionellosis/LD

- Detection of the bacterium in tissue or body fluids by Immunofluorescent microscopy (e.g. direct immunofluorescence assay (DFA) testing). Available in the Scottish *Legionella* Reference Laboratory.
- Detection of bacterial DNA in respiratory specimens using polymerase chain reaction (PCR). Not fully validated but available in Reference Laboratory.

5.1.2. Results Management

- All *Legionella* isolates from patient and environmental specimens should be submitted to the Reference laboratory for speciation, serotyping and genotyping.
- PCR detection methods may develop enough to allow genotyping of *Legionellae* in culture negative specimens.

5.2. Centres for Testing Human and Environmental Samples During an Outbreak

This section clarifies where human and environmental samples should be sent for testing during an outbreak in Scotland.

5.2.1. Human Samples

5.2.1.1. Human Samples – Service Provision

Currently all NHS Diagnostic Laboratories in Scotland are accredited to receive human samples:

- Respiratory secretions for culture
- Urine for antigen detection
- Serum for antibody
- Diagnostic laboratories should forward specimens to the Reference Laboratory for additional testing when appropriate as indicated in Section 5.1.1.

5.2.1.2. Human Samples – Laboratory Capacity

Laboratory capacity for patient specimens is unlikely to present a problem unless a very large outbreak occurs.

5.2.1.3. Human Samples – Accreditation

NHS Diagnostic Laboratories are required to be accredited by CPA (UK) Ltd.

5.2.2. Samples from Water Systems

Paragraph 188 of *The HSE Approved Code of Practice and Guidance on The Control of Legionella Bacteria in Water Systems – L8* states that:

“Analysis of water samples for *Legionella* should be carried out by a UKAS accredited laboratory, which takes part in the HPA Water Microbiology External Quality Assessment Scheme for the Isolation of *Legionella* from Water. The interpretation of any results should be carried out by experienced microbiologists.”

5.2.2.1. Samples of Water Systems – Service Provision

Currently (March 2009) four public service laboratories in Scotland are UKAS accredited to carry out *Legionella* analysis:

- NHS Grampian Microbiology Laboratory - Aberdeen Royal Infirmary
- Dundee City Council – Tayside Scientific Services
- Edinburgh City Council – Public Analyst Services
- Glasgow City Council – Public Analyst Services

The laboratories have the **capability to process water and biofilm (swab) samples** taken from environmental sources implicated in an outbreak of Legionnaires' disease.

The main techniques used in the processing of environmental samples are **concentration of the sample** followed by **conventional culture onto agar plates** which are selective for *Legionella* species. The methods used in the laboratories are based on International Standard methods for the detection of *Legionella* bacteria (ISO, 1998).

Suspect *Legionella* isolates are then broadly grouped into 1 of 3 groupings: *Legionella pneumophila* serogroup 1, *Legionella pneumophila* serogroups 2-14 or *Legionella* species. Further work is then carried out by the Scottish *Legionella* Reference Laboratory to enable matching of the environmental isolates of *Legionella* with isolates from human cases.

5.2.2.2. Samples of Water Systems – Laboratory Capacity

Following contact with respective laboratories each facility advises it can process approximately 25–50 water and/or water systems samples per day depending on the type of sample submitted.

There is a good geographical split across Scotland in terms of access to laboratory facilities and the aggregated capacity ranges from 100 to 200 samples per day therefore should be possible to meet the demands of one or more ICT/OCTs running concurrently.

6. Risk Assessment (Risk to Public Health)

6.1 Introduction

Risk is defined as the probability of a problem occurring, and the damage it would cause if such an event occurs.

- **In an outbreak of Legionellosis**, we should ask:

What is the likelihood of a population continuing to be exposed to Legionella and what is the impact on their health?

- Answering this question requires an assessment of the risks to public health
- This exercise should be derived from interpreting the collated findings from the epidemiological, microbiological and water systems investigations and reflecting on how these compare to the findings from previous similar episodes
- The assessment will guide the definition and prioritisation of control measures and what to communicate to the public, especially those who may have been or could continue to be put at risk. It will provide a framework for evaluating the impact of control measures and identifying whether the risks to health could recur.

6.2 Process

The risk assessment process will consider the following three STEPS:

STEP 1 - Identifying the hazard

- **Identification of the organism:** In general terms, *Legionella pneumophila* serogroup 1 causes over 90% of the human disease, Legionellosis, in the UK. It is not greatly infective (probability) but does have a significant case fatality ratio associated with infection (severity)
 - It is important to have knowledge of its ability to survive in different environments, its infectivity and pathogenicity. Specialist advice with regards to *Legionella* (Appendix 2) should be sought from the reference laboratory.
- **Identifying and characterising the likely or definitive source(s) of exposure to Legionella**
 - The location and nature of any producer of an aerosol which the findings from investigation indicate may have been the source
 - The scale of aerosol production

- The level of contamination of an actual or putative source of a water system with *Legionella*
- The likely cause of contamination
- The periodicity and timing of production of a contaminated aerosol i.e. is it or has it been continuous?; is it possible to identify an event which may have led to the contamination e.g. disruption of control measures?
- **Identifying the route and nature of any likely or definitive exposure to *Legionella***
 - The nature of any plume of aerosols produced by a likely source
 - The factors likely to have influenced its dispersion e.g. prevailing wind, climatic conditions
 - The probable extent of its dispersion and the relationship this has to the spatial distribution of cases during the incubation period of their illness.

STEP 2 - Identifying the population at risk

- **Defining the population from which cases have arisen and who may have been or are likely to continue to be exposed to *Legionella***
 - The number of persons involved
 - Their location (place) e.g. whether this is a workplace, institution, place of residence
 - The time during which the population at risk has likely been exposed
 - Their level of susceptibility e.g. age, underlying medical conditions, lifestyle or other risk factors
 - Defining the likely perception of risk and any factors likely to allay or amplify anxiety.

STEP 3 – Evaluate, Reduce risk and Protect

- **Formulating the hypothesis of risk and summary statement**

The key conclusions from the previous steps should be collated and any interrelationships defined. This will enable the development, evaluation and refinement of a hypothesis of risk. In this process, a particular question will help: is there evidence that the exposure has ceased or is it likely to be ongoing?

- **Estimating the potential for risk reduction**

- The capability and commitment of those responsible for any putative source to put in place any risk reduction measures required (considering best practice and legal requirements)
- The likelihood of these being fully implemented and effective.

- **Implementing control and prevention measures** (See section 8)

- **Communicating risk** (See section 7)

- **Recording** (See section 9).

7. Communication

7.1. Legionnaires' Disease: a Notifiable Disease

In Scotland, the list of notifiable diseases is captured in Part 2 and Schedule 1 of the Public Health etc. (Scotland) Act 2008, available at <http://www.opsi.gov.uk/>

Outbreak with international implications

- In Europe, a notification and surveillance scheme has been developed to facilitate detection and investigation of travel-associated infections (EWGLINET, 2003). When a case is confirmed for *Legionella* infection, HPS is notified and the case is also notified to EWGLI.
- The International Health Regulations (IHR) (WHO, 2005) are designed to provide security against the international spread of infectious diseases.
- Although Legionellosis is not incorporated into the lists of diseases in the IHR (WHO, 2005), any disease event that meets the criteria described in the Regulations (serious public health impact, unexpected, likely to spread internationally or likely to result in travel or trade restrictions) must be notified to WHO following the inception of the IHR (2005) in June 2007.

