Public Health England

Legionnaires' disease in England and Wales
2012

Citation
This report from Public Health England evaluates and summarises data analysed from cases of Legionellosis reported to the National Surveillance Scheme for Legionnaires' disease in residents of England and Wales with onset of symptoms in 2012.

About Public Health England

Public Health England's mission is to protect and improve the nation's health and to address inequalities through working with national and local government, the NHS, industry and the voluntary and community sector. PHE is an operationally autonomous executive agency of the Department of Health.

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Summary

In 2012, 309 cases of Legionnaires' disease (confirmed and presumptive) were reported.

Of the 306 confirmed cases of Legionnaires' disease reported in 2012, 218 (71.2%) were male and 88 (28.8%) were female, giving a male to female ratio of 2.47.

Only 38 (12.4%) of the 306 reported cases of Legionnaires' disease were in people under 50 years of age.

Over the three year period 2010 – 2012, the incidence rate for England and Wales was 5.33 per million population (pmp). The peak incidence was in the areas covered by East Midlands PHE Centre (7.72 pmp), the West Midlands (6.54 pmp) and Avon, Gloucestershire and Wiltshire PHE Centre (6.23 pmp).

Of the 306 confirmed cases of Legionnaires' disease, 168 (54.9%) cases were considered to have been exposed to the infecting organism in the community, 127(41.5%) cases were associated with travel abroad and 11 (3.6%) were considered to have links to a healthcare facility (nosocomial).

At least one underlying condition/risk factor was found in 193 (63.1%) confirmed cases of Legionnaires' disease; with heart disease being the most frequently reported underlying condition.

Mortality analysis over the period 2003 to 2012 suggests there has been no improvement to the death rate. A high level of mortality remains among individuals diagnosed with Legionnaires' disease.

The number of cases where polymerase chain reaction (PCR) testing has been carried out continues to rise, with 18.3% of cases tested by PCR during 2012. Conversely, serological testing is reducing and for the first time no cases were tested through this method.

The two most common *Legionella pneumophila* serogroup 1 subtypes were ST1 and ST47.

Although the number of clusters/outbreaks of Legionnaires' disease affecting England and Wales residents was the same as 2011 (16 clusters/outbreaks), the number of cases involved was much higher: 38 cases in 2011 compared to 80 in 2012.

There were 127 cases of Legionnaires' disease in residents of England and Wales associated with travel abroad. The greatest number of cases where Legionnaires' disease was thought to have been acquired abroad was in individuals travelling to Spain: 41 cases in 2012. However, the country with the highest rate of cases per million visits by UK residents was Thailand with 10.37cases per million visits.

Introduction

Legionnaires' disease is a severe but uncommon form of pneumonia associated with exposure to water systems (natural or man-made) colonised by legionella bacteria. This report presents the epidemiological data on reported cases of Legionnaires' disease whose symptoms started during 2012 and who were residents of England and Wales. Comparative data from previous years are included where appropriate. The data presented in this report are collected by local Health Protection Teams (HPTs) in Public Health England Centres, then collated and verified by the National Surveillance Scheme for Legionnaires' disease, managed at Public Health England (PHE), Centre for Infectious Disease Surveillance and Control (CIDSC), Colindale, London.

Prevention and control of Legionellosis

Legionellosis is the generic term used to describe human infection with the bacteria *Legionella pneumophila* or any other *Legionella* species. Infection by the organism can cause two syndromes of note: Legionnaires' disease [1,2], characterised by a severe, potentially fatal, form of pneumonia and Pontiac fever [3], a non-fatal, mild, self-limiting, influenza-like illness. Background information on these two conditions can be found in previous reports [4]. A third atypical form of the disease is characterised by symptoms similar to those of Legionnaires' disease but with the absence of pneumonia is termed non-pneumonic Legionellosis.

Legionella infections only occur through direct exposure to aerosols/droplets from an environmental source colonised by the legionella bacteria – there are no reported or documented cases of Legionnaires' disease associated with person to person transmission. Legionella grows in warm, stagnant water in natural and artificial water systems, in particular cooling towers, evaporative condensers, hot and cold water systems and spa pools. These environments, as well as being ideal for growth, may also provide the means by which aerosols/droplets are generated and disperse the organism into the atmosphere.

Regulation of man-made water systems aims to prevent and/or control the risk of Legionnaires' disease by limiting the environmental factors that support the growth and dissemination of legionella and the exposure of susceptible hosts to this organism. Systems should be designed to avoid stagnation, regulate cold and hot water temperatures, minimise the generation of aerosols/droplets and where appropriate, conduct regular disinfection [5]. A colonised water system which is not appropriately managed can operate as the source of major outbreaks of Legionnaires' disease similar to those that occurred in Murcia in Spain (2001) [6], Barrow-in-Furness (2002) [7] and the outbreak associated with the BBC (1988) [8].

