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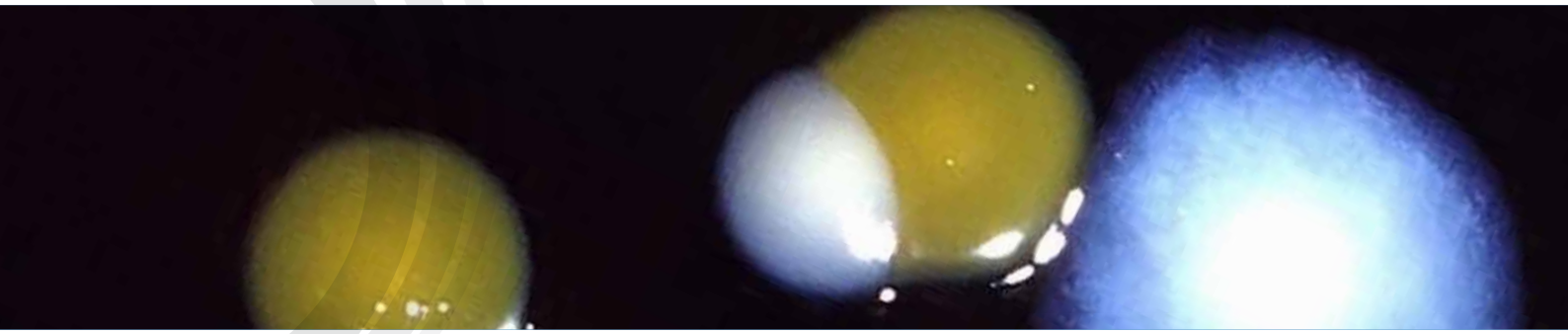

Legionnaires' disease in Europe

2015

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Abbreviations

CF	Case fatality
CI	Confidence interval
EEA	European Economic Area
ELDSNet	European Legionnaires' Disease Surveillance Network
ESCMID	European Society of Clinical Microbiology and Infectious Diseases
ESGLI	ESCMID study group for legionella infections
EU	European Union
EWGLINET	The European surveillance scheme for travel associated Legionnaires' disease (2002–2010)
IQR	Interquartile range
LD	Legionnaires' disease
MAb	Monoclonal antibodies
NUTS	Nomenclature of territorial units for statistics
PCR	Polymerase chain reaction
PR	Prevalence ratio
TALD	Travel-associated Legionnaires' disease
TESSy	The European Surveillance System
UAT	Urinary antigen test

Executive summary

This surveillance report is based on Legionnaires' disease (LD) surveillance data collected for 2015. The surveillance is carried out by the European Legionnaires' Disease Surveillance Network (ELDSNet) and coordinated by the European Centre for Disease Prevention and Control (ECDC) in Stockholm. Data were collected by appointed ELDSNet experts in each European country and electronically reported to The European Surveillance System (TESSy) database.

The surveillance data are from two different schemes:

- Cases reported from European Union (EU) Member States, Iceland and Norway, with the following objectives:
  - to monitor trends over time and to compare them across Member States
  - to provide evidence-based data for public health decisions and actions at EU and/or Member State level
  - to monitor and evaluate prevention and control programmes targeting LD at national and European level
  - to identify population groups at risk and in need of targeted preventive measures.
- Reports of travel-associated cases of Legionnaires' disease (TALD), including reports from countries outside the EU/EEA. This approach aims primarily at identifying clusters of cases that may otherwise not have been detected at the national level, thus enabling timely investigations and control measures at the implicated accommodation sites in order to prevent further infections.

All notified cases

For 2015, 7 034 cases of LD were reported by 28 EU Member States, plus Iceland and Norway. The number of notifications per 100 000 inhabitants was 1.37, which was the highest ever observed. Four countries (France, Germany, Italy, and Spain) accounted for 69% of cases. Notification rates ranged from 0.01 per 100 000 inhabitants in Bulgaria to 5.14 per 100 000 in Slovenia. Most cases (69%) with known probable setting of infection were community-acquired, while 22% were travel-associated, and 8% were linked to healthcare facilities. Cases over 50 years of age accounted for 81% of all cases. The male-to-female ratio was 2.5. Case fatality was 8% in 2015, comparable to previous years.

Most cases (89%) were confirmed by urinary antigen test, and approximately 13% were culture-confirmed, but an increasing proportion of cases (10%) are reported to have been diagnosed by PCR. *L. pneumophila* serogroup 1 was the most commonly identified pathogen, accounting for 81% of culture-confirmed cases.

ECDC is giving priority to assisting countries with notification rates below one per million inhabitants to improve both diagnosis and reporting of LD.

Travel-associated Legionnaires' disease

For 2015, 1 141 cases of TALD were reported by 22 EU/EEA countries and three other countries. This is lower than the total number of reported TALD cases because cases who stayed with relatives or friends are not reported under this scheme. The case numbers for 2015 were 20% higher than in 2014 (955 cases). Six countries (the United Kingdom, Italy, France, the Netherlands, Germany and Spain) reported three quarters of the cases. The 1 141 TALD cases made a total of 1 606 international journeys, 1 221 (76%) of which were within the EU/EEA. Similar to previous years, there were twice as many male than female cases, and the median age was 62 years.

A total of 155 standard clusters[1] was detected, 17% more than in the previous year, which is in line with the overall increase in cases. Satisfactory control measures were implemented in a timely manner in all but eight notified clusters, with ELDSNet receiving feedback from a first risk assessment within two weeks and a final assessment within six weeks. The eight remaining accommodation site names were temporarily published on the ECDC website.

Sixty percent of the clusters of travel-associated Legionnaires' disease involved cases from different countries and would probably not have been detected without the international collaboration in ELDSNet.