Further details on legal aspects of privacy and confidentiality versus public protection are given in Appendix 8.

7.2. Information Disclosure and Dissemination

- Procedures for disseminating information from the outbreak investigation should be agreed in advance, so that all relevant professionals are aware of the latest findings and developments in the investigation.
- All members of the ICT/OCT should be available and informed promptly of any relevant progress of the investigations and informed through regular meetings and/or teleconferences.
- When results of laboratory findings are being released, or testing of specimens is being requested, the channels of communication should be made clear, so that the appropriate professionals are informed appropriately. Normally, the ICT/OCT chairperson will receive the results of all diagnostic tests and forward them to the relevant members of the ICT/OCT.

Communication strategy should cover:

- Intra and inter agency communications
- Communications with the public
- Media coverage.

Media coverage

- A media spokesperson or a single member of the team should be designated to speak to the media and ensure consistency. A pre-approved press statement is recommended.
- Occasionally, the media can be used to help find cases and protect public health by providing advice. Questions and answers could be available on the internet for the public and the media. See examples of information on *Legionella* for the public at

<http://www.fitfortravel.nhs.uk/advice/diseases/respiratoryinfections.htm>

http://www.cdc.gov/ncidod/dbmd/diseaseinfo/Legionellosis_g.htm

Further guidance on Risk Communication can be found at:

- HPS website <http://www.hps.scot.nhs.uk/pubs/index.aspx> and or at HPN website <http://www.hps.scot.nhs.uk/about/publications.aspx>
- Scottish Government Health Department, Managing Incidents Presenting Actual or Potential Risk to the Public Health – Guidance on the Roles and Responsibilities of Incident Control Teams (2003).

<http://www.scottishexecutive.gov.uk/Resource/Doc/47021/0013914.pdf>

- Department of Health (1998), Communicating About Risks to Public Health - Pointers to Good Practice, London, UK, TSO. (This document offers insights from well-established material and provides pointers to good practice for communicating effectively about risks.)

http://www.dh.gov.uk/prod_consum_dh/groups/dh_digitalassets/@dh/@en/documents/digitalasset/dh_4039670.pdf

8. Control

This chapter deals with control measures as part of the management of an incident or an outbreak in relation to eliminating the source of exposure to *Legionella*, which may include stopping a process or system. The chapter also covers the conditions required for the re-starting of such processes or systems.

8.1. Control of the Putative Source(s) of *Legionella*

8.1.1. General Action

The following actions will form the basis of an outbreak investigation. Actual practices may vary depending on the circumstances, e.g. the approach may change where the outbreak is associated with single premises rather than with a group of premises. The same approach may be used where there is a single case.

8.1.2. Response During an Outbreak

- HSE and/or the Local Authority should seek to visit all relevant premises within the “outbreak” zone which are putative sources of *Legionella*. Local knowledge of premises and processes will be used to assist in prioritisation. There will be an initial phase where the purpose is to deal with immediate issues and eliminate the risk to people and minimise the potential for further infection. Inspections will follow normal procedures, although very rapid assessments and decisions will be made on actions. The nature of action taken will be in accordance with HSE or Local Authorities Enforcement Policy.
- In the second phase, HSE and/or Local Authority activity will focus more on compliance with legislation (i.e. COSHH Regulations 2002 (as amended) and ACoP (L8)). Further action may be taken where there are clear failures to comply with relevant legislation or significant risks still exist. The type of action taken and the formal issuing on any enforcement notices would depend on the exact nature of the circumstances and conditions. Some situations may lead the serving of a Prohibition Notice. Notices would be served in accordance with HSE or LA's enforcement policy. Organisations may also decide to stop processes voluntarily or cease activities.

8.1.3. Specialist Support

Where required, both HSE field officers and LA EHOs may call on specialised advice from HSE Specialist Inspectors to assist in risk assessment of operations and activities within suspected premises. This specialist support is particularly relevant both for identifying potential sources of *Legionella* bacteria and advising on the activity, process etc. requiring formal action to reduce the risk to the community.

8.1.4. Specific Local Authority Action

LA EHO's have a dual public health and health and safety enforcement role within an ICT/OCT. In addition to visiting/inspecting Local Authority enforced premises within the "outbreak" zone, EHOs may also visit HSE enforced premises on the instruction of the ICT/OCT.

These visits will be part of the investigation to identify probable sources of *Legionella* as part of a Risk Assessment Programme. If these visits are agreed within the ICT/OCT, early notification to the HSE must be undertaken. However as it is recommended in Section 2.1.4.1 that HSE is invited to the initial ICT/OCT meeting, these visits should only occur on rare occasions.

8.1.5. Other Legislation

In addition to H&S legislation the EHO has other powers under the Public Health etc. (Scotland) Act 2008 and Nuisance procedure under Section 79(1) of the Environmental Protection Act 1990. These powers can be applied to all premises whether enforced under the HSE or LA in terms of the HASAWA 1974.

It is recommended that every effort should be made by the LA to advise the HSE of their intention to use such powers in order to allow the HSE to participate in the process and where possible offer to utilise their powers if appropriate. Independent action should only be taken if directed by the OCT in the interest of controlling the outbreak.

8.1.6. Criteria for Control

Each premises and process should be identified as possible sources of *Legionella* bacteria. This must be considered within each situation, as set out in ACoP (L8). These are well established standards and set the bench marks. Where there are risks to health and/or there is non-compliance with these standards, action will be taken to eliminate the risks and secure compliance. The actions taken will be in line with HSE's and/or Local Authorities enforcement policy.

In relation to nosocomial infections – consider healthcare settings, hospitals, nursing homes, etc. –, please refer to hospital plans.

8.2. Re-starting of a Process or System Considered a Putative Source of *Legionella*

8.2.1. General Action

The following actions apply to both HSE and Local Authority controlled premises. The actions will apply following an outbreak of LD but are also relevant for and may also apply where there is a single case.

8.2.2. Response During an Incident or an Outbreak

HSE and/or Local Authority activity will initially seek to eliminate the risk to people and focus on compliance with legislation (i.e. COSHH Regulations and ACoP (L8)). Where the risk has been significant or there have been clear failures to comply with relevant legislation, enforcement action will have been taken in order to control the risk of further cases of LD, to allay public concern and to ensure future compliance. This action can include stopping process and systems, which may lead to closure or partial closure of premises.

Restarting a process will only be allowed once the system has been adequately cleaned and disinfected, suitable treatment and monitoring programmes are in place. The results of monitoring must be reviewed to establish the effectiveness of the cleaning and treatment regime, and/or the need for further cleaning and disinfection.

8.2.3. Main Control Methods For Treating/Managing Water Systems

The following control methods mostly apply to hot and cold (H&C) systems and only suggest control methods available. Their indications and relevance for specific systems and cooling towers should be qualified at individual basis.

- Thermal disinfection: High temperature and/or flush – The temperature of the water leaving the calorifier should be sufficient to maintain > 60°C throughout the system for at least an hour. Each tap must be run sequentially for at least 5 minutes and the temperature measured (ACoP (L8)). Problems include risk of scalding, inability to flush whole system at once (dead legs).
- Biocide treatment: Chemical disinfection using oxidising biocides (such as chlorine or bromine solutions) or non-oxidising biocides (NOTE: chlorine gas should **NOT** be used). Problems include limited residence time in solution, taste, local water quality regulations and accelerated system corrosion.