The National Surveillance Scheme

Enhanced Legionnaires' disease surveillance data has been collected in England and Wales since 1980. It is maintained and managed by the Legionella Section, Respiratory Diseases Department, Colindale, in order to:

- identify clusters and issue alerts to HPTs
- support the management and control of outbreaks and incidents
- monitor trends over time
- identify risk group and categories
- operate as the national collaborating centre for ECDC to report travel-associated cased of Legionnaires' disease to the European Legionnaires' disease Surveillance Network (ELDSNet) and follow up cases linked to accommodation sites in England and Wales.
- issue alerts on possible travel-associated clusters in other countries
- validate and assure the quality of the data submitted to the scheme

The National Surveillance Scheme is also responsible for the following outputs:

- local and regional datasets to support investigations, outbreaks, and research
- monthly legionella reports
- annual datasets for legionella
- annual statistics for the World Health Organisation and the European Surveillance System (TESSy) operated by ECDC

Methodology

All data presented in this report were extracted from the National Surveillance Scheme database for Legionnaires' disease covering residents of England and Wales. The majority of confirmed and suspected cases were reported to the National Surveillance Scheme by local health protection teams (HPTs) in England and in Wales. Some cases were reported by the Bacteriology Reference Laboratory (formerly the Respiratory and Systemic Infection Laboratory), the national reference laboratory, at Public Health England, Colindale.

Case definition – confirmed case of Legionnaires' disease

- A clinical or radiological diagnosis of pneumonia with laboratory evidence of one or more of the following:
  - isolation (culture) of legionella species from clinical specimens;
  - the presence of *L. pneumophila* urinary antigen determined using validated reagents/kits;

Case definition – presumptive case of Legionnaires' diseases

- A clinical or radiological diagnosis of pneumonia with laboratory evidence of one or more of the following:
  - detection of *Legionella* spp. nucleic acid (eg PCR) in a clinical specimen;
  - a positive direct fluorescence (DFA) on a clinical specimen using validated *L. pneumophila* monoclonal antibodies (also

referred to as a positive result by Direct Immunofluorescence (DIF);

Population data was used from the Office of National Statistics mid-2011 population estimates. Statistical analysis was carried out using STATA 12.

Descriptive epidemiology

Legionellosis

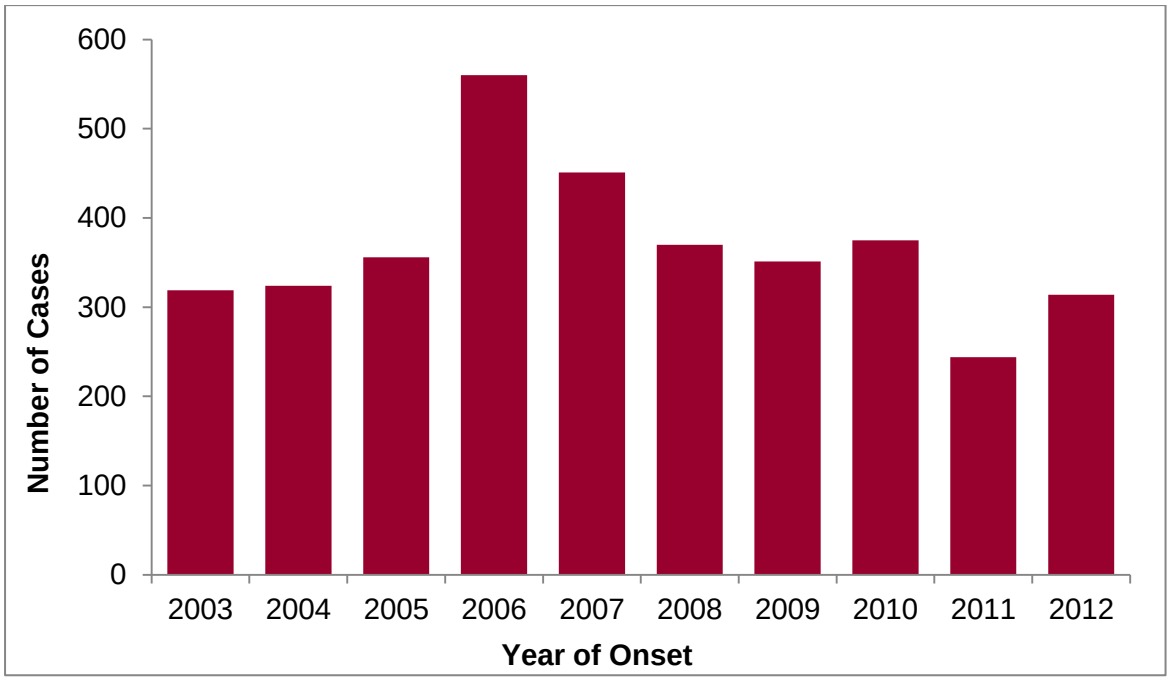
In 2012, there were 314 cases of either confirmed or presumptive Legionellosis, human infection caused by any *Legionella* spp., table 1. Based on the case definitions above, 309 cases are classified as confirmed or presumptive cases of Legionnaires' disease. These numbers are consistent with data from 2008-2010, figure 1. The reason for the reduction in numbers observed in 2011 remains unexplained.