[1] Clusters associated with only one accommodation site.

1 Background

Legionnaires' disease (LD) is a severe and sometimes fatal form of an infection with *Legionella* spp. These gram-negative bacteria are found in freshwater and soil worldwide and tend to contaminate man-made water systems [1]. The disease was first described and named after a large outbreak among members of a US organisation of war veterans (American Legion) in the 1970s [2]. People are infected through inhalation of contaminated aerosols or aspiration of contaminated water. Person-to-person transmission has only been reported once [3]. LD is typically described as a severe pneumonia that may be accompanied by systemic symptoms such as fever, diarrhoea, myalgia, impaired renal and liver functions, and delirium. Known risk factors for LD include increasing age, being of male sex, smoking, chronic lung disease, diabetes, and various conditions associated with immunodeficiency [4]. In Europe, most cases (approximately 70%) are community-acquired and sporadic [5]. Studies suggest that the incidence of LD may be higher under certain environmental conditions such as warm and wet weather [6,7].

Legionnaires' disease is notifiable in all EU and EEA countries, but is thought to be underreported for two main reasons. Firstly, it is underdiagnosed by clinicians who only rarely test patients for LD before empirically prescribing broad-spectrum antibiotics likely to cover *Legionella* spp. Secondly, some health professionals fail to notify cases to health authorities [1].

The reported situation in Europe is heterogeneous, with a broad range of notification rates across countries reflecting both the quality of the national surveillance system and the local risk for LD. Some countries (e.g. France, Italy or the Netherlands) have already assessed their systems' sensitivity, mainly through capture-recapture studies, and showed improvement over time [8–10]. For other countries such as Greece, a study using TALD notification and tourism denominator data strongly suggested substantial under-ascertainment [11]. In eastern and south-eastern countries (e.g. Bulgaria, Poland or Romania), the numbers of cases reported have remained very low and are unlikely to reflect the true burden of LD [12,13]. Differences in laboratory practice may also partly explain these differences in notification rates [14].

Since 2010, the surveillance of LD in Europe has been operated by ELDSNet under the coordination of ECDC. Two distinct LD surveillance systems are currently in place. One is based on an annual reporting of all LD cases, the other on the daily reporting of TALD cases. Since some countries are unable to link the two reporting methods (i.e. TALD cases reported daily and those reported annually), it is not possible to merge the two databases.

This is the seventh annual report presenting the analysis of disaggregated LD surveillance data in Europe and the sixth annual report covering both surveillance systems [14].

2 Methods

2.1 The European Legionnaires' Disease Surveillance Network

ELDSNet involves 28 EU Member States, plus Iceland and Norway. The network aims to identify relevant public health risks, enhance the prevention of cases through the detection of clusters, and monitor epidemiological trends. The latter objective provides the rationale for the annual collection, analysis and reporting of LD cases notified during the previous year.

2.2 Data collection

2.2.1 Legionnaires' disease

National data collected by appointed ELDSNet members in each country were electronically reported to the TESSy database, following a strict protocol. The deadline for 2015 data submission was 1 May 2016. Following data validation and cleaning, data for analysis were extracted on 8 February 2017. All LD cases in 2015 meeting the European case definition (see box below) were included.

The EU case definition was amended in August 2012, and since then it has no longer been possible to report probable cases by only referring to an epidemiological link. TALD cases with a history of travelling abroad were reported by their country of residence. Cases are classified as travel-associated if they stayed at an accommodation site away from home during an incubation period of two to ten days prior to falling ill.

EU case definition of Legionnaires' disease [15]

Clinical criteria

Any person with pneumonia

Laboratory criteria for case confirmation

At least one of the following three:

- Isolation of *Legionella* spp. from respiratory secretions or any normally sterile site;
- Detection of *Legionella pneumophila* antigen in urine;
- Significant rise in specific antibody level to *Legionella pneumophila* serogroup 1 in paired serum samples.

Laboratory criteria for a probable case

At least one of the following four:

- Detection of *Legionella pneumophila* antigen in respiratory secretions or lung tissue e.g. by DFA staining using monoclonal-antibody-derived reagents;
- Detection of *Legionella* spp. nucleic acid in respiratory secretions, lung tissue or any normally sterile site;
- Significant rise in specific antibody level to *Legionella pneumophila* other than serogroup 1 or other *Legionella* spp. in paired serum samples;
- Single high level of specific antibody to *Legionella pneumophila* serogroup 1 in serum.

Case classification

Probable case: Any person meeting the clinical criteria AND at least one positive laboratory test for a probable case.

Confirmed case: Any person meeting the clinical AND the laboratory criteria for case confirmation.

2.2.2 Travel-associated Legionnaires' disease

Individual cases of TALD are reported to ECDC on a daily basis via TESSy. The reporting country is generally the country where the case is diagnosed. Therefore, the reporting country can differ from the case's country of residence. Case reports include age, sex, date of onset of disease, method of diagnosis and travel information for the places where the case had stayed from two to ten days prior to onset of disease. Only cases who stayed at a commercial (or public) accommodation site are reported (as opposed to cases of LD who stayed with relatives or friends). After receiving the report, each new case is classified as a single case or as part of a cluster, in accordance with the definitions agreed by the network:

- A single case: a person who stayed at a commercial accommodation site in the two to ten days before onset of disease; the site has not been associated with any other case of Legionnaires' disease in the previous two years.
- A cluster: two or more cases who stayed at the same commercial accommodation site in the two to ten days before onset of disease, and whose dates of onset were within the same two-year period.