- Ozone treatment: Problems include expense, potentially hazardous, short duration effect and limited range within a system.
- UV treatment at source or at outlet: Problems include cost, can become ineffective due to fouling and have no impact on biofilms within system.
- Copper/Silver ionisation units: Problems include cost, can become ineffective due to fouling and strict local limits on water quality.
- Physical replacement or cleaning of outlet points (taps, aerator units and shower heads), regular use of all outlets and the elimination of dead legs within the system.
- Outlet microbial filtration units however this leaves contamination within system untreated unless used in conjunction with one of the above systems.

8.2.4. Remedial Action

- It is generally agreed that *Legionella* cannot be wholly eradicated from water systems and that continued control can only be achieved by repeated (or continuous) treatment/management of the system as a whole. The effectiveness of these controls can only be assured by adhering to agreed control threshold levels in terms of colony forming units/litre (CFU/L) – table 2 (cooling systems) and table 4 (H&C systems) of the ACoP (L8). Current UK standards set out in table 4 of the ACoP (L8) are to maintain a level of <1000 CFU/L at all times and to aim for a stable control threshold of <100 CFU/L. This is the desired control methodology as specified in the current ACoP (L8).
- All of the above options can eradicate *Legionella* in the *in vitro* state (in laboratory suspension) either by continuous dosing or by a shock treatment. However none of the methods can permanently eradicate *Legionella* from a complete system. One reason for this is that *Legionella* can survive the treatment methods by sheltering inside the scale and biofilm layers which build up inside the pipework of a system. Another explanation is that *Legionella* can survive (and indeed multiply) inside certain species of host amoebae, some of which are very resistant to high temperatures and/or harsh environmental conditions.

- The result is that the water produced by a system following a treatment can initially test negative for *Legionella* but the contamination will return rapidly following recolonization from these “reservoirs”. Some research papers state that the concentration of *Legionella* in the water supplies increases more rapidly and exceeds the pre-existing levels following a treatment. The reason given is that most of the microbes, which would normally compete with *Legionella*, have been removed from the system. There is also evidence that the proportions of certain strains of *Legionella* increase following a treatment as they are more resistant, (or have a greater affinity with potential treatment resistant host organisms), than other strains.

8.2.5. Re-starting a Process or System Considered a Putative Source of *Legionella*

Once the management of the water system has complied with the standards set out in table 4 of the ACoP (L8), consideration can then be given to re-starting the process or system considered a putative source of *Legionella*. If there is sufficient confidence in the management controls being applied to the system, consideration could be given to opening the premises based on colony counts within the water with the proviso that regular monitoring must be carried out to confirm the standards set out in table 4 of the ACoP (L8).

- Therefore the eradication of *Legionella* from a system is not possible and control of contamination (as set out above) **within the water contained in the system, is the only realistic option.**

9. Reporting

Incident and outbreak control management plans and procedures need to be reported and documented by the ICT/OCT.

The ICT/OCT should also produce a final report for dissemination to:

- Members of the team
- The Chief Medical Officer (CMO)
- The Chief Executive of the NHS Board or Boards where the outbreak took place
- Any other relevant stakeholders and participating agencies.

9.1. Reporting Documents

The scope and nature of records and documentation should be identified, as should minimum retention times.

Requirements for documentation and record keeping should be considered.

Reports required include:

- Executive summary
- Overview of the outbreak: definition of cases, chronology of events
- Management progress – personnel involved, OCT, clear statements of responsibilities
- Investigation of the outbreak
- Control measures
- Communication with media and public
- Lessons learned
- Appendices
- Details of building assessment
- Plans of water systems (if available)
- Details of system assessment
- Monitoring plans
- Results of monitoring, verification, inspections, investigations and any associated remedial action.

List of Appendices

- Appendix 1** Guideline Development Process
 - Membership of the Guideline Development Group
 - Editorial Group

- Appendix 2** Background – *Legionella* and Legionellosis

- Appendix 3** Epidemiology of Legionellosis in Scotland

- Appendix 4** ICT/OCT Membership and Meetings Agenda

- Appendix 5** Epidemiological Investigation Form

- Appendix 6** Hypothesis Generating Questionnaire

- Appendix 7** Laboratory Tests for *Legionella* and Legionellosis

- Appendix 8** Privacy and Confidentiality Versus Public Protection

Appendix 1

Development of the guideline

This guideline represents the view of a multidisciplinary group convened in Scotland for this purpose in 2006, and working together for the course of two years. Under the auspices of the Health Protection Network (HPN), the guideline development group (GDG) followed a systematic development framework proposed by the HPN (see page 51), in line with the principles of SIGN methodology.

Recommendations given in this guideline resulted after careful review and consideration of the evidence available, current legislation and principles of best practice. The evidence base for this guideline was synthesised from that collated using an explicit search strategy devised by the Editorial Group, SIGN information officers and members of the GDG. The search covered MEDLINE, EMBASE, CINAHL and various Environmental Health databases, meta-search engines, and internet, from 1990 to Dec 2006.

The evidence base was updated during the course of development of the guideline, and the search was supplemented by reviewing references and key guidelines identified from WHO, CDC, EWGLINET, Eurosurveillance, the European Union, and from personal databases of the guideline development group members. Further details on the search strategy can be requested from HPS – contact found through the HPN website