Table 1: Number of cases of Legionellosis (including presumptive) by disease type and year of onset, 2010-2012

	Number of confirmed (presumptive*) cases		
	2010	**2011**	**2012**
Legionnaires' disease	357 (4)	235 (4)	306 (3)
Non-pneumonic Legionellosis	13	5	5
Pontiac Fever	1	-	-
Total	**371 (4)**	**240 (4)**	**311 (3)**

* Presumptive cases are cases with a serological diagnosis (a single high titre) or PCR result

Figure 1: Number of cases of Legionellosis (confirmed and presumptive) in residents of England and Wales by year of onset, 2003-2012



Age/gender distribution

Of the 306 confirmed cases of Legionnaires' disease reported in 2012, 218 (71.2%) were male and 88 (28.8%) were female, giving a male to female ratio of 2.47(see table 2a). The excess number of cases in men is thought to be associated with historical differences in occupation (industrial) and lifestyle-related risk factors (such as smoking) between men and women. The proportion of male cases over time appears to be decreasing as these differences become less apparent: 75.1% in 2010, 72.3% in 2011 and 71.2% in 2012.

Table 2a: Number and proportion (%) of confirmed cases of Legionnaires' disease by gender and age group, 2010-2012

	2010 (%)		**2011** (%)		**2012** (%)	
	Females	**Males**	**Females**	**Males**	**Females**	**Males**
< 50 yrs	15 (20.5)	58 (79.5)	16 (32.7)	33 (67.3)	7 (18.4)	31 (81.6)
50-59 yrs	15 (19.7)	61 (80.3)	10 (21.7)	36 (78.3)	23 (29.5)	55 (70.5)
60-69 yrs	34 (288)	84 (71.2)	22 (26.5)	61 (73.5)	28 (30.4)	64 (69.6)
70+ yrs	25 (27.8)	65 (72.2)	17 (29.8)	40 (70.2)	30 (30.6)	68 (69.4)
All Ages	**89 (24.9)**	**268 (75.1)**	**65 (27.7)**	**170 (72.3)**	**88 (28.8)**	**218 (71.2)**

Legionnaires' disease is predominantly a disease affecting older people, only 38 (12.4%) of the 306 reported cases were in people under 50 years of age (see table 2b).

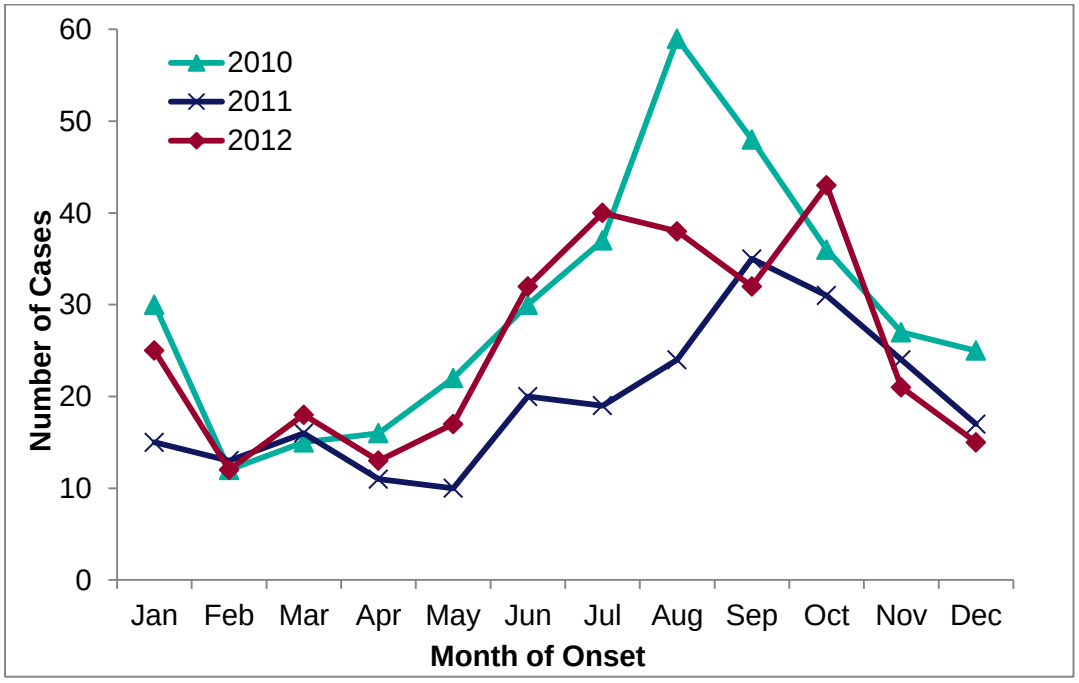
Table 2b: Number/proportion (%) of confirmed Legionnaires' disease cases by year of onset and age group, 2010-2012

	2010 (%)	**2011** (%)	**2012** (%)
< 50 yrs	73 (20.4)	49 (20.9)	38 (12.4)
50-59 yrs	76 (21.3)	46 (19.6)	78 (25.5)
60-69 yrs	118 (33.1)	83 (35.3)	92 (30.1)
70+ yrs	90 (25.2)	57 (24.3)	98 (32.0)

Seasonality

Legionnaires' disease has a pronounced seasonality, with the peak number of cases reported over the summer months. Figure 2 shows the seasonality for 2012 with 2011 and 2010 for comparison. Peak activity in 2012 was from June through to November; unusually, there was a second peak in October 2012.