If two or more clusters have at least one case in common, the combined cluster is notified as a 'complex cluster'. A cluster of three cases or more, with onset of disease within a three-month period, is called a 'rapidly evolving cluster', and a summary report is sent to tour operators. When a cluster is detected, an investigation by public health authorities is required at the accommodation site. Preliminary results from such a risk assessment and the initiation of control measures should be reported back to ELDSNet by nationally appointed contact points within two weeks of the alert, using a preliminary form (Form A). A final form (Form B) is then used to report – within a further four weeks – the final results of environmental sampling and control measures. If the forms are not returned timely, or if they state that actions and control measures are unsatisfactory, ECDC publishes the name of the accommodation site associated with the cluster on its website and informs tour operators accordingly.

2.2.3 Event-based surveillance

ECDC identifies and monitors health threats through epidemic intelligence activities from a broad range of formal and informal sources on a daily basis. These threats, including outbreaks of Legionnaires' disease, are documented and monitored through a dedicated database and a standard protocol. Experts evaluate and select threats that may require further attention by the nationally appointed contact points, depending on the potential impact these threats could have on the health of EU residents. More details on tools used for threat detection and threat communication can be found on an ECDC webpage dedicated to epidemic intelligence [16].

In 2016, ELDSNet started a new data collection for outbreaks of non-travel associated Legionnaires' disease. Data from the previous year are collected using a standardised questionnaire and submitted as an Excel spreadsheet. Data categories include the reporting country, the number of outbreaks, the size of the outbreaks, epidemiological and microbiological information of the investigation, and whether a vehicle or source was found.

2.3 Data analysis

2.3.1 Legionnaires' disease

Cases that were reported without specifying the laboratory method were excluded from the analysis. Since countries use diverse dates for national statistical purposes, TESSy collects the so-called 'date used for statistics' which can be the date of onset, diagnosis, or notification. Only cases with a 2015 date used for statistics were included in the analysis. Since environmental investigations are the responsibility of the Member States, we only analysed variables related to investigations of domestic cases.

The distribution of cases and subsets with a fatal outcome were described by relevant independent variables. Continuous variables were summarised as medians with interquartile ranges (IQRs [Q1–Q3]) and compared across strata by using the Mann-Whitney U test. Prevalence ratios were calculated to test possible associations between categorical variables and are presented with their 95% confidence intervals, assuming a Poisson distribution. Age-standardised rates were calculated using the direct method and the average age structure of the EU population for the period 2000–2010.

2.3.2 Travel-associated Legionnaires' disease

We analysed the TALD data at the level of cases, travel visits and accommodation sites, and clusters. All reported cases with a date of onset in 2015 and their travel records were included in the analysis. For cases, we analysed epidemiological and diagnostic characteristics and described the temporal and geographic distribution. The number of travel visits and clusters were mapped at country level. The number of clusters within the EU/EEA was additionally mapped at level 2 of the nomenclature of territorial units for statistics (NUTS 2).

3 Results

3.1 Legionnaires' disease

3.1.1 Cases

Case validation and data completeness

For 2015, 7 034 cases were reported by 30 countries.

Overall, data completeness[2] was stable between 2011 and 2015 (Table 1), with an increasing proportion of cases that were reported with a known outcome.

Table 1. Completeness of reporting for Legionnaire' disease cases, selected variables, EU/EEA, 2011–2015

Variable	2011 %	2012 %	2013 %	2014 %	2015 %
Date of onset (complete date)	97.7	98.3	95.2	94.8	94.6
Outcome (not reported as unknown)	69.9	71.1	76.8	79.1	80.2
Probable country of infection [a] (not missing)	97.3	93.7	94.4	91.6	94.9
Place of residence (not missing or not reported at country level)	47.5	41.0	49.5	60.7	55.1
Sequence type (not missing)	3.3	4.1	4.2	4.4	4.3
Setting of infection (not missing or reported as unknown)	90.8	88.2	88.8	86.5	87.4
Environmental investigation (not reported as unknown)	39.9	49.2	62.4	67.9	48.5
Legionella found [b] (not missing or reported as unknown)	92.1	90.4	97.6	91.2	95.1
Positive sampling site [c] (not missing or reported as unknown)	82.7	77.9	94.5	99.9	97.8

[a] *Completeness determined in cases reported to have been imported.*
[b] *Completeness determined in cases reported to have prompted an environmental investigation.*
[c] *Completeness determined in cases for which positive findings in an environmental investigation were reported.*

Case classification and notification rate

Of the 7 034 notified cases, 6 570 (93.4%) were classified as confirmed and the remaining 464 (6.6%) as probable. Of 464 probable cases, 201 (43.3%) were reported by Germany. In 2015, the overall notification rate of Legionnaires' disease was 1.37 per 100 000 population, which was the highest ever observed (Figure 1).

[2] Data completeness was calculated at time of analysis. Since reporting countries have the possibility to update their data, completeness for earlier years might differ from what was presented in previous reports.