<http://www.hps.scot.nhs.uk/about/contactus.aspx>

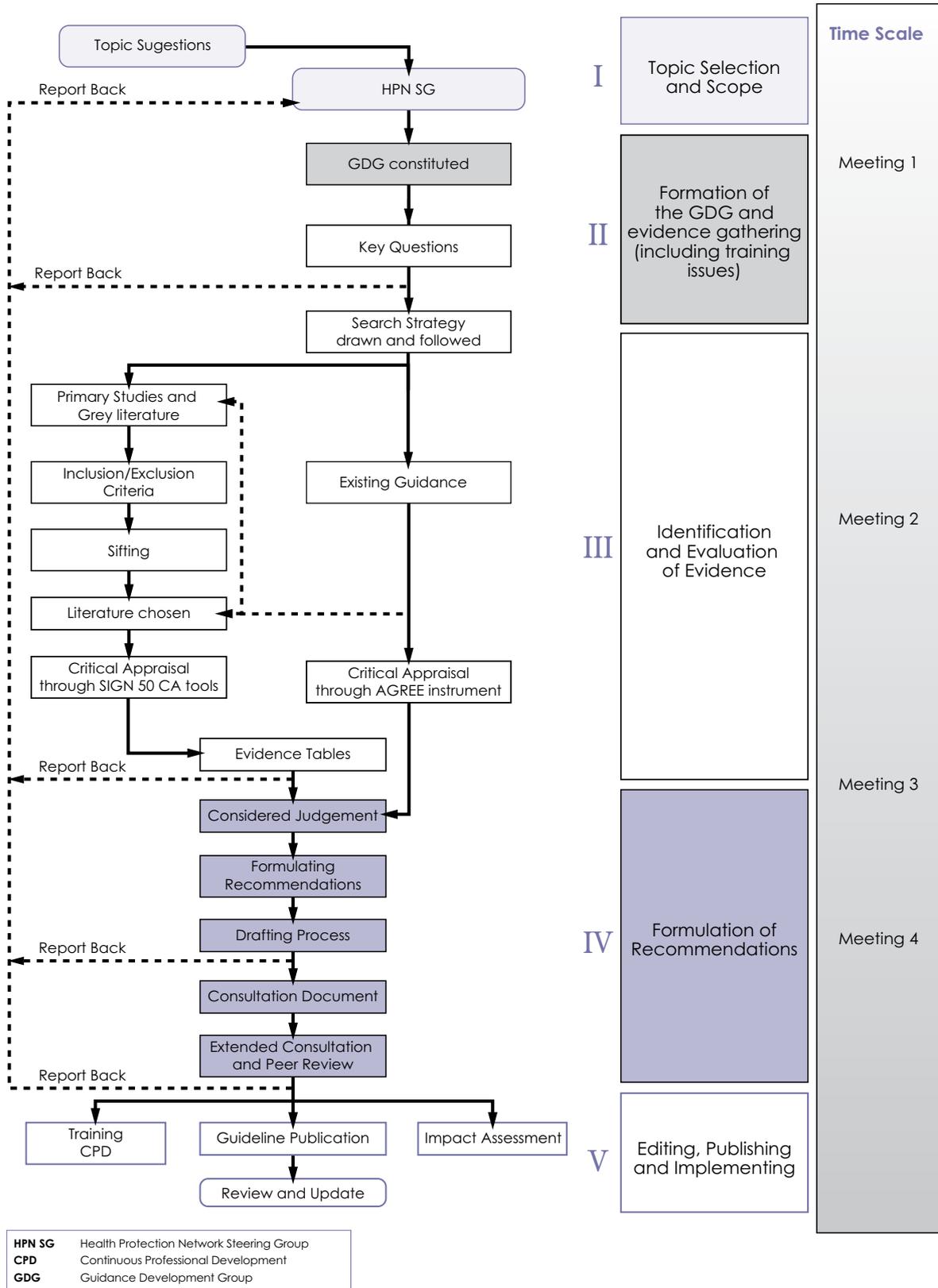
The GDG appraised the literature available, using the SIGN 50ⁱ appraisal tools. The GDG found that the conventional grading systems available do not correspond to the range of literature and evidence supporting this document. As a result of this, it was unanimously decided not to grade the recommendations given in the guideline. Reference to supportive evidence has been given, though, where relevant literature was found.

Professionals involved in the investigation and management of *Legionella* incidents, outbreaks and clusters, in Scotland, are expected to take this guideline fully into account when exercising their professional judgment. The guidance does not, however, override the individual responsibility of professionals to make decisions appropriate to the circumstances of the individual incidents and cases, in consultation with partner agencies and stakeholders.

Implementation of this guidance is the responsibility of the health protection community across Scotland. Professionals are reminded that it is their responsibility to implement the guidance, in their local context, in light of their duties to avoid unlawful discrimination and to have regard to promoting equality of opportunity. Nothing in this guidance should be interpreted in a way which would be inconsistent with compliance with those duties.

i <http://www.sign.ac.uk/guidelines/fulltext/50/index.html>

HPN/HPS Guidance Development Framework



Membership of the Guideline Development Group

The membership of the guideline development group (GDG) was confirmed following consultation with the health protection community in Scotland. Health Protection Scotland (HPS) holds further details on membership and declaration of interests.

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Operations Manager, EH, Argyll and Bute Council, on behalf of the Society of
Chief Officers of Environmental Health (SoCOEH)

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CPHM, NHS Greater Glasgow and Clyde

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Epidemiologist, Travel Health, HPS

Simone Thorn

Health Protection Nurse Specialist (HPNS), on behalf of the Health Protection
Team, NHS Lothian

Appendix 2

Background. *Legionella* and Legionellosis

I. Disease Description and Causative Organism

The term Legionellosis groups a collection of infections, first recognised in 1976, caused by the *Legionella pneumophila* and related *Legionella* bacteria which are distributed widely in both natural and artificial water environments.

The causative organism, usually *Legionella pneumophila*, is an opportunistic human pathogen and fastidious gram-negative bacterium. The number of species, subspecies and serogroups of *Legionellae* continues to increase, as 70% of human infections are caused by *L. pneumophila* serogroup 1; 20-30% by other serogroups; and 5-10% by non-pneumophila species (WHO, 2007).

Legionellae are found in natural water environments such as rivers, reservoirs etc. and are usually only in low numbers. It is within artificial water systems within buildings, cooling towers, and heat exchangers that problems can arise.

Bacteria's presence, survival and subsequent growth in these artificial environments will be determined by:

- water temperature;
- presence of other microorganisms;
- and the formation of biofilms.

These factors and the likelihood that a source would cause an infection will be considered in this guideline, as it would help in understanding risk assessment, management of incidents and outbreaks, as well as controlling the bacteria in artificial water systems.

II. Factors Affecting Growth of the Bacteria

II. I. Temperature

Water temperatures in the range of 20-45°C favour growth of *Legionella*, with an optimal temperature range of 32-42°C (Yee RB, Wadowsky RM, 1982).

The bacteria do not appear to multiply below 20°C or above 45°C (Kusnetsov JM, 1996). There is evidence to believe it will not survive above 60°C, and destroyed almost instantly at 70°C (Dennis PJ, Green D, Jones BP, 1984).

Legionella bacteria, however, may survive for long periods in cool water and then proliferate when the temperature increases.

Temperatures may also influence virulence; in such a way that 37°C sets an environment for the bacteria to have greater virulence than at lower temperatures (HSE, 2000).

Control of temperature

- The recommended temperature for storage and distribution of cold water, to prevent *Legionella* infection, is below 25°C, and ideally below 20°C
- Ideally, maintain hot water above 50°C at all outlets after 1 minute
- Avoid water temperatures between 20°C and 45°C to prevent *Legionella* colonisation.

II.II. Other Microorganisms

Legionella bacteria also require the presence of nutrients in the water, and other microorganisms to proliferate. Numerous studies have found that amino acids are the main nutrient requirement for the bacteria to grow (Pine *et al*, 1979; Wadowsky RM, Yee RB (1985)).

Protozoa have been found in sources of Legionellosis, and they have been described as an important vector for the survival and growth of *Legionella* (Quinn FD, Keen MG, Tomkins TA, 1989), as they help to protect the bacteria from the effects of biocides and thermal disinfection (Storey MV, Ashbolt J, Stenstrom TA, 2004). As *Legionella* bacteria can live in encysted amoebal cells, this might help the bacteria to survive adverse environmental conditions (Skinner AR, *et al*, 1983).

II.III. Biofilms

The presence of biofilms on the surfaces of poorly managed water systems in buildings or cooling towers is an important factor for *Legionella* survival and growth in water systems (Goossens H, 2001; Rogers J *et al*, 1994).

As biofilms provide a protective and nutritional environment to microorganisms – like *Legionella* and protozoa – biofilm prevention is an important control measure against growth of *Legionella*. Preventing its formation – more likely in areas of low water flow and where water is allowed to stagnate – is important because, once established, they are difficult to remove.

