Public Health England

Protecting and improving the nation's health

Legionnaires' Disease in England and Wales 2014

About Public Health England

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

Public Health England
Wellington House
133-155 Waterloo Road
London SE1 8UG
Tel: 020 7654 8000
www.gov.uk/phe
Twitter: @PHE_uk
Facebook: www.facebook.com/PublicHealthEngland

Prepared by: FC Naik and G Dabrera
For queries relating to this document, please contact: legionella@phe.gov.uk

Published June 2015
PHE publications gateway number: 2015145

Contents

Executive summary

In 2014, 342 cases of legionellosis (confirmed and presumptive) were reported to the National Surveillance Scheme for Legionnaires' disease in residents of England and Wales.

Of the 331 confirmed cases of Legionnaires' disease reported in 2014, 230 (69.5%) were male and 101 (30.5%) were female, giving a male to female ratio of 2.3.

Two hundred and eighty-one (84.9%) of the 331 confirmed cases of Legionnaires' disease were in individuals aged 50 years and over.

Over the three-year period 2012 to 2014, the incidence rate in England and Wales was an average of 5.4 per million population (pmp). Peak incidence was reported in the areas covered by the West Midlands (7.8 pmp) and East Midlands (7.6 pmp) PHE centres.

Of the 331 confirmed cases of Legionnaires' disease, 186 (56.2%) cases were considered to have been exposed to the infecting organism in the community, 139 (42.0%) cases were associated with travel abroad and six (1.8%) were considered to have links to a healthcare facility (nosocomial).

At least one underlying condition/risk factor was found in 243 (73.4%) confirmed cases of Legionnaires' disease; with smoking being the most frequently reported risk factor.

The crude case fatality rate in 2014 was 7.6%, which is the lowest it has been in the last decade.

The number of cases identified by polymerase chain reaction (PCR) testing has fallen since 2013 from 36.8% to 25.7% of cases tested by PCR during 2014.

The two most common *Legionella pneumophila* serogroup 1 subtypes identified in clinical isolates continues to be ST1 and ST47.

As in 2013 there were no nosocomial outbreaks/clusters identified during 2014. A total of fifteen clusters/outbreaks were identified in 2014 compared to 18 in 2013.

Of the 139 cases of Legionnaires' disease in residents of England and Wales associated with travel abroad in 2014, Spain was again the most frequent destination that cases travelled to. However, the country with the highest incident rate was China with 15.6 cases per million visits, followed by Thailand with 15.2 cases per million visits.

Introduction

Legionnaires' disease is a severe atypical pneumonia caused by exposure to legionella bacteria that inhabit natural and man-made water systems. In England and Wales the disease has been notifiable since April 2010, although records have been kept since 1980, with enhanced surveillance undertaken on every case reported in residents of England and Wales with the primary purpose of identifying clusters to prevent or minimise the impact of potential outbreaks.

Prevention and control of legionellosis

Legionellosis is the generic term used to describe human infection with any species of the legionella bacteria but predominantly *Legionella pneumophila*. Infection by the organism can cause one of two recognised syndromes; Legionnaires' disease [1,2], a severe, potentially fatal, form of pneumonia and Pontiac fever [3], a self-limiting, non-fatal, mild influenza-like illness. A third atypical form of the disease also exists and is characterised by symptoms similar to those of Legionnaires' disease but with the absence of pneumonia and termed non-pneumonic legionellosis. Further information on these conditions are included in previous reports [4].

There have been no documented cases of Legionnaires' disease associated with person-to-person spread. The principal route of infection occurs through direct exposure to aerosols/droplets from an environmental source colonised by the legionella bacteria but in rare instances can be caused through aspiration. Legionella naturally grows in the environment, in warm, stagnant water such as ponds, lakes and streams. Artificial water systems have been created by man which mimic the natural environment conducive to the growth of *Legionella spp*. In particular, cooling towers, evaporative condensers, hot and cold water systems and spa pools are ideal for growth and have the added risk of providing the organism with the means to spread out into the atmosphere through the creation and dispersal of aerosols/droplets.

The most effective method of preventing the disease has been proven to be through the introduction of stringent regulations on the management and maintenance of man-made water systems. National regulations aim to limit the environmental factors that support the growth and dissemination of legionella, thereby preventing the exposure of susceptible hosts to this organism. Regulations and guidance are in place to ensure water systems are designed and managed to avoid stagnation, regulate cold and hot water

temperatures independently, minimise the production and dissemination of aerosols/droplets and where appropriate, incorporate regular disinfection of the system [5]. Mis-managed and poorly maintained water systems can rapidly become colonised and become 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

Legionnaires' disease was first identified in 1976 in Philadelphia, US, and by 1980 the National Surveillance Scheme for Legionnaires' disease was established to collect enhanced surveillance data on all cases of Legionnaires' disease in residents of England and Wales. The scheme includes reports from health protection teams and is managed by the Legionella Section, Respiratory Diseases Department, Colindale, with the aim of:

- identifying clusters to prevent potential outbreaks
- validate and assure the quality of the data submitted to the scheme
- issue notifications and alerts to health protection teams (HPTs)
- support the management and control of outbreaks and incidents
- monitor trends over time
- identify risk group and categories
- report travel-associated cased of Legionnaires' disease to the European Legionnaires' Disease Surveillance Network (ELDSNet)
- as a collaborating member of ELDSNet, implement the European guidelines for travel associated cases of Legionnaires' disease
- collaborate with international counterparts to follow up cases associated with accommodation sites in England and Wales
- issue alerts on possible travel-associated clusters in other countries

Other formal responsibilities of the National Surveillance Scheme include the composition and provision of the following outputs:

- local and regional datasets to support investigations, outbreaks, and research
- monthly legionella reports
- annual Office for National Statistics (ONS) dataset for Legionnaires' disease
- annual statistics for the World Health Organization

- annual dataset for ELDSNet operated by the European Centre for Disease Prevention and Control (ECDC)

Methodology

The data presented in this report is extracted from the national surveillance scheme database, which holds data on confirmed and suspected cases of Legionellosis in residents of England and Wales. The majority of cases were reported by HPTs and some were reported by the national reference laboratory, Respiratory and Vaccine Preventable Bacterial Reference Unit (formerly the Respiratory and Systemic Infection Laboratory), at PHE Colindale.

Data is collated and verified by the National Surveillance Scheme for Legionnaires' disease, managed at PHE's Centre for Infectious Disease Surveillance and Control in Colindale, London.