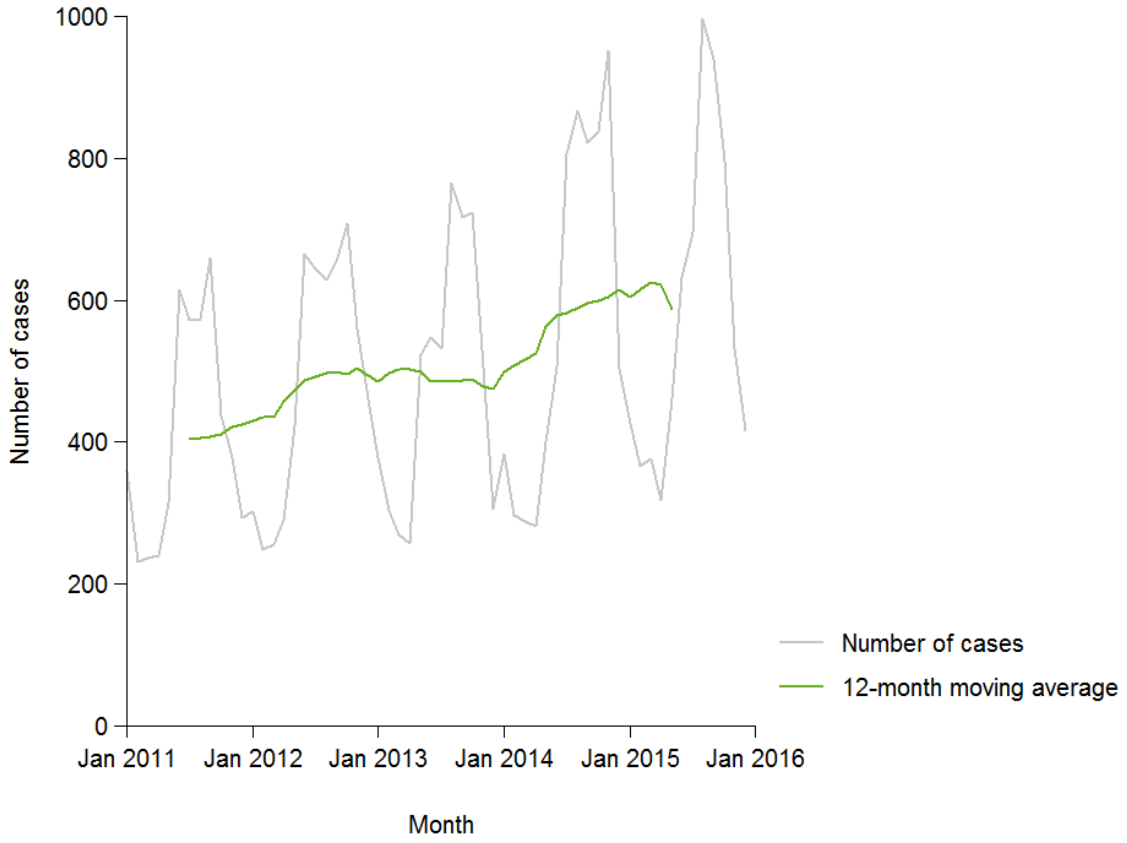
Figure 1. Notification rate of Legionnaires' disease in the EU/EEA*, by year of reporting, 1995–2015

** EWGLINET member countries not belonging to the EU/EEA were excluded for 1995–2008.*

Seasonality and geographical distribution

Of the 6 960 cases that were reported with a timestamp for the month of reporting, 4 062 (58.4%) were reported between June and October. The number of cases increased over the 2011–2015 period (Figure 2).

Figure 2. Number of Legionnaires' disease cases by month of reporting, EU/EEA, 2011–2015



Country-specific notification rates ranged from 0.01 cases per 100 000 inhabitants in Bulgaria to 5.14 per 100 000 in Slovenia (Figure 3 and Table 2). The four largest reporting countries (France, Germany, Italy, and Spain) accounted for 69% of cases. Conversely, the 15 lowest reporting countries merely accounted for 3% of cases (Table 2). Age-standardised notification rates did not differ substantially from crude notification rates (Table 2).

Figure 3. Notifications of Legionnaires' disease per 100 000 population, by reporting country, EU/EEA, 2015