Factors favouring the likelihood of biofilm formation are the following:

- Warm water
- Low flow or stagnation
- Scale and corrosion
- Nutrients (in the water and in the system)

III. Transmission and Infection

Investigations of disease outbreaks suggest that inhalation of aerosols (droplets of 1-5 micrometers in diameter) of water contaminated with *Legionella* might be the primary mechanism by which these organisms enter the human respiratory system. However, person-to-person transmission has not been observed.

Exposure to contaminated water aerosols or aspiration of contaminated water could potentially cause infection, but the likelihood that a source will cause an infection depends on a series of factors:

- The bacterial load
- The effectiveness of dissemination
- The way in which the bacteria multiplies and its virulence
- Its ability to form aerosols
- Idiosyncrasy of the individual(s) exposed

IV. Clinical Presentation

The severity of Legionellosis is associated with two clinically and epidemiologically distinct conditions that vary from mild febrile illness (Pontiac fever) to a potentially fatal form of pneumonia (Legionnaires' disease).

Legionnaires' disease is clinically described as a progressive pneumonia with a 2 to 10 days incubation period that may be accompanied by cardiac, renal and gastrointestinal involvement.

Although symptoms are often non-specific, several clinical symptoms and signs are classically associated with Legionnaires' disease:

- High fever and chills
- Headache
- Nonproductive dry cough – and sometimes expectoration, which is blood-streaked

- Diarrhoea (25-50% of cases)
- Vomiting and nausea (10-30%)
- Confusion, delirium and other central nervous system manifestations (50%)

Legionnaires' disease can affect anyone, but principally affects those who have a higher susceptibility due to age (usually 65 years or age or older), illness, immunosuppression or other risk factors, such as smoking.

Immunosuppressed patients from organ transplantation or chronic underlying illness, such as haematological malignancy or end-stage renal disease, are at the greatest risk for acquiring Legionnaires' disease and suffering complications and fatalities.

Persons with diabetes mellitus, chronic lung disease, non-haematological malignancy, HIV, the elderly, and persons who smoke are at moderately increased risk.

V. Public Health Interest

The disease is not known to be transmissible via person-to-person contact, but acquired by inhalation of aerosols from sources of infection. Outbreaks of Legionnaires' disease have been reported throughout the world. Numerous citations have appeared in the medical literature describing the link between Legionnaires' disease and potable water or aerosol-generating devices, such as nebulizers, cooling towers, showers, faucets, hot tubs, whirlpools/spas, respiratory therapy equipment, and room-air humidifiers.

Appendix 3

Epidemiology of Legionella in Scotland

Between 1996 and 2006, the incidence of Legionellosis experienced a significant rise in Europe.

The incidence of *Legionella* in Scotland is low, usually around 30 to 40 cases per year, the majority of which are contracted overseas. Thirty-two cases of human Legionellosis were reported by the Scottish *Legionella* Reference Laboratories (SLRL) to Health Protection Scotland (HPS) in 2004, 33 in 2005 and 42 in 2006 (Shakir E, Donaghy M, Abraham B, Johnston F, Edwards G, 2007). This is an increase when compared to the 20, 36 and 29 cases reported in 2001, 2002 and 2003 respectively.

Current annual total cases of Legionellosis in Scotland are shown on the HPS website - <http://www.hps.scot.nhs.uk/Search/default.aspx?search=Legionella>.

Figure 1 shows the annual total cases of Legionellosis reported to HPS from 1995-2006. The annual incidence rate in Scotland was 6.3 cases per million population reported in 2004, 6.4 in 2005 and 8.2 in 2006. The incidence is rising but figures remain relatively low when compared to the rest of Europe.

FIGURE 1: Enhanced surveillance of Legionellosis in Scotland: Annual total of cases reported to HPS 1995-2006

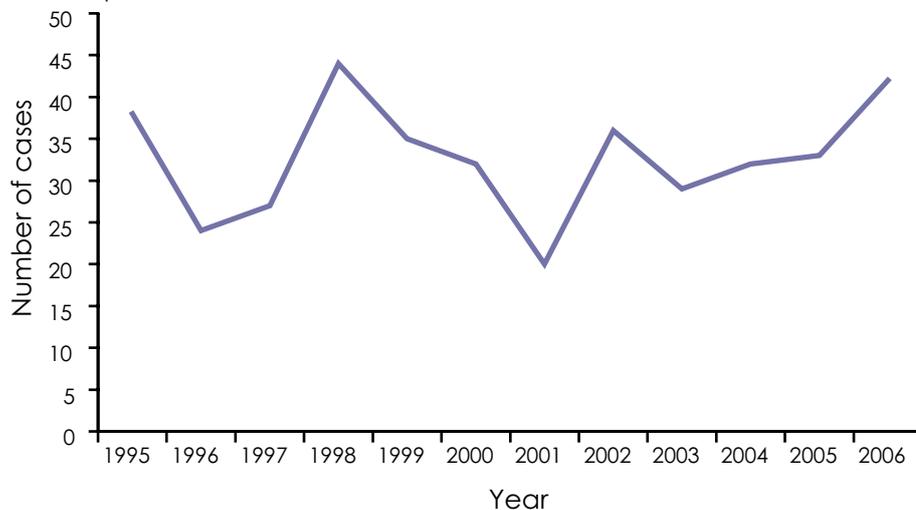


FIGURE 2: Cases of *Legionella* reported to HPS by age group, 1995-2006

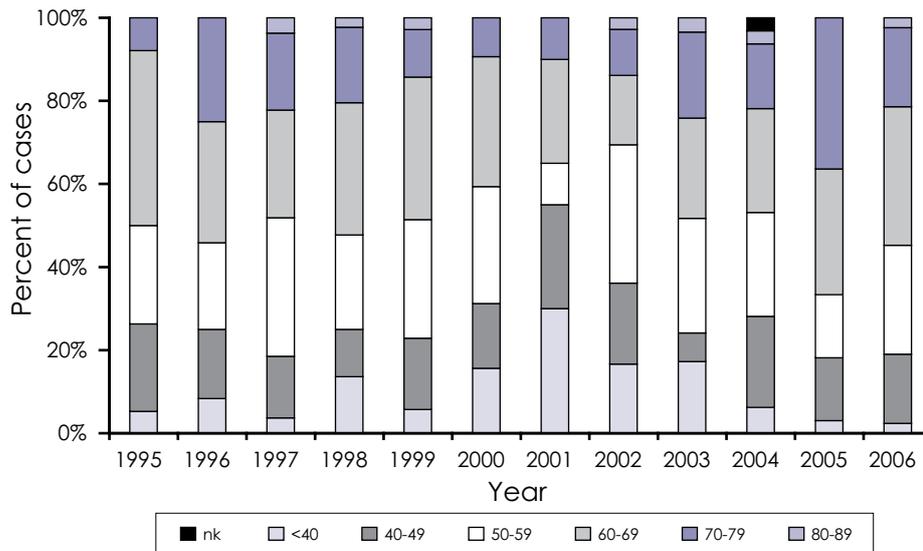
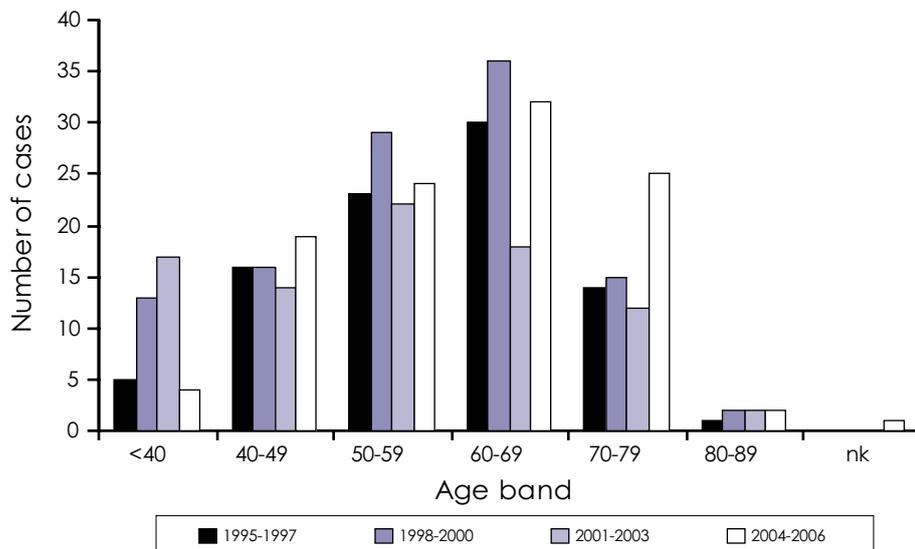