Cases thought to have Legionnaires' disease were reported to the national surveillance scheme through the completion of the national surveillance form that requests enhanced surveillance data to:

- establish whether an individual meets the case definition for Legionnaires' disease or one of the other syndromes listed below
- identify risk factors
- determine the likely category of exposure
- identify potential sources of infection

Legionellosis is the collective term used to describe infection caused by the Legionella bacteria. The organism can cause one of three syndromes:

- **Pontiac fever** – a non-fatal, non-pneumonic, mild, self-limiting influenza-like illness usually resolving within 24 to 48 hours
- **Legionnaires' disease** – severe, potentially fatal, atypical form of pneumonia
- **Non-pneumonic legionellosis** – a urinary antigen positive case, indicating infection by legionella species with symptoms that do no not fit those for Pontiac fever and with no evidence of pneumonia

Cases of Legionnaires' disease are defined as confirmed or presumptive based on their microbiology. The definitions are as follows:

Confirmed case of Legionnaires' disease

A clinical and/or radiological diagnosis of pneumonia with microbiological evidence of one or more of the following:

- isolation (culture) of legionella spp. from clinical specimens
- the presence of *L. pneumophila* urinary antigen determined using validated reagents/kits

Presumptive case of Legionnaires' diseases

A clinical and/or radiological diagnosis of pneumonia with microbiological 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)

Epidemiological analysis

Age and gender

The proportion of males and females were studied to determine the male to female ratio. Analysis was also carried out for gender by age group, with cases categorised into four groups; under 50 years, 50 to 59 years, 60 to 69 years, and 70 years and over.

Seasonality

Seasonality was studied through analysis of the number of confirmed cases of Legionnaires' disease by the reported month of onset of symptoms.

Geographical spread

The geographical spread of cases was analysed by dividing cases into the 15 PHE centres and three Public Health Wales HPTs in which the case resides. The average annual rates were calculated using population data from the Office for National Statistics mid-2013 population estimates.

Category of exposure

For this report, cases were categorised into one of three groups based on the most likely 'category of exposure'. The cases were divided in accordance with the following definitions;

- community acquired: Cases with no history of overnight stays outside the UK (travel abroad) or hospital admission or association with a health care facility during the incubation period prior to the onset of illness are deemed to be community acquired
- travel associated: Cases who spent one or more overnight stays in holiday or business accommodation abroad in the 2-10 days before the onset of symptoms. Overnight stays include accommodation in hotels, camp sites, ships, rented holiday apartments or other tourist facilities
- nosocomial (hospital/healthcare facility acquired):
  - definite nosocomial: cases of Legionnaires' disease who were in a hospital or nursing home or other health care facility for at least 10 days before the onset of symptoms
  - probable nosocomial: cases of Legionnaires' disease who stayed or spent time (eg as an outpatient or healthcare worker) in a hospital or other health care facility for part of the incubation period for Legionnaires' disease and where the facility has been associated with one or more previous cases of Legionnaires' disease
  - possible nosocomial: cases of Legionnaires' disease who stayed or spent time (eg as an outpatient) or who worked in a hospital or other health care facility for part of the incubation period for Legionnaires' disease but where there have been no previous cases of Legionnaires' disease or isolates from the hospital water system at about the same time

Risk factors

Each reported case had their medical history reviewed by the reporter and any underlying conditions recorded. The underlying conditions were analysed by separating the individual ailments/conditions into one of eight groups:

- diabetes
- heart conditions – includes all cardiovascular conditions, stroke, blood disorders, hypertension
- liver conditions
- neoplasms – past and current cancers of all types, blood cancers
- renal disorders – includes various kidney conditions, dialysis, transplants
- respiratory conditions – includes full range of respiratory disorders from asthma, chronic obstructive pulmonary disorder, lung transplants, tuberculosis

- smoking – past and current smoking
- immunosuppression – any other condition not included in the above seven groups that cause immunosuppression, including arthritis, HIV, prescribed use of steroids, systemic lupus erythematosus.

Mortality

The national surveillance scheme are informed of the outcome of cases by the investigating HPT and where available, through the ONS deaths data for cases where the cause of death has been registered as Legionnaires' disease, with an ICD code A481. These figures were used to calculate the case fatality rate by year of onset of symptoms, by category of exposure and by age group. Statistical analysis of mortality was carried out using the statistical package, STATA 13.

Microbiology

Confirmed cases of Legionnaires' disease must have positive microbiology carried out by local hospital laboratories and sent to the national reference laboratory for confirmation.

Urine samples were tested for the presence of antigens, single or paired sera were tested for the presence of antibodies and respiratory samples were cultured and examined by polymerase chain reaction (PCR).

PCR enables respiratory samples to be analysed further to deduce the sequence-based type in order to identify the strain of organism infecting the case. The most prevalent strains were identified from cases where respiratory samples were tested and PCR successfully performed.

Clusters/outbreaks

Every reported case undergoes detailed analysis by the national surveillance team in order to check for association with any other recently reported case(s) in terms of geography, time, travel or any other possible links. Cases that met the following definitions formed a cluster or outbreak:

- **Cluster**: Two or more cases that initially appear to be linked by area of residence or work, including a healthcare or other type of community setting and which have sufficient proximity in dates of onset of illness (eg six months) to warrant further investigation
- **Outbreak**: An outbreak is defined as two or more cases where the onset of illness is closely linked in time (weeks rather than months) and where there is epidemiological evidence of a common source of infection, with or without microbiological evidence

Travel cases
Travel associated cases were analysed to determine the rate of infection associated with each country of travel, these were calculated using travel statistics obtained from the Office for National Statistics 2013 travel trends for 'UK residents visits abroad'.

This report presents the epidemiological data collated by the National Surveillance Scheme based on reported cases of Legionnaires' disease among residents of England and Wales who experienced the onset of symptoms during 2014. Data from previous years have been included, where appropriate, for comparison.

Descriptive epidemiology

Legionellosis

A total of 449 individual reports of Legionellosis, human infection caused by legionella *spp*., were reported to the National Surveillance Scheme for Legionnaires' disease in residents of England and Wales, during 2014. Of these reports, 342 were classified as confirmed or presumptive cases of legionellosis, (Table 1). In accordance with the case definitions above, 331 cases with onset of symptoms during 2014 met the case definition for a confirmed case of Legionnaires' disease and seven were classified as presumptive cases. The remainder were non-pneumonic legionellosis cases.