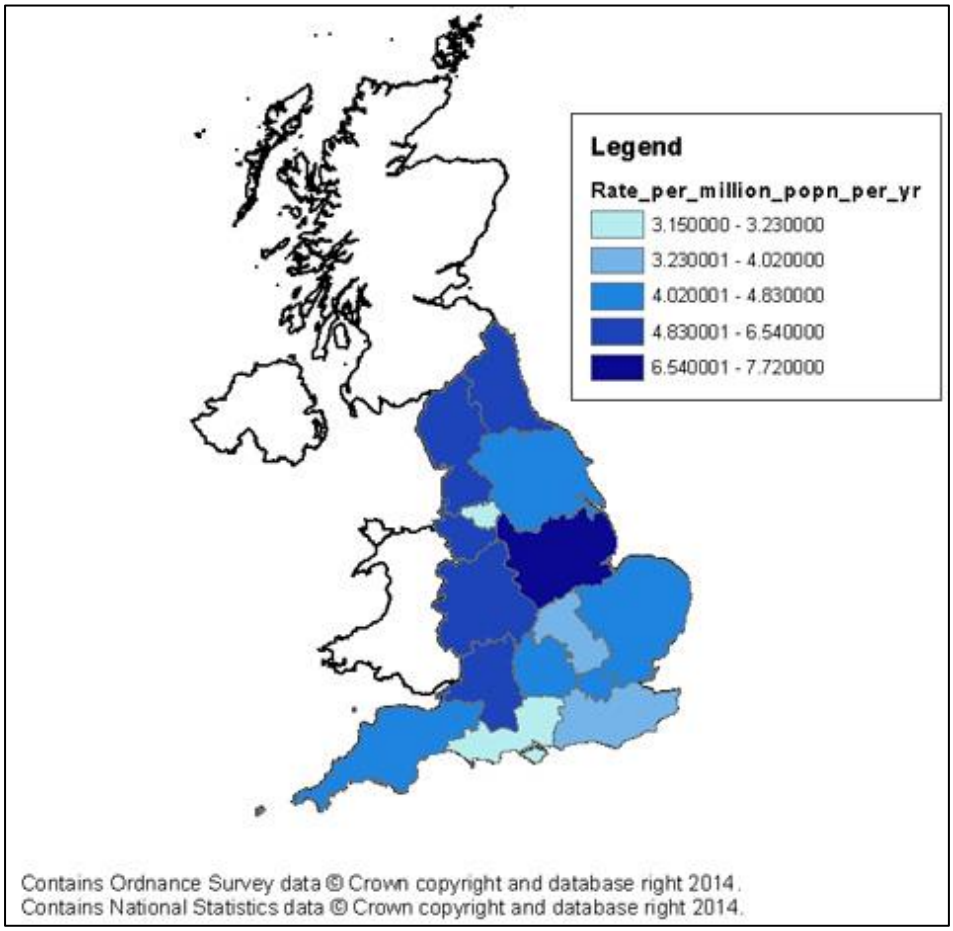
Figure 2: Number of confirmed cases of Legionnaires' disease by month and year of onset, 2010-2012.



Geographic distribution

Cases of Legionnaires' disease have been detected in all areas of England and Wales. The peak incidences over the three year period were in the areas covered by East Midlands PHE Centre, the West Midlands and Avon, Gloucestershire and Wiltshire PHE Centre (figure 3 and table 3).

Figure 3: Incident rate per million population* of confirmed Legionnaires' disease cases by PHE Centre of residence and year of onset, 2010-2012



* Population denominators based on the ONS 2011 population.

Table 3: The incidence rate per million population* of confirmed Legionnaires' disease cases by area of residence and year of onset, 2010-2012

Public Heath England Centres and Wales	**2009**	**2010**	**2011**	**Total**	**Average Rate** per million pop^{n} per yr*
Anglia and Essex	22	15	21	58	**4.69**
Avon, Gloucestershire and Wiltshire	15	16	13	44	**6.23**
Cheshire and Merseyside	10	11	19	40	**5.53**

Cumbria and Lancashire	14	12	6	32	**5.44**
Devon, Cornwall and Somerset	11	8	12	31	**4.69**
East Midlands	34	25	30	89	**7.72**
Greater Manchester	7	8	11	26	**3.23**
London	53	26	40	119	**4.83**
North East	19	14	12	45	**5.78**
South Midlands and Hertfordshire	11	6	13	30	**3.73**
Sussex, Surrey and Kent	21	18	15	54	**4.02**
Thames Valley	14	5	10	29	**4.77**
Wessex	9	5	11	25	**3.15**
West Midlands	37	22	51	110	**6.54**
Yorkshire and Humber	36	19	17	72	**4.54**
Wales – North	3	6	4	13	**6.29**
Wales – Mid and West Wales	14	8	13	35	**11.29**
Wales – South East	27	11	5	43	**10.68**
Other	-	-	1	1	**-**
Unknown	-	-	2	2	**-**
Total	**357**	**235**	**306**	**898**	**5.33**

* Population denominators based on the ONS 2011 population.