FIGURE 3: Cases of Legionellosis reported to HPS by age band, three-year period 1995-2006



The mean *Legionella* incidence rate for Europe (as provided by EWGLI) was 11.2 per million population in 2006, 10.3 in 2005 and 8.3 in 2004. Therefore the rise in Legionellosis in Scotland is similar to the rise seen across the rest of Europe.

The 2004-2006 three-year mean shows 67.5% (73) cases occurred in males and 32.5% (34) in females which is comparable to the three-year mean of 2001-2003 where 65.1% of cases were male and 34.9% females.

The male to female ratio of cases from 1995 to 2006 reflects the historical predominance of male cases over female cases, and it is apparent for most of the age ranges and especially for those aged under 50 years (all ages 68.2% males, under 50 years rises to 82.6% males from 2004-2006).

Appendix 4

Incident Control Team (ICT) / Outbreak Control Team (OCT) – Membership

An ICT/OCT should include at least the following members:

- Consultant of Public Health Medicine (CPHM), (ICT/OCT Chair)
- Health Protection Scotland
- Reference Laboratory/LA Microbiologist
- Clinician (ideally, involved with the confirmed cases of *Legionella*)
- Health and Safety Executive
- Environmental Health Officer (advised by LA)
- Media spokesperson
- Other members from partner agencies as decided by the ICT/OCT chairperson.

Incident/Outbreak Control Meeting – (Suggestions for an Agenda)

1. Introduction and reminder of “confidentiality”.
2. Declarations of conflicts or vested interests.
3. Minutes of last meeting (if applicable) including review of actions agreed at previous meeting.
4. Incident/outbreak resume/update – risk assessment:
 - 4.1. General situation statement
 - 4.2. Case definition and patient(s) report
 - 4.3. Microbiological report
 - 4.4. Environmental health report – inspection of premises, sampling undertaken
 - 4.5. HSE report – inspection of premises, sampling advised
 - 4.6. Other relative reports.
5. Management of incident/outbreak – risk management:
 - 5.1. Control measures
 - 5.1.1. Closure of premises
 - 5.1.2. Reopening of premises
 - 5.2. Investigation
 - 5.2.1. Inspection
 - 5.2.2. Epidemiological
 - 5.2.3. Microbiological aspects (specimen and resources).
6. Advice to risk communication:
 - a. Premises and related companies in relation to main suspected premises
 - b. Advice to professionals (GPs, hospital doctors, other National Health Service Boards, HPA etc.)
 - c. Media/press
 - d. Agree content of further press statements
 - e. EWGLI (where appropriate)
 - f. Nominate others to assist CPHM in interviews (if required)
 - g. Consider need for Helpline or arrangement for enquiries from the public.
7. Obtain telephone numbers of all key personnel within and outwith hours.
8. Agree actions required and a timetable for action. Identify individuals responsible for delivering actions as agreed.
9. Agree criteria for defining the end of the outbreak.
10. Date and time of next meeting.

Appendix 5

HPS Scottish *Legionella* Surveillance Programme

Objectives of *Legionella* Surveillance in Scotland

- To detect clusters or outbreaks of *legionella* infection in the UK or abroad through the national surveillance of all reported cases in residents of Scotland
- To identify sources of infection so that control measures can be applied to prevent further cases
- To disseminate *legionella* surveillance information to all those who need to know

Please return or fax completed form to:

Dr Martin Donaghy
HPS
Clifton House, Clifton Place
Glasgow G3 7LN
Fax number: 0141 300 1172

REPORT A CASE OF: Legionnaires' Disease or Pontiac Fever or Asymptomatic *Legionella* infection

Name of person completing form:

Job Title: NHS Board: Date:

1. Patient Details

SURNAME: FORENAME(S):

HOME ADDRESS: OCCUPATION:

WORK ADDRESS:

POSTCODE:

DATE OF BIRTH: POSTCODE:

AGE (YEARS): SEX: M F

2. Clinical Details

Date of onset of symptoms: Known or Estimated Smoker Yes No

Did this patient have pneumonia? Yes No Not Known

Main Clinical Features:

Has the patient had a recent organ transplant? Yes No Not Known

Was the patient immunocompromised for other reasons? Yes No Not Known

If YES, please give details:

Please give details of any other underlying condition:

Hospital Name:

Date of admission:

Outcome: Death (Date of death)

Still ill Recovered Not Known

3. Laboratory Details

Reporting Laboratory: Lab No.:

TICK AS APPROPRIATE					
Method of diagnosis [may be >1]	Culture		Serology fourfold rise	Single high titre	Other/ Unknown
	Respiratory antigen		Urinary antigen	PCR	
Organism	<i>L.pneumophila</i> serogroup 1		Other		
If other than <i>L.pneumophila</i> serogroup 1	Legionella species:		Serogroup:		

4. Source of Infection

Was there a suspected source of infection for this individual? Yes No

If yes, was it suspected to be Travel Related Hospital acquired Community acquired

Any potentially associated others who are ill? Yes No Not Known

5. Suspected Travel Case

Did the patient spend any nights away from home (UK or abroad) in the two weeks before onset? Yes No
 If yes please give details:

LOCATION No.	1	2	3	4
Arrival date (dd/mm/yy)				
Departure return date (dd/mm/yy)				
Country				
Region (incl. islands, cruise areas)				
City/town				
Accommodation name and room no. (hotel, place of stay)				
Accommodation type*				
Tour Operator				

*Enter letter: Hotel, Apartment, Private Residence, Campsite, Other/unspecified

Did the patient bathe in a whirlpool/spa?