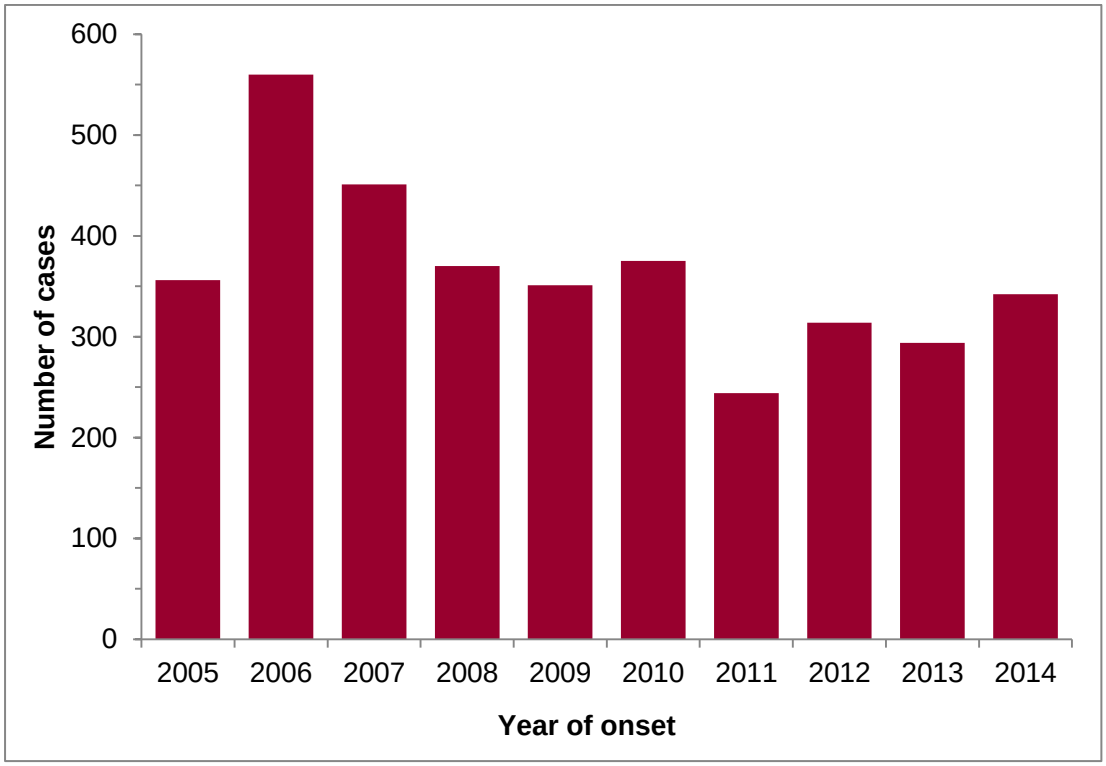
Table 1: Number of cases of legionellosis (including presumptive) by disease type and year of onset, 2012 to 2014

	Number of confirmed (presumptive*) cases		
	2012	**2013**	**2014**
Legionnaires' disease	306 (3)	285 (2)	331 (7)
Non-pneumonic Legionellosis	5	7	4
Pontiac Fever	-	-	-
Total	**314** (311 confirmed, 3 presumptive)	**294** (292 confirmed, 2 presumptive)	**342** (335 confirmed, 7 presumptive)

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

Figure 1 indicates that the number of cases of Legionnaires' disease with onset of symptoms during 2014 is consistent with most years of the past decade with the exception of the rise in case numbers seen in 2006 and 2007; possibly a consequence of certain meteorological conditions [9]. The reduction in numbers observed in 2011 remains unexplained [10]. The remainder of this report will describe analyses of confirmed Legionnaires' disease cases only.

Figure 1: Number of cases of Legionellosis (confirmed and presumptive) in residents of England and Wales by year of onset, 2005 to 2014



Age and gender distribution

Legionnaires' disease is known to affect males more than females, [11], at a male: female ratio of 3:1. In 2014, 230 (69.5%) reported cases of Legionnaires' disease were in males and 101 (30.5%) were females, (Table 2a), resulting in a male: female ratio of 2.3:1, compared to 2011 and 2012 when the male: female ratio was 2.5 and 3.0, respectively. Risk factors considered to contribute to the higher proportion of cases in males compared to females include differences in occupation (with men more likely to be working in industrial and labour-intensive occupations) and lifestyle-related risk factors, such as drinking and smoking, [11].

Table 2a: Number and proportion (%) of confirmed cases of Legionnaires' disease by gender and age group, 2012 to 2014

	2012		2013		2014	
	Females (%)	**Males** (%)	**Females** (%)	**Males** (%)	**Females** (%)	**Males** (%)
< 50 yrs.	7 (18.4)	31 (81.6)	13 (26.0)	37 (74.0)	11 (22.0)	39 (78.0)
50-59 yrs.	23 (29.5)	55 (70.5)	15 (26.3)	42 (73.7)	27 (32.5)	56 (67.5)
60-69 yrs.	28 (30.4)	64 (69.6)	23 (24.2)	72 (75.8)	31 (31.3)	68 (68.7)
70+ yrs.	30 (30.6)	68 (69.4)	21 (25.3)	62 (74.7)	32 (32.3)	67 (67.7)
All Ages	88 (28.8)	218 (71.2)	72 (25.3)	213 (74.7)	101 (30.5)	230 (69.5)

Older age is a well-documented risk factor for Legionnaires' disease [11]. The risk of infection increases with age and individuals over the age of 50 years have the highest risk. Table 2b illustrates this commonly observed pattern with only 50 (15.1%) of the 331 cases in 2014 aged below 50 years. Eighty-three cases (25.1%) were aged 50 to 59 years, and 99 cases (29.9%) were aged 60 years and over.

In 2014, the age of male cases ranged from 23 to 94 years, with a median age of 63 years. For female cases ages ranged from under the age of one year to 95 years, with a median age of 65 years.