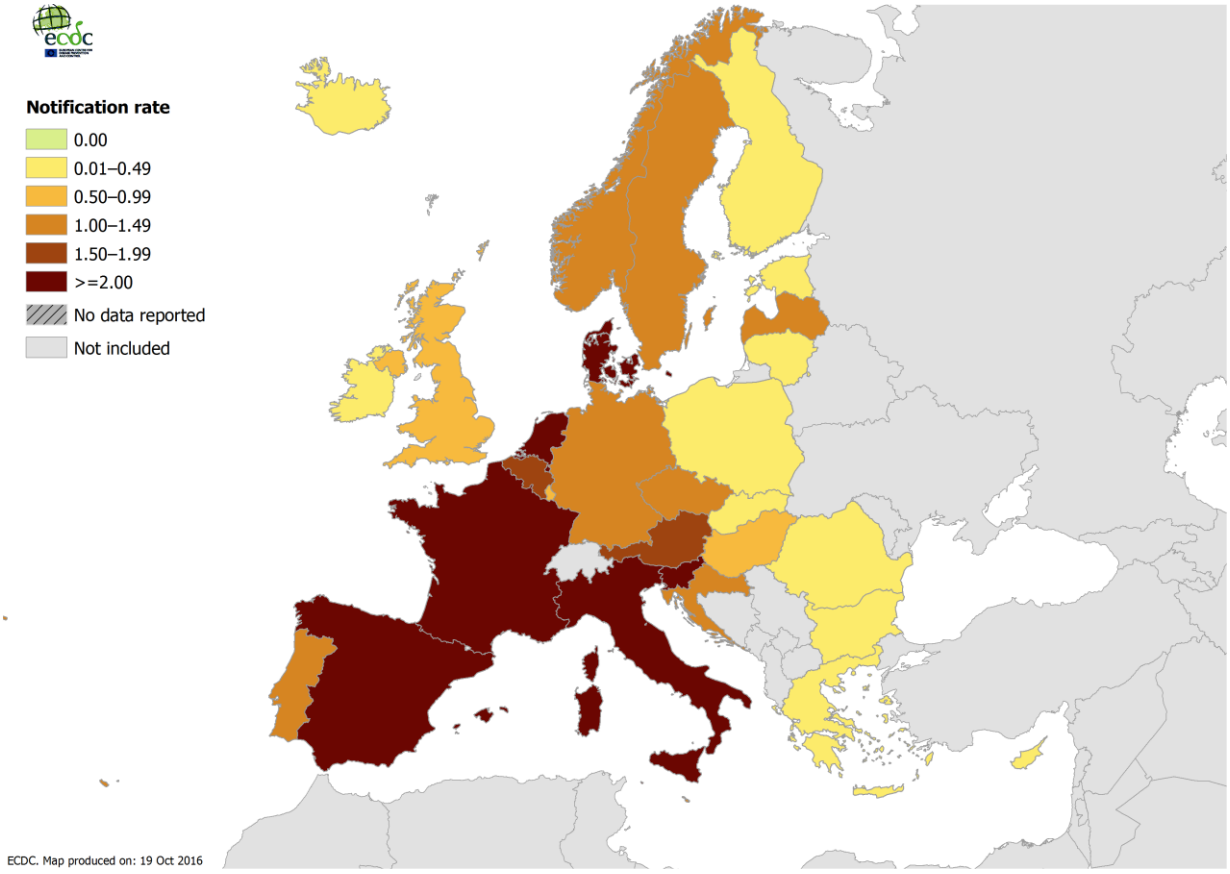


Table 2. Reported cases and notifications of Legionnaires' disease per 100 000 population, by reporting country, EU/EEA, 2015

Country	Cases[a] (n)	Population (n)	Notification rate (n/100 000)	Age-standardised notification rate (n/100 000)	Average notification rate 2010–14 (n/100 000)
Slovenia	106	2 062 874	5.14	4.98	3.57
Denmark	185	5 659 715	3.27	3.24	2.52
Italy	1 553	60 795 612	2.55	2.23	2.26
Netherlands	419	16 900 726	2.48	2.39	2.01
Spain	1 024	46 449 565	2.21	2.12	1.86
France	1 389	66 415 161	2.09	2.07	1.97
Austria	160	8 576 261	1.87	1.79	1.40
Belgium	165	11 258 434	1.47	1.44	1.14
Sweden	142	9 747 355	1.46	1.42	1.32
Portugal	145	10 374 822	1.40	1.30	2.02
Malta	6	429 344	1.40	1.38	1.38
Norway	60	5 166 493	1.16	1.22	0.83
Czech Republic	120	10 538 275	1.14	1.10	0.78
Croatia	48	4 225 316	1.14	1.08	-
Latvia	22	1 986 096	1.11	1.09	1.89
Germany	865	81 197 537	1.07	0.95	0.93
Luxembourg	5	562 958	0.89	0.91	1.04
United Kingdom	412	64 875 165	0.64	0.65	0.55
Hungary	58	9 855 571	0.59	0.56	0.38
Estonia	6	1 313 271	0.46	0.43	0.51

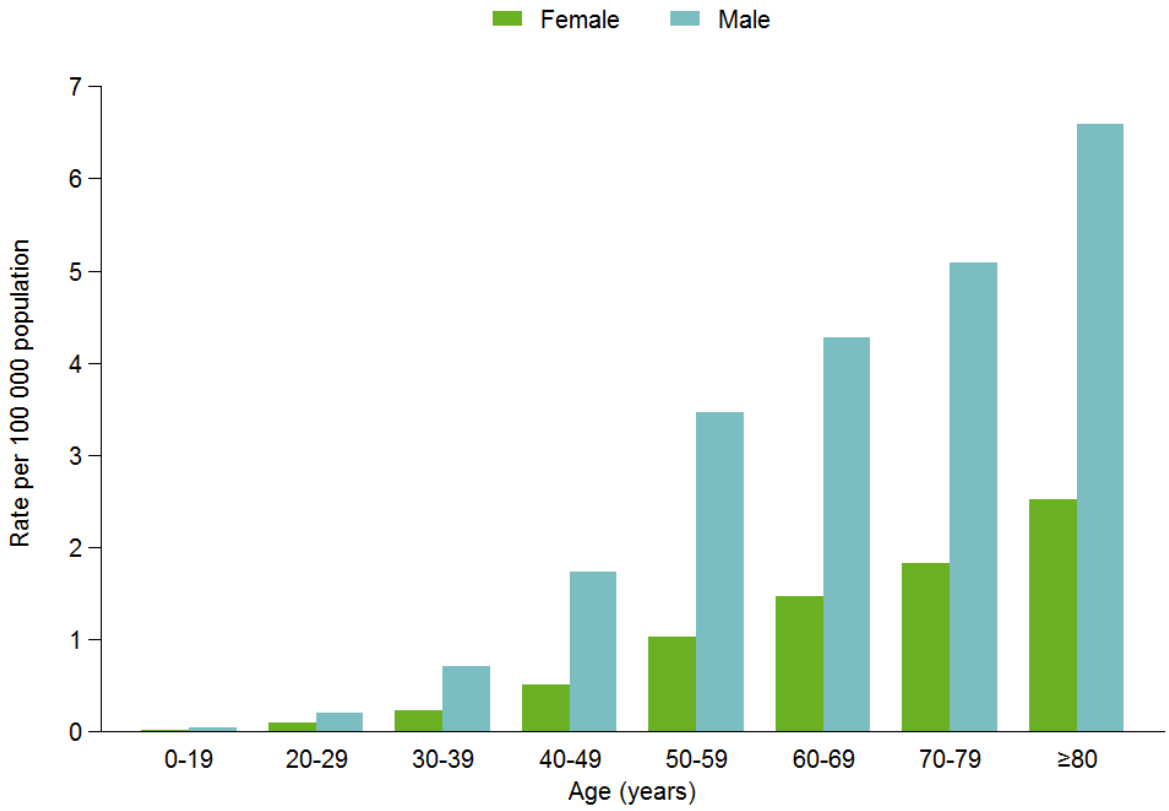
Country	Cases [a] (n)	Population (n)	Notification rate (n/100 000)	Age-standardised notification rate (n/100 000)	Average notification rate 2010–14 (n/100 000)
Finland	17	5 471 753	0.31	0.27	0.22
Iceland	1	329 100	0.30	0.36	0.62
Greece	29	10 858 018	0.27	0.25	0.26
Slovakia	14	5 421 349	0.26	0.27	0.17
Lithuania	7	2 921 262	0.24	0.25	0.18
Ireland	11	4 628 949	0.24	0.30	0.24
Cyprus	2	847 008	0.24	0.25	0.51
Poland	23	38 005 614	0.06	0.06	0.04
Romania	5	19 870 647	0.03	0.03	0.01
Bulgaria	1	7 202 198	0.01	0.01	0.01
EU/EEA total	**7 000**	**513 946 449**	**1.37**	**1.31**	**1.20**