Yes No Not Known Details: _____
 Any other comments: _____

6. Suspected Community Acquired Case

Were any environmental sources suspected? Yes No
 If yes please give details including time, origin and nature of exposure: _____

In the two weeks before onset of symptoms, did the patient use or spend time near a whirlpool/spa?
 Yes No Not Known If YES, please specify: _____
 Any other comments: _____

7. Suspected Hospital Acquired Case

If the patient stayed in hospital for any time in the two weeks BEFORE the date of onset of symptoms of legionellosis:

Diagnosis on admission: _____
 Date of admission:
 Type of ward or unit in which patient was resident: _____

If the patient was transferred from another hospital, please give details:

Name of hospital transferred from: _____
 Date of stay from: to
 Any other comments: _____

8. Environmental Investigations

With regard to questions 5, 6 and 7, were possible environmental sources investigated? Yes No
 If yes please give details: _____

Was *legionella* detected in any of the suspected environmental sources? Yes No
 If yes please give results: _____

Any other comments: _____

Many thanks for your help.

Appendix 6

Hypothesis Generating Questionnaire and *Legionella* Investigation Form

Date of notification:	<input type="text"/>
Date of interview:	<input type="text"/>
Notified by:	<input type="text"/>
Name of Investigating Officer:	<input type="text"/>
Legionnaires' disease	<input type="checkbox"/>
Pontiac fever	<input type="checkbox"/>
Asymptomatic <i>Legionella</i> infection	<input type="checkbox"/>
Confirmed	<input type="checkbox"/>
Presumptive	<input type="checkbox"/>

Confirmed cases*

An acute lower respiratory infection with focal signs of pneumonia on clinical examination and/or radiological evidence of pneumonia and one or more of the following:

- Isolation of any *Legionella* organism from respiratory secretion, lung tissue or blood.
- A fourfold or greater rise in specific serum antibody titre *L. pneumophila* sg 1.
- The detection of specific *Legionella* antigen in urine using validated reagents recommended by EWGLI in 1998.

Presumptive cases

An acute lower respiratory infection with focal signs of pneumonia on clinical examination and/or radiological evidence of pneumonia and one or more of the following:

- A fourfold or greater rise in specific serum antibody titre to *L. pneumophila* other serogroups or other *Legionella* species.
- A single high titre* in specific serum antibody to *L. pneumophila* sg 1 or other serogroups or other *Legionella* species.
- The detection of specific *Legionella* antigen in respiratory secretion or direct fluorescent antibody (DFA) staining of the organism in respiratory secretion or lung tissue using evaluated monoclonal reagents.
- The detection of *Legionella* specific DNA by polymerase chain reaction (PCR)

* **A single high serological titre:** as differing serological testing methods are used in different countries, and as an internationally accepted validation exercise has not been carried out, no specific serological test or titre level can be specified. It is suggested however that the single high titre result considered to indicate recent *Legionella* infection, in the presence of compatible symptoms, be set at a sufficiently high level to be specific for *Legionella* infection (i.e. to produce a low level of false positives).

Legionella Investigation Form

Case details

Surname:

Forename(s):

Date of Birth:

Age:

Sex:

Address:

Postcode:

Telephone:

Email:

Name of GP:

Telephone:

Address:

:

Admitted to hospital: Yes No

If yes, name of hospital/ward:

Date of admission:

Outcome: Death (date of death)

Still ill Recovered Not known

Smoker: Yes No

Immunocompromised: Yes No

Occupation:

Employer:

1. Did you experience any of the following symptoms? If yes, please give approximate date of onset.

Headache	Yes <input type="checkbox"/>	No <input type="checkbox"/>	<table border="1" style="display: inline-table; border-collapse: collapse;"> <tr> <td style="width: 20px; height: 20px; text-align: center;">D</td> <td style="width: 20px; height: 20px; text-align: center;">D</td> <td style="width: 20px; height: 20px; text-align: center;">M</td> <td style="width: 20px; height: 20px; text-align: center;">M</td> <td style="width: 20px; height: 20px; text-align: center;">Y</td> <td style="width: 20px; height: 20px; text-align: center;">Y</td> </tr> </table>	D	D	M	M	Y	Y
D	D	M	M	Y	Y				
Diarrhoea	Yes <input type="checkbox"/>	No <input type="checkbox"/>	<table border="1" style="display: inline-table; border-collapse: collapse;"> <tr> <td style="width: 20px; height: 20px; text-align: center;">D</td> <td style="width: 20px; height: 20px; text-align: center;">D</td> <td style="width: 20px; height: 20px; text-align: center;">M</td> <td style="width: 20px; height: 20px; text-align: center;">M</td> <td style="width: 20px; height: 20px; text-align: center;">Y</td> <td style="width: 20px; height: 20px; text-align: center;">Y</td> </tr> </table>	D	D	M	M	Y	Y
D	D	M	M	Y	Y				
Fever	Yes <input type="checkbox"/>	No <input type="checkbox"/>	<table border="1" style="display: inline-table; border-collapse: collapse;"> <tr> <td style="width: 20px; height: 20px; text-align: center;">D</td> <td style="width: 20px; height: 20px; text-align: center;">D</td> <td style="width: 20px; height: 20px; text-align: center;">M</td> <td style="width: 20px; height: 20px; text-align: center;">M</td> <td style="width: 20px; height: 20px; text-align: center;">Y</td> <td style="width: 20px; height: 20px; text-align: center;">Y</td> </tr> </table>	D	D	M	M	Y	Y
D	D	M	M	Y	Y				
Dry Cough	Yes <input type="checkbox"/>	No <input type="checkbox"/>	<table border="1" style="display: inline-table; border-collapse: collapse;"> <tr> <td style="width: 20px; height: 20px; text-align: center;">D</td> <td style="width: 20px; height: 20px; text-align: center;">D</td> <td style="width: 20px; height: 20px; text-align: center;">M</td> <td style="width: 20px; height: 20px; text-align: center;">M</td> <td style="width: 20px; height: 20px; text-align: center;">Y</td> <td style="width: 20px; height: 20px; text-align: center;">Y</td> </tr> </table>	D	D	M	M	Y	Y
D	D	M	M	Y	Y				
Muscle pain	Yes <input type="checkbox"/>	No <input type="checkbox"/>	<table border="1" style="display: inline-table; border-collapse: collapse;"> <tr> <td style="width: 20px; height: 20px; text-align: center;">D</td> <td style="width: 20px; height: 20px; text-align: center;">D</td> <td style="width: 20px; height: 20px; text-align: center;">M</td> <td style="width: 20px; height: 20px; text-align: center;">M</td> <td style="width: 20px; height: 20px; text-align: center;">Y</td> <td style="width: 20px; height: 20px; text-align: center;">Y</td> </tr> </table>	D	D	M	M	Y	Y
D	D	M	M	Y	Y				
Abdominal pain	Yes <input type="checkbox"/>	No <input type="checkbox"/>	<table border="1" style="display: inline-table; border-collapse: collapse;"> <tr> <td style="width: 20px; height: 20px; text-align: center;">D</td> <td style="width: 20px; height: 20px; text-align: center;">D</td> <td style="width: 20px; height: 20px; text-align: center;">M</td> <td style="width: 20px; height: 20px; text-align: center;">M</td> <td style="width: 20px; height: 20px; text-align: center;">Y</td> <td style="width: 20px; height: 20px; text-align: center;">Y</td> </tr> </table>	D	D	M	M	Y	Y
D	D	M	M	Y	Y				

2a. Did you travel outwith your permanent/habitual residence in the two weeks before onset of symptoms?

Yes No

2b. Did you have any overnight stays away from your home address in the two weeks before onset of symptoms?