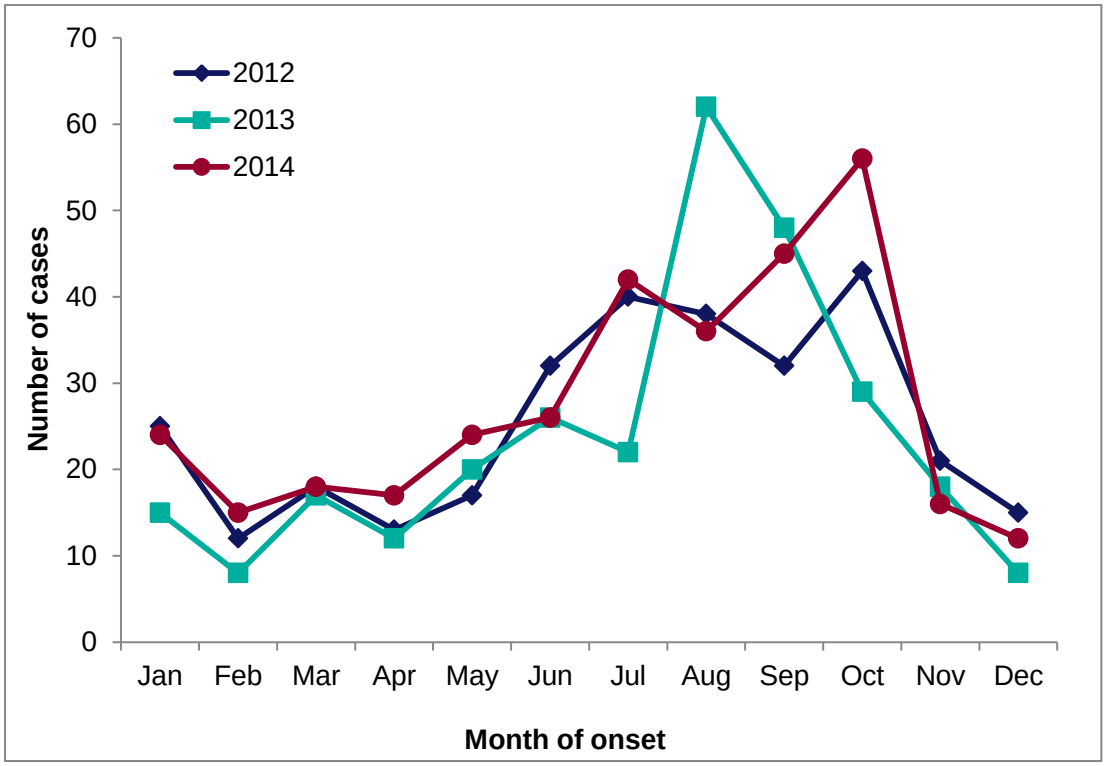
Table 2b: Number and proportion (%) of confirmed Legionnaires' disease cases by year of onset and age group, 2012 to 2014

	2012 (%)	**2013** (%)	**2014** (%)
<50 years	38 (12.4)	50 (17.5)	50 (15.1)
50 to 59 years	78 (25.5)	57 (20.0)	83 (25.1)
60 to 69 years	92 (30.1)	95 (33.3)	99 (29.9)
70+ years	98 (32.0)	83 (29.1)	99 (29.9)

Seasonality

Legionnaires' disease is a seasonal disease, with activity in England and Wales increasing during the summer months, usually reaching a peak between July and September. In 2014, almost a quarter of all cases (24.5%) reported onset of symptoms during August and September, this compares to 29.5% of cases in the same time period in 2013 (Figure 2). Higher temperatures and humidity are thought to contribute to the variation in cases observed during the summer months [12].

Figure 2: Number of confirmed cases of Legionnaires' disease by month and year of onset, 2012 to 2014

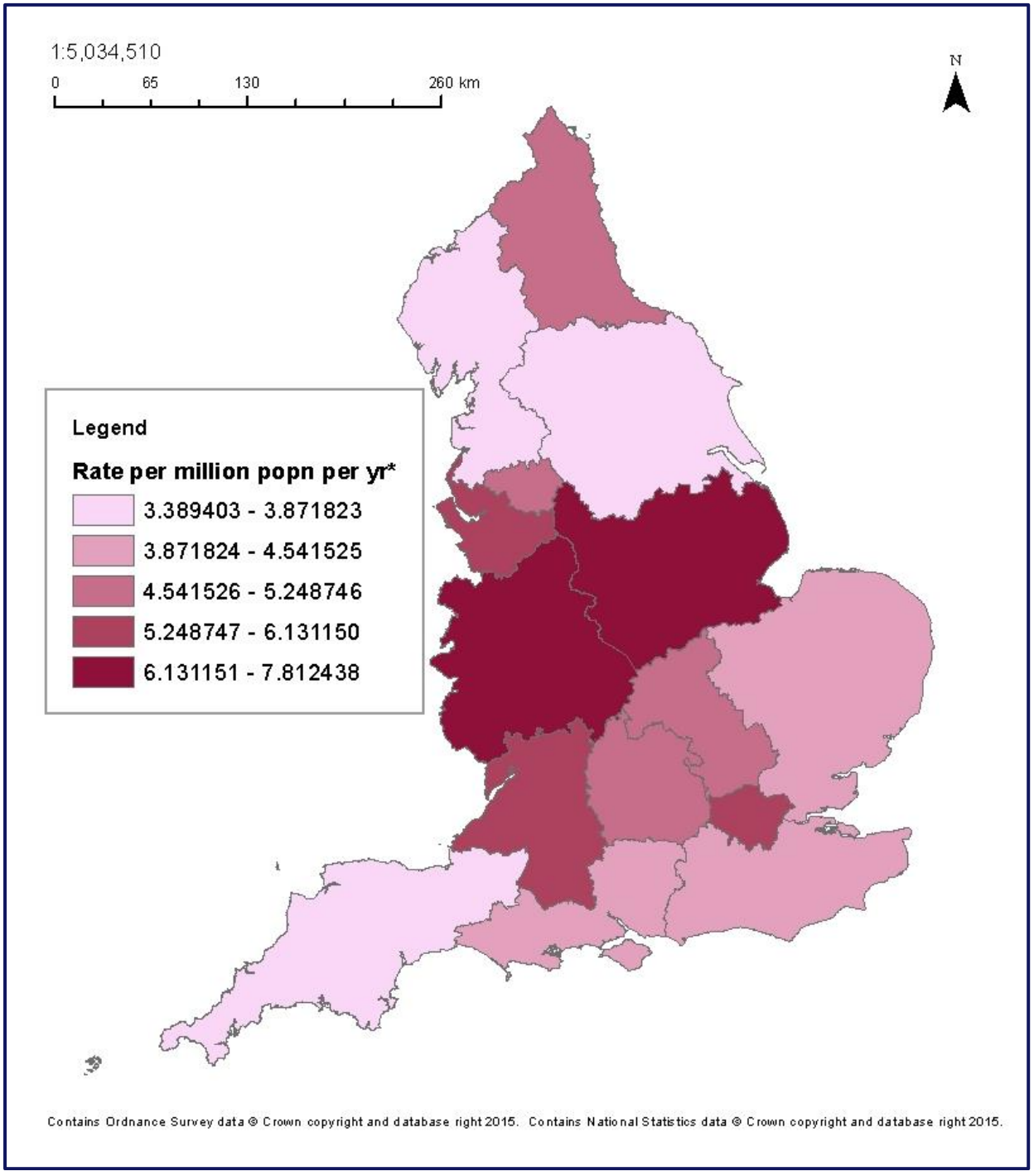


Geographic distribution

The distribution of Legionnaires' disease cases by PHE centre of residence reported to the national surveillance scheme varies across the 15 PHE centres and three centres in Wales. The highest number of cases with onset of symptoms during 2014 was observed in London followed by the West Midlands; 48 (14.5%) of all cases were reported in London residents and 38 (11.5%) cases in West Midlands residents (Table 3).