[a] *Cases with known age and sex.*

Age and sex

The median age at date of onset was 63 years (IQR 53–74). It was significantly higher in females (67 years, IQR 55–78) than in males (62 years, IQR 52–73) ($p<0.01$). Notification rates increased with age, with a maximum of 6.60 cases per 100 000 population in males aged 80 years and older (Figure 4). People older than 50 years of age accounted for 5 699 (81.4%) of 7 000 cases with known age and sex. Of the 7 000 cases with known age and sex, 4 989 (71.3%) were male. In all age groups, LD was more common in males, with an overall male-to-female ratio of 2.5:1. The male-to-female ratio peaked at 3.4 in the age group of 40–49 years.

Figure 4. Notification rates of Legionnaires' disease per 100 000, by sex and age group, EU/EEA, 2015



Settings

Of 6 144 cases with reported setting of infection, 4 226 (68.8%) were reported as community-acquired (Table 3). In 2015, travel-related and healthcare-associated cases accounted for 21.7% and 7.7% of the total, respectively. The remaining cases (1.9%) were reported with other probable settings of infection. The distribution of cases by probable setting of infection has remained unchanged since 2008. Healthcare-associated cases represented a substantial proportion of cases in older age groups and in those under 20 years of age (Table 4).

Table 3. Reported cases of Legionnaires' disease, by country and setting of infection, EU/EEA, 2015a

Country	Community		Nosocomial		Other healthcare		Travel abroad		Domestic travel		Other		Total	
	n	(%)	n	(%)	n	(%)	n	(%)	n	(%)	n	(%)	n	(%)
Austria	115	(71.9)	7	(4.4)	1	(0.6)	34	(21.3)	3	(1.9)	0		160	(100)
Belgium [b]	29	(51.8)	4	(7.1)	2	(3.6)	19	(33.9)	2	(3.6)	0		56	(100)
Bulgaria	1	(100)	0	(0.0)	0	(0.0)	0		0	(0.0)	0		1	(100)
Croatia	45	(93.8)	2	(4.2)	0	(0.0)	0		1	(2.1)	0		48	(100)
Czech Republic	88	(82.2)	6	(5.6)	0	(0.0)	5	(4.7)	6	(5.6)	2	(1.9)	107	(100)
Denmark	98	(60.5)	13	(8.0)	7	(4.3)	43	(26.5)	1	(0.6)	0		162	(100)
Estonia	4	(66.7)	1	(16.7)	0	(0.0)	1	(16.7)	0	(0.0)	0		6	(100)
Finland	6	(37.5)	0	(0.0)	0	(0.0)	10	(62.5)	0	(0.0)	0		16	(100)
France	820	(59.2)	107	(7.7)	61	(4.4)	107	(7.7)	197	(14.2)	93	(6.7)	1 385	(100)
Germany [b]	234	(57.4)	18	(4.4)	7	(1.7)	107	(26.2)	42	(10.3)	0	(0.0)	408	(100)
Greece	19	(65.5)	1	(3.4)	0	(0.0)	6	(20.7)	2	(6.9)	1	(3.4)	29	(100)
Hungary [b]	0		18	(81.8)	0	(0.0)	1	(4.5)	0	(0.0)	3	(13.6)	22	(100)
Iceland	0		0		0	(0.0)	1	(100)	0	(0.0)	0		1	(100)
Ireland	6	(54.5)	0		0	(0.0)	3	(27.3)	2	(18.2)	0		11	(100)
Italy	1 221	(78.5)	83	(5.3)	37	(2.4)	25	(1.6)	178	(11.4)	12	(0.8)	1 556	(100)
Latvia	19	(90.5)	0	(0.0)	0	(0.0)	0		2	(9.5)	0		21	(100)
Lithuania [b]	1	(33.3)	1	(33.3)	0	(0.0)	0		1	(33.3)	0		3	(100)
Luxembourg [b]	0		0		0	(0.0)	2	(100)	0	(0.0)	0		2	(100)
Netherlands	242	(57.9)	2	(0.5)	3	(0.7)	147	(35.2)	24	(5.7)	0		418	(100)
Norway	23	(38.3)	0		0	(0.0)	37	(61.7)	0	(0.0)	0		60	(100)
Poland b	2	(28.6)	0		0	(0.0)	5	(71.4)	0	(0.0)	0		7	(100)
Portugal [b]	75	(68.8)	11	(10.1)	6	(5.5)	9	(8.3)	8	(7.3)	0		109	(100)
Slovakia	9	(64.3)	2	(14.3)	0	(0.0)	3	(21.4)	0	(0.0)	0		14	(100)
Slovenia	103	(97.2)	0		0	(0.0)	3	(2.8)	0	(0.0)	0		106	(100)
Spain	916	(89.5)	34	(3.3)	21	(2.1)	12	(1.2)	35	(3.4)	6		1 024	(100)
United Kingdom	150	(36.4)	14	(3.4)	1	(0.2)	205	(49.8)	42	(10.2)	0		412	(100)
Total	**4 226**	**(68.8)**	**324**	**(5.3)**	**146**	**(2.4)**	**785**	**(12.8)**	**546**	**(8.9)**	**117**	**(1.9)**	**6 144**	**(100)**