Source of exposure

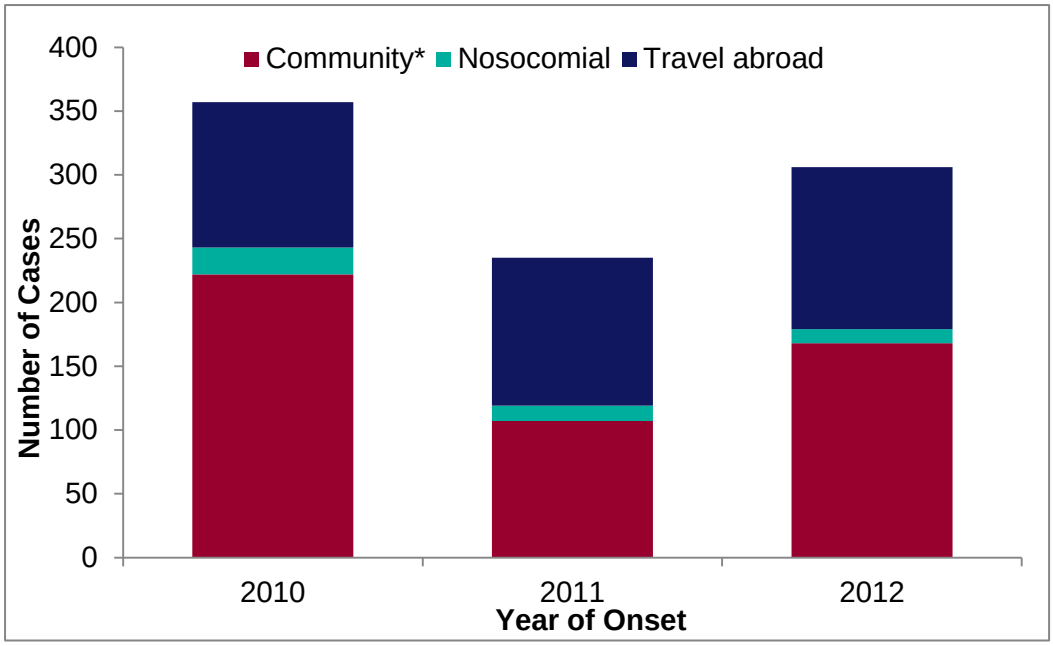
Most cases of Legionnaires' disease are classified as community acquired. In 2012, there were 168 community acquired cases, representing 54.9% of the cases reported across England and Wales (table 4 and figure 4). This is in contrast to 2011 when 107 (45.5%) of cases were considered to be community acquired. Nosocomial cases still comprise a small, but high profile, proportion of the total number of cases.

Table 4: Number of confirmed Legionnaires' disease cases by category of exposure and year of onset, 2010-2012.

Category	**Community*** (%)	**Nosocomial** (%)	**Travel abroad** (%)
2010	222 (62.2)	21 (5.9)	114 (31.9)
2011	107 (45.5)	12 (5.1)	116 (49.4)
2012	168 (54.9)	11 (3.6)	127 (41.5)

** Includes cases who travelled within the UK*

Figure 4: Number of confirmed Legionnaires' disease cases by year of onset and category of exposure, 2010-2012.



** Includes cases who travelled within the UK*

Risk factors

Certain underlying conditions or risk factors such as heart disease and smoking are associated with Legionnaires' disease. In 2012, 193 (63.1%) of cases were found to have at least one underlying condition/risk factor (table 5). The most frequently reported underlying condition in 2012 was heart disease.

Table 5: Cases of Legionnaires' disease with underlying conditions/risk factors, 2010-2012

	2010 (%)	**2011** (%)	**2012** (%)
Any underlying condition	**240 (67.2)**	**136 (69.4)**	**193 (63.1)**
Diabetes	46 (12.1)	38 (15.3)	43 (15.1)
Heart Disease	114 (30.1)	74 (29.8)	103 (36.3)
Immunosuppression*	48 (12.7)	33 (13.3)	31 (10.9)
Liver conditions	20 (5.3)	9 (3.6)	9 (3.2)
Neoplasms	27 (7.1)	21 (8.5)	22 (7.7)
Renal disorder	17 (4.5)	12 (4.8)	10 (3.5)
Respiratory conditions	38 (10.0)	18 (7.3)	34 (12.0)
Smoking	69 (18.2)	43 (17.3)	32 (11.3)

NB -More than one risk factor may be recorded for a patient
** Immunosuppression due to conditions other than neoplasms*

Mortality

Statistical analysis (in the form of a chi-square test for trend at 0.05 level of significance) of the annual number of deaths and the year of onset for cases between 2003 and 2012 suggests there has been no improvement to the death rate over this time period (p-value of 0.5915 - not significant). A high level of mortality remains among individuals associated with Legionnaires' disease (figure 5).