The highest average incidence rate for 2012–2014 of 7.8 cases per million population was observed in West Midlands, closely followed by 7.6 cases per million population in residents of East Midlands (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, 2012 to 2014



* Population denominators based on the ONS 2013 population.

Table 3: Incidence rate per million population* of confirmed Legionnaires' disease cases by area of residence and year of onset, 2012 to 2014

Public Health England centres and Wales	2012	2013	2014	Total	Average annual rate per million popn (2012-2014)*
Anglia and Essex	21	21	11	53	**4.4**
Avon, Gloucestershire and Wiltshire	13	7	24	44	**6.1**
Cheshire and Merseyside	19	8	15	42	**5.8**
Cumbria and Lancashire	6	5	9	20	**3.4**
Devon, Cornwall and Somerset	12	4	9	25	**3.7**
East Midlands	30	21	38	89	**7.6**
Greater Manchester	11	10	17	38	**4.7**
London	40	58	48	146	**5.8**
Mid and West Wales	13	4	3	20	**6.4**
North East	12	10	15	37	**4.7**
North Wales	4	3	6	13	**6.3**
South East Wales	5	8	17	30	**7.4**
South Midlands and Hertfordshire	13	17	11	41	**5.0**
Sussex, Surrey and Kent	15	24	23	62	**4.5**
Thames Valley	10	9	11	30	**5.3**
Wessex	11	9	13	33	**4.1**
West Midlands	51	44	38	133	**7.8**
Yorkshire and Humber	17	23	22	62	**3.9**
Other	1	-	1	2	**-**
Unknown	2	-	-	2	**-**
Total	**306**	**285**	**331**	**922**	**5.4**

* Population denominators based on the ONS 2013 population.

Source of exposure

More than half of all cases reported with onset of symptoms during 2014 were thought to have acquired their infection in the community (Table 4). The proportion of community acquired cases is lower than in 2013 when 67.4% of cases were reported to have been exposed to the source in the community but is in line with the proportion seen in 2012. Conversely, the proportion of cases diagnosed following travel during the incubation period has increased from 30.9% of cases in 2013 to 42.0% in 2014 but is similar to 2012 (Figure 4).

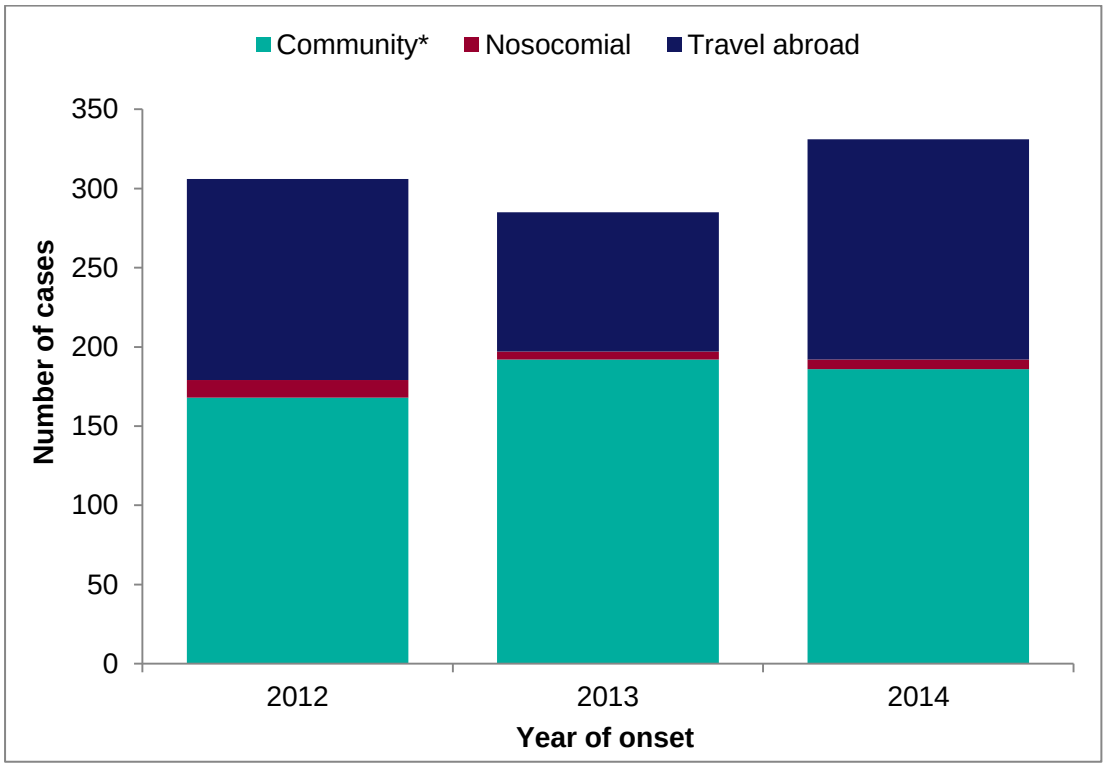
The number of cases considered to have acquired their infection from a healthcare facility remains the same as in 2013 at 1.8%.

Table 4: Number of confirmed Legionnaires' disease cases by category of exposure and year of onset, 2012 to 2014

Category	**Community*** (%)	**Nosocomial** (%)	**Travel abroad** (%)
2012	168 (54.9)	11 (3.6)	127 (41.5)
2013	192 (67.4)	5 (1.8)	88 (30.9)
2014	186 (56.2)	6 (1.8)	139 (42.0)

* Includes cases who travelled within the UK

Figure 4: Number of confirmed Legionnaires' disease cases by year of onset and category of exposure, 2012 to 2014



* Includes cases who travelled within the UK

Risk factors

The proportion of cases with one or more reported underlying medical conditions/risk factors in 2014 was 73.4%, similar to that observed in 2013 where 74.7% of cases reported an underlying condition (Table 5). Some underlying medical conditions are known to be associated with Legionnaires' disease such as smoking and diabetes [13]. The conditions predominantly reported in residents of England and Wales diagnosed with Legionnaires' disease has shown little change since 2013; heart conditions and smoking are still the primary conditions reported among cases, but smoking increased marginally from 27.4% in 2013 to 33.2% in cases with onset during 2014. Smoking was followed by heart conditions reported by 29.0% of cases, then diabetes in 15.1% of cases with onset of symptoms in 2014.