[a] *Cyprus, Malta, Romania, and Sweden did not report setting of infection.*
[b] *Country reported 50% or more cases without probable setting of infection.*

Table 4. Reported cases of Legionnaires' disease by setting of infection and age group, EU/EEA, 2015

Country	Community		Nosocomial		Other healthcare		Travel abroad		Domestic travel		Other		Total	
	n	(%)	n	(%)	n	(%)	n	(%)	n	(%)	n	(%)	n	(%)
0-19	16	(66.7)	6	(25.0)	0		2	(8.3)	0		0		24	(100)
20-29	63	(76.8)	4	(4.9)	0		10	(12.2)	3	(3.7)	2	(2.4)	82	(100)
30-39	207	(74.7)	3	(1.1)	3	(1.1)	26	(9.4)	28	(10.1)	10	(3.6)	277	(100)
40-49	532	(72.7)	19	(2.6)	5	(0.7)	97	(13.3)	61	(8.3)	18	(2.5)	732	(100)
50-59	958	(68.6)	49	(3.5)	7	(0.5)	230	(16.5)	112	(8.0)	41	(2.9)	1 397	(100)
60-69	977	(66.7)	78	(5.3)	10	(0.7)	235	(16.0)	147	(10.0)	18	(1.2)	1 465	(100)
70-79	783	(65.1)	92	(7.6)	30	(2.5)	148	(12.3)	134	(11.1)	16	(1.3)	1 203	(100)
≥80	687	(71.5)	73	(7.6)	91	(9.5)	37	(3.9)	61	(6.3)	12	(1.2)	961	(100)
Total	**4 223**	**(68.8)**	**324**	**(5.3)**	**146**	**(2.4)**	**785**	**(12.8)**	**546**	**(8.9)**	**117**	**(1.9)**	**6 141**	**(100)**

Time to diagnosis

Both date of onset and date of diagnosis were available in only 26.8% of cases (1 884/7 034). The median time from date of onset to diagnosis was five days (IQR 3–7), similar to previous years.

3.1.3 Mortality

Time and location

The reported mortality rate of LD in 2015 was 0.09 cases per 100 000 inhabitants, which was consistent with the rates recorded since 2008, which have been hovering between 0.07 and 0.09 per 100 000. Of 5 642 cases with a known outcome, 456 were reported to have died, giving a case–fatality ratio (CFR) of 8.1%. In countries that reported less than 25% of cases with unknown outcome, the average CFR was 7.6% (Table 5).

Table 5. Reported outcome of Legionnaires' disease and case–fatality ratio by reporting country, EU/EEA, 2015