Figure 5: Legionnaires' disease case fatality ratio by year, 2003-2012

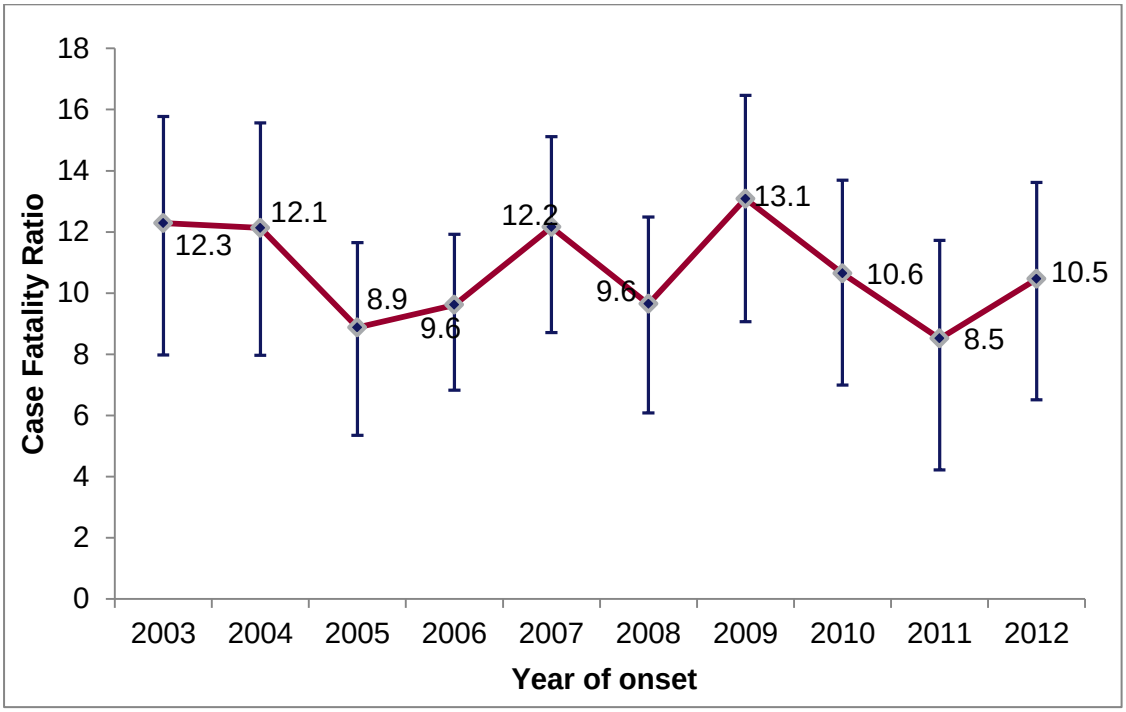


Table 6 shows the differences in mortality according to the likely exposure category. There is a clear difference in mortality depending on the likely exposure which is supported by a chi-square test giving a p-value of <0.0001 at 0.05 level of significance, thus providing very strong evidence of an association between the type of exposure and mortality. The highest mortality is associated with nosocomial cases. For the 2010-2012 period, the case fatality rate (CFR) for nosocomial cases averaged 25%. The lowest CFR was in cases associated with travel abroad.

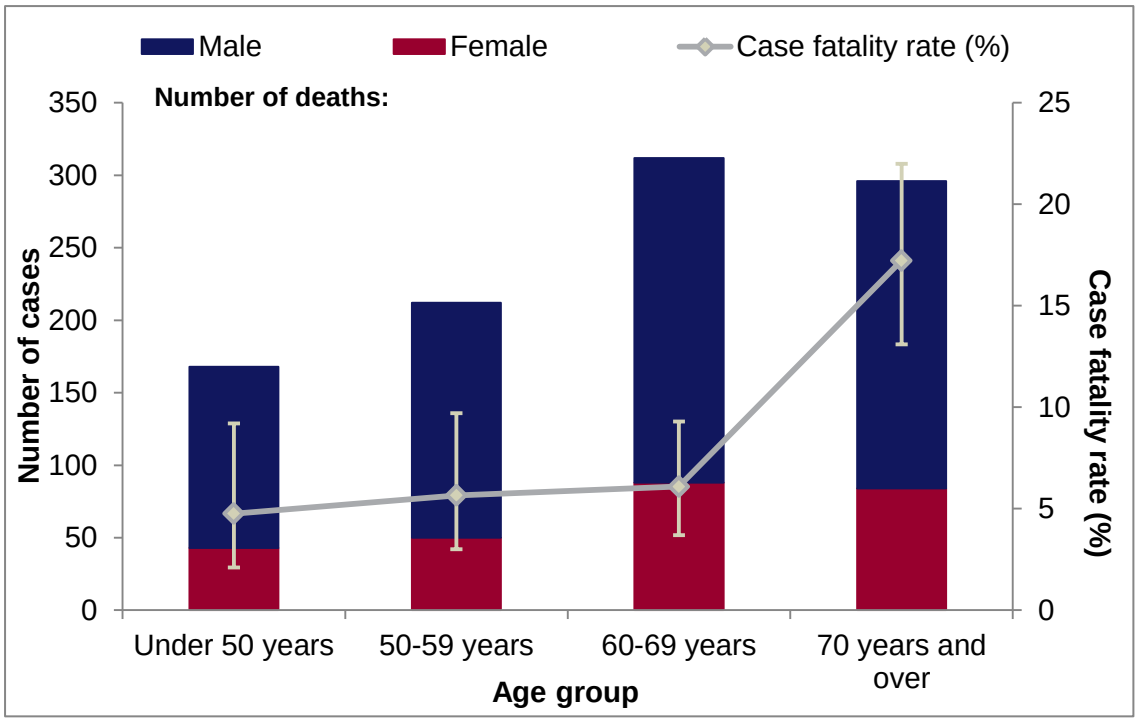
Table 6: Legionnaires' disease case-fatality rates by category of exposure, 2010 – 2012