Table 5: Cases of Legionnaires' disease with underlying conditions/risk factors, 2012 to 2014

	2012 (%)	**2013** (%)	**2014** (%)
Any underlying condition	**192 (62.7)**	**213 (74.7)**	**243 (73.4)**
Diabetes	44 (14.4)	42 (14.7)	50 (15.1)
Heart conditions	105 (34.3)	89 (31.2)	96 (29.0)
Immunosuppression*	32 (10.5)	31 (10.9)	41 (12.4)
Liver conditions	7 (2.3)	14 (4.9)	12 (3.6)
Neoplasms	24 (7.8)	30 (13.0)	25 (7.6)
Renal disorder	9 (2.9)	9 (3.2)	9 (2.7)
Respiratory conditions	35 (11.4)	37 (13.0)	28 (8.5)
Smoking	32 (10.5)	78 (27.4)	110 (33.2)

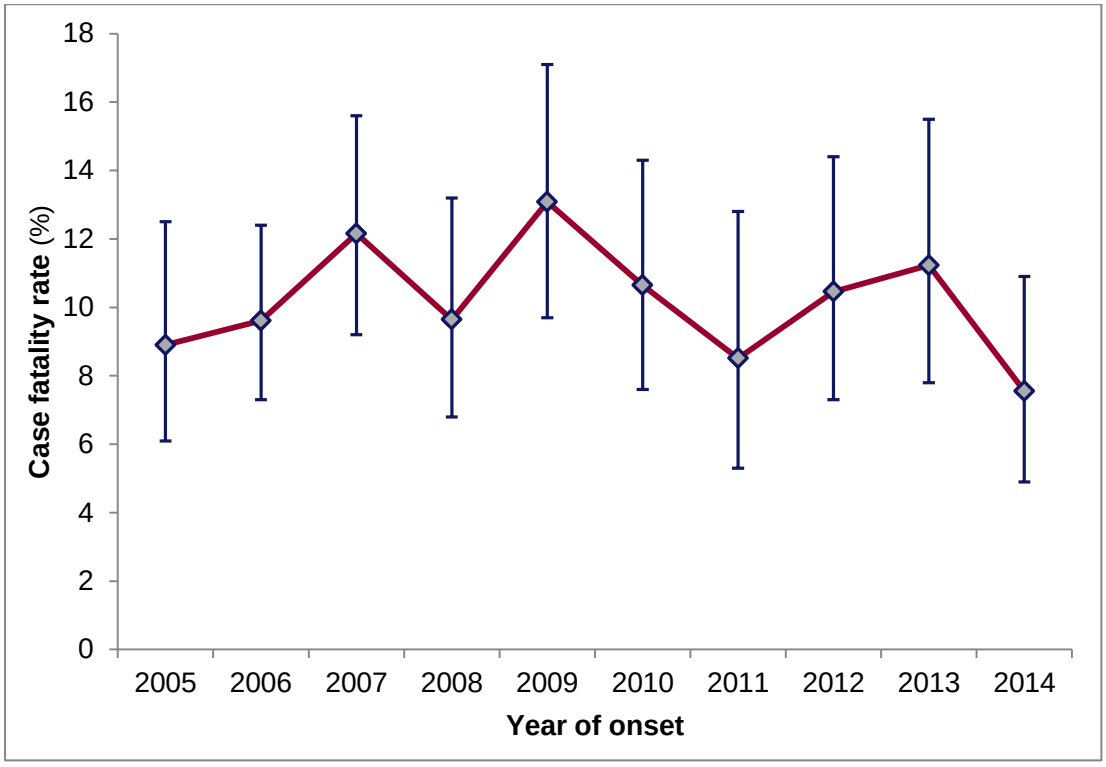
* Immunosuppression due to conditions other than neoplasms
NB More than one risk factor may be recorded for a patient

Mortality

Between 2005 and 2013, the annual number of deaths, reported to the national surveillance scheme or from death certificates recording Legionnaires' disease as the cause of death, ranged from 20 deaths in 2011 to 53 in 2007. However, the crude case fatality rate (CFR) across this period remained fairly constant, oscillating within a CFR of 8.5 and 13.1% (Figure 5). The crude CFR for 2014 was 7.6%, markedly lower on the CFR in 2013 where it reached 11.2%

Although the crude CFR in 2014 has fallen considerably from previous years, a chi-square test for trend at 0.05 level of significance indicated that the number of deaths per year between 2005 and 2014 shows no evidence of a linear trend between the year of onset of symptoms and a fatal outcome (p-value; 0.6406, not significant). This suggests that there has been no significant improvement in the death rate over this period.

Figure 5: Legionnaires' disease crude case fatality rate by year, 2005 to 2014



However, analysis of the outcome of cases by category of exposure in more recent years, 2012 to 2014, gives a crude CFR for nosocomial cases lower than expected, at 13.6%, and is similar to the crude CFR for community-acquired cases, (12.1%), Table 6. Cases associated with travel abroad had the lowest CFR at 4.5%.

Table 6: Legionnaires' disease crude case-fatality rates by category of exposure, 2012 to 2014

	Cases	**Deaths**	**Case fatality rate** (%) **(95% CI)**
Community*	546	70	12.1 (10.1 - 15.9)
Nosocomial	22	3	13.6 (2.8 - 33.6)
Travel abroad	354	16	4.5 (2.6 - 7.2)
Total	**922**	**89**	**9.7 (7.8 - 11.7)**