Yes No If yes, please give details in Q3 below.

3. Details within 14 days of onset of illness:

Please complete table for travel within 14 days prior to disease onset: attach extra location details if necessary

LOCATION NO:	1	2	3	4
Arrival Date				
Departure Date				
Country				
Region <i>(including islands, cruise area)</i>				
City/town				
Accommodation name <i>(place of stay)</i>				
Accommodation type*				
Tour operator				
Flight details				

* Enter letter: **H**otel, **A**partment, **P**rivate Residence, **C**ampsite, **O**ther (specify)

4. Other persons with possibly associated illness (See symptom list in Q1 above):

Name	Sex	DOB	Relationship	Occupation	Date of Onset

5. Did you visit any hospitals in the two weeks before onset of symptoms?

Yes No If yes, please give details below.

Name of Hospital(s)

6. Did you visit any shopping centres or garden centres in the two weeks before onset of symptoms?

Yes No If yes, please give details below.

Name, location and dates of visit to shopping centre/garden centre(s)

7. Did you use a shower in the two weeks before onset of symptoms?

Yes No If yes, was this at home or elsewhere - please give details below.

8. Did you visit any sports centres or swimming pools in the two weeks before onset of symptoms?

Yes No If yes, please give details below.

Name, location and dates of sports centre/swimming pool(s)

9. Did you use a whirlpool/spa in the two weeks before onset of symptoms?

Yes No

9b. If yes, was this in your home?

Yes No If no, please give details below:

Name & location of whirlpool/spa

10. Did you work with or near any water/water storage systems or cooling towers, in the two weeks before onset of symptoms?

Yes No If yes, please give details below.

11. Did you have a secondary employment or do "homers" in the two weeks before onset of symptoms?

Yes No If yes, please give details below.

12. Did you visit any pubs, hotels, restaurants, discos, theatres etc. in the two weeks before onset of symptoms?

Yes No If yes, please give details below.

13a. Did you do any gardening in the two weeks before onset of symptoms?

Yes No

13b. Did you handle any compost in the two weeks before onset of symptoms?

Yes No

13c. Did you use a pressure hose in the two weeks before onset of symptoms?

Yes No

14a. Have you had any problems with your household water system?

Yes No

14b. Have you recently used any household water systems which have not been in use for over one week, e.g. showers?

Yes No

Further details:

Please discuss press release:

Press release discussed? Yes No

Objections to press release? Yes No

Patient Information leaflet given? Yes No

Appendix 7

Laboratory Tests for Legionella and Legionellosis

- Urinary Antigen Detection
 - Usual diagnostic test (commercial kits)
 - Only reliable for *L. pneumophila* SG 1
 - Available in most Diagnostic Laboratories
 - Reference Laboratory can investigate borderline and confirm positive results
- Serum Antibody Detection by ELISA
 - Secondary diagnostic test
 - Only detects *L. pneumophila* SG1 infection
 - Positives need to be confirmed by IFA
 - May be useful for screening in large outbreaks
 - Available in some Diagnostic Laboratories
- Serum Antibody Detection by IFA (immunofluorescence)
 - Gold standard antibody test
 - All species and serotypes
 - Only available in Reference Laboratory
- Culture from Respiratory Specimens
 - Gold standard diagnostic test if positive (negatives of less value)
 - All species and serotypes
 - Available in most Diagnostic Laboratories
 - Enrichment techniques (used in Ref Lab) improve reliability.
- PCR from Respiratory Specimens
 - Not fully validated
 - Not available in Diagnostic Laboratories
 - Potential for development of typing from culture negative specimens

- Culture (quantitative) from Environmental Specimens
 - Requires UKAS accreditation
 - Reference Lab has expertise but not UKAS accreditation
 - Some Scottish Labs (NHS & Local Authority) have UKAS accreditation
- Environmental Specimens without *Legionella* culture
 - Non-culture *Legionella* detection or total bacterial counts
 - Very limited value when investigating outbreak
- Full identification and typing of *Legionella* isolates
 - Reference Laboratory only
 - Required for clinical and environmental outbreak isolates

Appendix 8

Privacy and Confidentiality Versus Public Protection

Patient health information is collected primarily to provide care for individual patients and it can be used freely for this purpose subject to the constraints set out in the Department of Health code of Confidentiality – Confidentiality: NHS Code of Practice (DH, 2003)ⁱ.

Confidentiality of patient data should be respected at all times. Information on *Legionella* cases received in professional confidence should, therefore, be confined to members of the ICT/OCT and should be referred to without patient identifiers when reports are produced for wider dissemination.

Press releases should also respect the confidentiality of the data on which they are based.

Patient data – e.g. patients with Legionellosis, involved in outbreaks or clusters may be disclosed to an appropriate and secure authority and used for secondary purposes if:

- They have been effectively anonymised
- They are identifiable but required by law – the principal subjects of statute and regulations are potential dangers to society from serious communicable diseases and in the interests of order and justice
- The patients have given explicit consent
- The health professional is satisfied that the patient is aware of the use and has not objected to it and so has effectively provided implied consent
- Advice is sought from the SGHD
- The health professional is satisfied that the legal and professional criteria for disclosure without consent are in the public interest. Advice from the GMC is available, in the case of any doubt.

i http://www.dh.gov.uk/en/Publicationsandstatistics/Publications/PublicationsPolicyAndGuidance/DH_4069253

Sources of confidentiality rights and protections

- Data Protection Act 1998ⁱ
- Human Rights Act 1998ⁱⁱ
- Health and Social Care Act 2001ⁱⁱⁱ
- Professional Standards (GMC)^{iv}
- Policies and Organisational Standards – the Caldicott Guardian Manual (2006)^v, the Department of Health Confidentiality NHS Code of Practice (2003) (DH, 2003)^{vi} and the Scottish Government NHS Code of Practice on Protecting Patient Confidentiality (2003)^{vii}.

Disclosures in the public interest

In the absence of patient consent or anonymisation, any decision as to whether identifiable information is to be shared with third parties must be made on a case by case basis and must be justifiable in the “public interest”. Traditionally, disclosures in the “public interest” based on common law are made where disclosure is essential to prevent a serious and imminent threat to public health, national security, the life of the individual or a third party, or to prevent or detect serious crime.

GMC advice on disclosure in the public interest

“Personal information may be disclosed in the public interest, without patient's consent, and in exceptional circumstances where patients have withheld consent, **where the benefits to an individual or to society of the disclosure outweigh the public and patient's interest in keeping the information confidential**” (GMC, 2004), (emphasis added).

i http://www.opsi.gov.uk/Acts/Acts1998/ukpga_19980029_en_1

ii http://www.opsi.gov.uk/ACTS/acts1998/ukpga_19980042_en_1

iii http://www.opsi.gov.uk/Acts/acts2001/ukpga_20010015_en_1

iv <http://www.gmc-uk.org/>

v http://www.connectingforhealth.nhs.uk/systemsandservices/infogov/caldicott/caldresources/guidance/caldicott_2006.pdf

vi http://www.dh.gov.uk/en/Publicationsandstatistics/Publications/PublicationsPolicyAndGuidance/DH_4069253

vii http://www.elib.scot.nhs.uk/SharedSpace/ig/Uploads/2008/Oct/20081002150659_6074NHSCode.pdf

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