	Cases	**Deaths**	**Case Fatality Rate** (%) (95% CI)
Community*	497	60	**12.1 (9.3 - 15.3)**
Nosocomial	44	11	**25.0 (13.2 - 40.3)**
Travel Abroad	357	19	**5.3(3.2 - 8.2)**
Total	**898**	**90**	**10.0 (8.1 - 12.2)**

* Includes travel UK cases

Figure 6 shows the increased mortality associated with age, with the highest CFR occurring in people with Legionnaires' disease who are 70 years or older. Statistical analysis of mortality provides evidence of a linear association between age group and mortality (chi-square test for trend at 0.05 level of significance gives a p-value of <0.0001). However analysis of an association between gender and mortality shows that there is no significant difference in the risk of death between males and females; (chi-square test for association, at 0.05 level of significance, gives a p = 0.753)

Figure 6: Number of confirmed cases of Legionnaires' disease by age and gender, with case fatality ratio (%) and 95% CI, 2010-2012.



Microbiology

The three tests commonly used for diagnosing Legionnaires' disease are urinary antigen testing, culture and polymerase chain reaction (PCR) – serological methods are rarely used now. Each method has different advantages in terms of results time, sensitivity and specificity. Culture is considered the 'gold standard' as it allows speciation of any legionella organism that is identified. Table 7 shows that in 2012 urinary antigen testing was carried out in 306 of the 308 cases (99.4%). Positive cultures were obtained in 50 cases (16.3%) and PCR testing was carried out 56 cases (18.6%). There were no confirmed cases diagnosed by serology in 2012.

Table 7: Legionnaires' disease cases by diagnostic test and year of onset, 2010-2012

	2010 (%)	**2011** (%)	**2012** (%)
Culture	69 (19.3)	61 (25.9)	50 (16.3)
Urinary antigen	350 (98.0)	227 (96.6)	304 (99.4)
Four-fold rise - (serology)	2 (0.6)	1 (0.4)	-
Single High Titre - (serology)	8 (2.2)	5 (2.1)	-
Polymerase Chain Reaction	51 (14.3)	38 (16.2)	56 (18.3)

Individual cases may have been tested using one or more of the methods of diagnosis. Culture and PCR are usually only undertaken where a patient has already been confirmed by urinary antigen testing.

Where a clinical sample (sputum, material from a bronchoalveolar lavage or lung tissue) was available and could be cultured or tested by PCR, further sub-typing was carried out. The two most common subtypes were *Legionella pneumophila* serogroup 1, ST 1 and 47 (table 8).

Table 8: The 14 most prevalent strains of *L.pneumophila* identified in clinical isolates 2009 – 2011

Sequence Type (ST)	**Number of Cases**			
	2010 (%)	**2011** (%)	**2012** (%)	**Total** (2010–2012)
1	7 (2.0)	5 (2.1)	9 (2.9)	21 (2.3)
23	1 (0.3)	5 (2.1)	2 (0.7)	8 (0.9)
27	1 (0.3)	2 (0.9)	-	3 (0.3)
37	7 (2.0)	3 (1.3)	-	10 (1.1)
42	1 (0.3)	1 (0.4)	1 (0.3)	3 (0.3)
45	-	-	2 (0.7)	2 (0.2)
47	10 (2.8)	-	10 (3.3)	22 (2.4)
48	2 (0.6)	-	1 (0.3)	3 (0.3)
62	1 (0.3)	3 (1.3)	2 (0.7)	6 (0.7)
74	8 (2.2)	1 (0.4)	2 (0.7)	11 (1.2)
104	1 (0.3)	-	1 (0.3)	2 (0.2)
110	-	1 (0.4)	1 (0.3)	2 (0.2)
117	2 (0.6)	-	-	2 (0.2)
569	1 (0.3)	-	2 (0.7)	3 (0.3)
615	1 (0.3)	1 (0.4)	-	2 (0.2)
950	2 (0.6)	-	-	2 (0.2)
1268	-	-	9 (2.9)	9 (1.0)
Other 'single' ST's*	20 (5.6)	7 (3.0)	15 (4.9)	42 (4.7)
No isolate, no ST	292 (81.8)	204 (86.8)	249 (81.4)	745 (83.0)

** 42 different isolates identified in 42 sporadic cases*

Table 9 shows the number and proportion of cases from each exposure category where it was possible to carry out sequence based typing. The greatest proportion of cases with sequence based typing was among cases considered nosocomial.