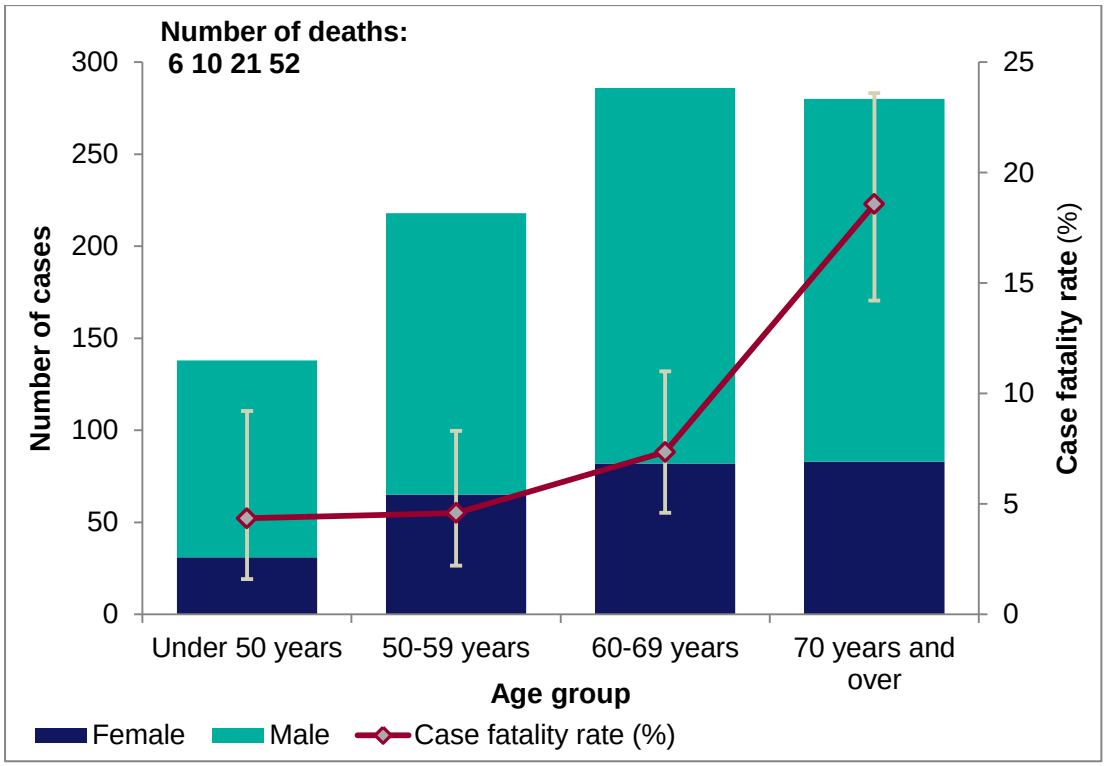
* Includes travel UK cases

The number of deaths in cases with onset of symptoms during 2014 reported to the national surveillance scheme by local units or from death certificates recording Legionnaires' disease as the cause of death was 25; this included

17 males aged 43 to 93 years and eight females ranging in age from under one year to 89 years.

As shown in Table 2b, during 2012 to 2014, the crude CFR for the under 50yrs age group was 4.3% (95% CI 2.7-4.9) increasing to a crude CFR of 18.6% (95% CI 4.4-5.0) in those 70 years or older. The observed increase in mortality with age is supported statistically with a chi-square test for trend at 0.05 level of significance, ($p<0.0001$). There is a non-significant association between gender and mortality (chi-square test for association, at 0.05 level of significance, gives a $p=0.052$).

Figure 6: Number of confirmed cases of Legionnaires' disease by age and gender, with crude case fatality rate (%) and 95% CI, 2012 to 2014



Microbiology

As in previous years the principal method of diagnosis for the majority of cases of Legionnaires' disease in 2014 was the urinary antigen test - 321 cases were positive for *Legionella pneumophila* serogroup 1using this method (Table 7). Of the ten cases that were either negative or not tested by urinary antigen, all were diagnosed by culture;serogroup information was available for four of these: one case was infected by *L. pneumophila* serogroup 10, two cases were infected by *L. pneumophila* serogroup 3 and

one showed that infection was caused by the species *Legionella longbeachae*, which has been previously associated with exposure to compost [15].

Urinary antigen tests may be the primary method used for diagnosis of Legionnaires' disease but culture still remains the gold standard due to its higher sensitivity and specificity and its ability to isolate non-serogroup 1 and non *L. pneumophila* species. A positive culture result was available in 82 (24.8%) of the 331 cases of Legionnaires' disease reported in 2014; a slightly lower proportion than observed in 2013 when 27.7% of cases reported positive culture results.

PCR has fallen by more than 10% compared to 2013 from 36.8% of cases reported to have positive PCR results to 25.7% in 2014. No confirmed cases had additional serological results in 2014.

Table 7: Legionnaires' disease cases by diagnostic test and year of onset, 2012–2014

	2012 (%)	**2013** (%)	**2014** (%)
Culture	50 (16.3)	79 (27.7)	82 (24.8)
Urinary antigen	304 (99.3)	280 (98.2)	321 (97.0)
Four-fold rise – (serology)	-	-	-
Single high titre – (serology)	-	-	-
PCR*	56 (18.3)	105 (36.8)	85 (25.7)

* Includes positive tests with complete and partial sequence-based types deduced
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.

Of the 331 cases reported with onset during 2014, 85 cases had the complete or partial sequence-based type of the infecting strain determined with ST47 most frequently identified (Table 8). Between 2012 and 2014, the two most commonly identified stains were ST1 and ST47, which concurs with previous studies [16].

Table 8: Complete or partial sequence-based types of *L. pneumophila* identified in clinical isolates, 2012 to 2014

Sequence type (ST)	Number of cases			
	2012 (%)	**2013** (%)	**2014** (%)	**Total**
1	9 (2.9)	6 (2.1)	5 (1.5)	20 (2.2)
1268	9 (2.9)	-	-	9 (1.0)
1554	-	5 (1.8)	3 (0.9)	8 (0.9)
23	2 (0.7)	3 (1.1)	2 (0.6)	7 (0.8)
42	1 (0.3)	4 (1.4)	9 (2.7)	14 (1.5)
46	-	7 (2.5)	2 (0.6)	9 (1.0)
47	10 (3.3)	14 (4.9)	13 (3.9)	37 (4.0)
616	1 (0.3)	1 (0.4)	5 (1.5)	7 (0.8)
62	2 (0.7)	4 (1.4)	4 (1.2)	10 (1.1)
74	2 (0.7)	4 (1.4)	3 (0.9)	9 (1.0)
6 different STs identified in three cases	1 (0.3)	7 (2.5)	10 (3.0)	18 (2.0)
13 different STs identified in two cases	8 (2.6)	7 (2.5)	11 (3.3)	26 (2.8)
38 different STs identified in one case	11 (3.6)	11 (3.9)	16 (4.8)	38 (4.1)
21 partially sequenced or novel STs in one case	3 (1.0)	14 (4.9)	4 (1.2)	21 (2.3)
No isolate, no ST	247 (80.7)	198 (69.5)	244 (73.7)	689 (74.7)

The proportion of cases where a sequence-based type has been determined has decreased compared to 2013, when 87 (30.5%) of cases had a partial or complete sequence deduced compared to 87 (26.3%) of cases in 2014 with a partial or complete sequence-based type determined using PCR (Table 9). As in previous years, cases associated with hospital exposure were more frequently tested by PCR to determine the identity of the infecting strain. This

may be due to the investigating team more readily encouraging clinicians to attempt to obtain respiratory samples from nosocomial cases or the greater ability of these cases to provide a respiratory sample compared to cases from other categories of exposures. The significance of having a clinical sample tested by PCR is that it is the only method by which the infecting sequence based type can be identified and subsequently compared with environmental samples from potential sources.