Table 9: Number and proportion, (%), of cases of Legionnaires' disease with sequence-based type identified by category of exposure

Category	2010 (%)	2011 (%)	2012 (%)
Community*	40 (18.0)	15 (14.0)	36 (21.4)
Nosocomial	8 (38.1)	5 (41.7)	6 (54.5)
Travel abroad	17 (14.9)	11 (9.5)	15 (11.8)

***** *includes UK travel cases*

Clusters and outbreaks

Outbreaks of Legionnaires' disease are usually associated with exposure to a single common source. In order to minimise the number of people exposed to a potential source of Legionnaires' disease, it is essential that potential clusters (cases linked by time, person or place) that may become outbreaks are identified quickly and investigated promptly.

Table 10: Number of outbreaks/clusters by category of exposure, 2010–2012.

	2010		2011		2012	
	OB/Cl	**Cases**	**OB/Cl**	**Cases**	**OB/Cl**	**Cases**
Community	12	49 (8)	2	6 (4)	6	47
Nosocomial	6	13 (1)	1	5 (2)	3	8 (2)
Travel Abroad	15	24 (3)	13	27 (4)	7	25 (3)
Total	**33**	**86 (12)**	**16**	**38 (10)**	**16**	**80 (5)**

Travel associated Legionnaires' disease (TALD)

By international agreement, travel associated cases of Legionnaires' disease (TALD) are classified as those cases where travel occurred in the 2-10 days before symptom onset. All cases of TALD are reported to the European Legionnaires' Disease Surveillance Network (ELDSNet) based in the European Centre for Disease Prevention and Control (ECDC), Stockholm, Sweden. Working to common definitions and standard operating procedures, ELDSNet attempts to identify clusters associated with accommodation and promote a consistent and timely approach to the investigation of these clusters within and outside of Europe.

Table 11, lists the countries most frequently associated with cases of Legionnaires' disease in residents of England and Wales. The rates use the number of UK visits as the denominator. It can be seen that while Spain has the highest number of cases, Thailand has the highest rate of cases per million UK visits.

Table 11: Top travel destinations for reported Legionnaires' disease in residents of England and Wales 2012

Country	LD cases	Visits by UK residents	Rate of cases per million visits
Spain	41	11,110,000	**3.69**
France	11	8,781,000	**1.25**
Greece	9	1,824,000	**4.93**
Italy	9	2,630,000	**3.42**
Turkey	8	1,419,000	**5.64**
United States of America	7	3,011,000	**2.32**
Thailand	6	371,000	**16.17**
Cruise ship**	5	482,000	**10.37**
United Arab Emirates	5	580,000	**8.62**
China	4	334,000	**11.98**
Germany	4	2,307,000	**1.73**
India	4	794,000	**5.04**

** According to 'Travel Trends' by the Office of National Statistics (2012)*
***: People travelled by cruise ship visiting multiple countries*

Table 12 shows that Spain was associated with the greatest number of clusters involving residents of England and Wales and the greatest number of cases associated with these clusters.

Table 12: Countries associated with clusters involving residents of England and Wales with onset of symptoms during 2012.

Country of Travel	No. Clusters	No. Associated Cases
Cruise ship	1	1
France	1	1
Greece	1	1
Hungary	2	2
India	2	2
Italy	4	4

Korea	1	1
Netherlands	1	1
Saudia Arabia	1	1
Spain	5	19
Thailand	1	1
Turkey	2	2
United Arab Emirates	2	2
United States of America	1	1

References

1. Fraser DW, Tsai TR, Orenstein W, Parkin WE, *et al* (1977). Legionnaires' disease: description of an epidemic of pneumonia. *N Engl J Med*. **297**(22):1189-97.

2. McDade JE, Shepard CC, Fraser DW, Tsai TR, *et al* (1977). Legionnaires' disease: isolation of a bacterium and demonstration of its role in other respiratory disease. *N Engl J Med.* **297**: 1197-1203.

3. Glick TH, Gregg MB, Berman B, Mallison G, Rhodes WW Jr, Kassanoff I (1978). Pontiac Fever: an epidemic of unknown aetiology in a health department: I. Clinical and epidemiologic aspects. *Am J Epidemiol*. **107**(2):149-60.

4. Naik FC, Zhao H, Harrison TG, Phin N Legionnaires' disease in England and Wales – 2011. Health Protection Report Vol 6, No.44 – published 02 November 2012.
http://www.hpa.org.uk/hpr/archives/2012/hpr4412.pdf

5. Legionnaires' disease: The control of legionella bacteria in water systems – Approved Code of Practice and guidance (2000). Health and Safety Executive, UK.

6. García-Fulgueiras A et al (2003). Legionnaires' Disease Outbreak in Murcia, Spain. *Emerg Infect Dis*. **9**(8): 915-921