Table 9: Number and proportion, (%), of cases of Legionnaires' disease with sequence-based type identified by category of exposure, 2012 to 2014

Category	**2012** (%)	**2013** (%)	**2014** (%)
Community*	37 (22.0)	66 (34.4)	54 (29.0)
Nosocomial	6 (54.5)	2 (40.0)	3 (50.0)
Travel abroad	**16 (12.6)**	**19 (21.6)**	**30 (21.6)**

***** *includes UK travel cases*

Clusters and outbreaks

Unlike other respiratory diseases, Legionnaires' disease is contracted from environmental sources generating droplets or aerosols; thus, although the majority of cases reported to the national surveillance scheme are sporadic cases, every case has the potential to be the first case of an outbreak. All identified clusters/outbreaks are notified to the appropriate HPTs and travel clusters cases are reported to the European Legionnaires' Disease Surveillance Network (ELDSNet).

Overall since 2012 the number of clusters/outbreaks identified has been decreasing from 21 clusters/outbreaks in 2012 to 15 in 2014 (Table 10). No hospital associated clusters/outbreaks were identified during 2014 while the number of community clusters/outbreaks continued to fall with five in 2012, four in 2013 and only three in 2014. Clusters/outbreaks associated with travel abroad remained the same as 2013 at 11 clusters/outbreaks while UK-travel related clusters/outbreaks returned to 2012 levels of one cluster involving two cases.

Table 10: Number of outbreaks/clusters by category of exposure, 2012 to 2014

	2012		2013		2014	
	OB/Cl	**Cases**	**OB/Cl**	**Cases**	**OB/Cl**	**Cases**
Community	5	47	4	15	3	22
Nosocomial	5	15 (2)	-	-	-	-
Travel abroad	10	36 (3)	11	23 (2) [1]	11	28 [1]
Travel UK	1	2	3	7 (2)	1	2
Total	**21**	**100 (5)**	**18**	**45 (4) [1]**	**15**	**52 [1]**

( ) number of cases associated with cluster/outbreak with onset of symptoms in year(s) prior to identification of the cluster/outbreak. [ ] non-pneumonic cases

Travel associated Legionnaires' disease (TALD)

During 2014, 139 cases of Legionnaires' disease were reported to have travelled to one or more of 41 different countries during their incubation period; the most frequently visited destinations are listed in Table 11. As in previous years, Spain was the destination most frequently travelled to by cases during their incubation period, by residents of England and Wales in 2014. In 2013 India was reported to have the highest rate of infection at 7.6 cases per million visits but the rate has fallen to 5.9 cases per million visits, Table 11. However, in 2014 China had the highest rate of infection at 15.6 cases per million visits closely followed by Thailand, at a rate of 15.2 cases per million visits.

Table 11: Top travel destinations for reported Legionnaires' disease in residents of England and Wales 2014

Country	LD cases	Visits by UK residents**	Rate of cases per million visits
Spain	15	11,749,000	1.3
Italy	10	2,829,000	3.5
United Arab Emirates	7	626,000	11.2
Turkey	7	1,361,000	5.1
Greece	6	2,423,000	2.5
Thailand	6	394,000	15.2
India	5	842,000	5.9
China	5	320,000	15.6
Croatia	3	1,044,000	2.9
France	3	8,854,000	0.3
Antigua	3	501,000	6.0
Cyprus	2	678,000	3.0
Egypt	2	403,000	5.0
Portugal	2	2,111,000	1.0

** *According to 'Travel Trends' by the Office of National Statistics (2013)*

Eighteen of the 41 destinations travelled to by residents of England and Wales during 2014 were reported by ELDSNet to form one or more clusters associated with an accommodation site where one or more England and Wales residents stayed (Table 12). The highest number of clusters were associated with accommodation sites in the United Arab Emirates where there were five clusters involving seven England and Wales cases and nine cases from other member countries (ie countries also participating in ELDSNet). Greece and Italy both had four clusters involving five and six England and Wales cases respectively.

Table 12: Countries associated with clusters involving residents of England and Wales with onset of symptoms during 2014

Country of travel	No. clusters	No. associated cases
Antigua	1	3
Czech Republic	1	1
Cruise	1	1
Cyprus	2	3
Egypt	1	2
France	2	2
Greece	4	5
India	2	3
Indonesia	1	1
Ireland	1	1
Italy	4	6
Malta	1	1
Mauritius	1	1
Spain	3	4
Thailand	3	3
Tunisia	1	1
Turkey	3	7
United Arab Emirates	5	7

References

1. Fraser DW, Tsai TR, Orenstein W *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, *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, *et al* (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 *et al* 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, Navarro C, Fenoll D *et al* (2003). Legionnaires ' disease Outbreak in Murcia, Spain. Emerge Infect Dis. **9**(8): 915-921

7. Bennett E, Ashton M, Calvert N *et al* (2014) Barrow-in-Furness: a large community legionellosis outbreak in the UK. Epidemiol. Infect. **142**(8), 1763–1777

8. Macfarlane J, Worboys M (2012) Showers, Sweating and Suing: Legionnaires' disease and 'New' Infections in Britain, 1977-90. Med Hist. **56**(1):72-93

9. Health Protection Agency (2006) National increase in cases of Legionnaires' disease. CDR weekly; 16 (**37**).

10. FC Naik, H Zhao, TG Harrison et al. (2012) Legionnaires' disease in England and Wales – 2011. HPR 6(**44**)

11. Marston BJ, Lipman HB, Breiman RF (1994) Surveillance for Legionnaires' disease. Risk factors for morbidity and mortality. Arch Intern Med **154**(21), 2147-22.

12. Ricketts KD, Charlett A, Gelb D et al (2009). Weather patterns and Legionnaires' disease: a meteorological study. Epidemiol Infect; **137** (7):1003-12.

13. Den Boer JW, Nijhof J, Friesema I. (2006) Risk factors for sporadic community-acquired Legionnaires' disease. A 3-year national case–control study. Public Health 120 (**6**), 566–571

14. England AC, Fraser DW (1981) Sporadic and epidemic nosocomial legionellosis in the United States: Epidemiologic features Am J Med. **70**(3): 707-11

15. Whiley H, Bentham R (2011) *Legionella longbeachae* and Legionellosis. Emerg Infect Dis. **17**(4): 579-583.

16. Harrison TG, Afshar B, Doshi N et al (2009) Distribution of Legionella pneumophila serogroups, monoclonal antibody subgroups and DNA sequence types in recent clinical and environmental isolates from England and Wales (2000–2008). Eur J Clin Microbiol Infect Dis 28:781–791