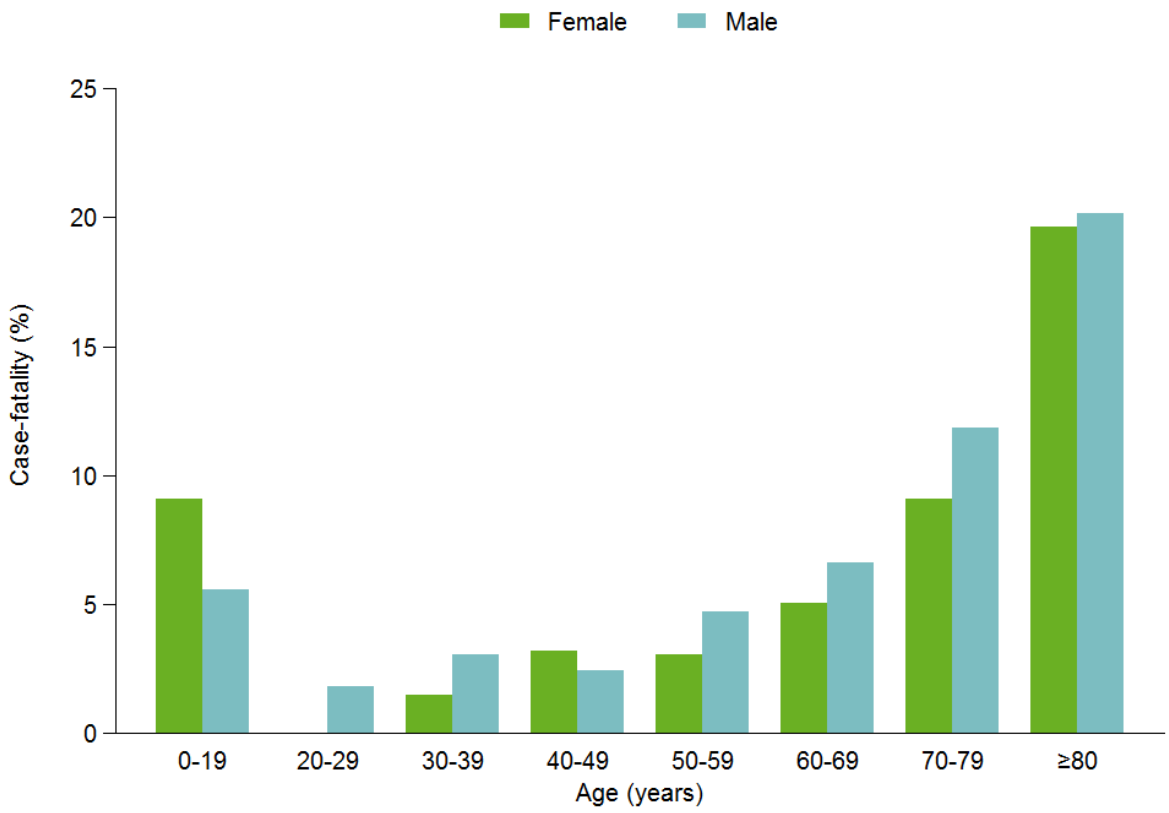
	Survival		Death		Unknown		Total	Case fatality [a]
Country	n	(%)	n	(%)	n	(%)	n	%
Ireland	8	(72.7)	3	(27.3)	0	(0.0)	11	27.3
Poland	19	(82.6)	4	(17.4)	0	(0.0)	23	17.4
Malta	5	(83.3)	1	(16.7)	0	(0.0)	6	16.7
Czech Republic	102	(85.0)	18	(15.0)	0	(0.0)	120	15.0
Hungary	50	(86.2)	8	(13.8)	0	(0.0)	58	13.8
Sweden	124	(87.3)	18	(12.7)	0	(0.0)	142	12.7
Denmark	164	(88.6)	21	(11.4)	0	(0.0)	185	11.4
Spain	709	(69.2)	72	(7.0)	243	(23.7)	1 024	9.2
France	1 182	(85.1)	117	(8.4)	90	(6.5)	1 389	9.0
United Kingdom	387	(93.9)	25	(6.1)	0	(0.0)	412	6.1
Slovenia	100	(94.3)	6	(5.7)	0	(0.0)	106	5.7
Germany	780	(90.2)	44	(5.1)	41	(4.7)	865	5.3
Portugal	132	(91.0)	7	(4.8)	6	(4.1)	145	5.0
Latvia	21	(95.5)	1	(4.5)	0	(0.0)	22	4.5
Greece	25	(86.2)	1	(3.4)	3	(10.3)	29	3.8
Austria	154	(96.3)	6	(3.8)	0	(0.0)	160	3.8
Netherlands	405	(96.7)	13	(3.1)	1	(0.2)	419	3.1
Croatia	47	(97.9)	1	(2.1)	0	(0.0)	48	2.1
Bulgaria	1	(100)	0	(0.0)	0	(0.0)	1	0.0
Cyprus	2	(100)	0	(0.0)	0	(0.0)	2	0.0
Estonia	6	(100)	0	(0.0)	0	(0.0)	6	0.0
Iceland	1	(100)	0	(0.0)	0	(0.0)	1	0.0
Romania	5	(100)	0	(0.0)	0	(0.0)	5	0.0
Slovakia	14	(100)	0	(0.0)	0	(0.0)	14	0.0
Belgium	74	(37.8)	5	(2.6)	117	(59.7)	196	NA [b]
Finland	0	(0.0)	0	(0.0)	17	(100)	17	NA
Italy	621	(39.9)	80	(5.1)	855	(54.9)	1 556	NA
Lithuania	4	(57.1)	1	(14.3)	2	(28.6)	7	NA
Luxembourg	3	(60.0)	0	(0.0)	2	(40.0)	5	NA
Norway	41	(68.3)	4	(6.7)	15	(25.0)	60	NA
Subtotal	5 186	(73.7)	456	(6.5)	1 392	(19.8)	7 034	8.1
EU/EEA total [c]	**4 443**	**(85.6)**	**366**	**(7.0)**	**384**	**(7.4)**	**5 193**	**7.6**

[a] *Denominator: cases with known outcome (survivals and deaths)*
[b] *Not applicable if ≥25% of outcomes unknown*
[c] *Includes only countries where <25% of outcomes unknown*

Age and sex

Case–fatality ratio was higher for older age groups in males and females (Figure 5). In people over 50 years of age, the CFR increased with age, showing a similar pattern in males and females. In older age groups, the CFR was slightly higher in males than females.

Figure 5. Reported case–fatality ratio of Legionnaires' disease by sex and age group, EU/EEA, 2015



Settings

The CFR was almost four times higher in healthcare-associated cases (nosocomial and other healthcare) than in community-acquired cases (Table 6). This is not surprising since healthcare-associated cases are probably more likely to have underlying conditions. Cases with a history of travel abroad had the lowest CFR. This could be due to a healthy traveller effect.

Table 6. Reported case fatality of Legionnaires' disease by setting, EU/EEA, 2015

Setting	Deaths n	Total n	CF %
Other healthcare	35	122	28.7
Nosocomial	76	271	28.0
Community	238	3 245	7.3
Domestic travel	27	412	6.6
Travel abroad	17	739	2.3
Other	3	104	2.9
Total	**396**	**4 893**	**8.1**

Adjusted predictors for fatal outcome

In a multivariable analysis adjusted for age and sex, healthcare-associated cases were significantly associated with a higher risk for fatal outcome (Table 7). Both being female and a history of travel abroad were protective.

Table 7. Adjusted predictors of fatal outcome of Legionnaires' disease, EU/EEA, 2015 (n=4 879)

Risk factor	Odds ratio	95%CI	P-value	Cases exposed %
Age	1.05	1.04-1.06	<0.01	100
Sex				
Female	1 (ref.)			28.9
Male	1.40	1.10-1.79	0.01	71.1
Probable setting of infection				
Community	1 (ref.)			66.4
Nosocomial	4.37	3.21-5.96	<0.01	5.6
Other healthcare	2.67	1.72-4.15	<0.01	2.5
Travel abroad	0.36	0.22-0.59	<0.01	15.0
Domestic travel	0.88	0.58-1.34	0.56	8.5
Other	0.47	0.15-1.51	0.21	2.1

3.1.4 Clinical and environmental microbiology

Laboratory methods

For the 7 034 cases reported, 8 052 laboratory tests were performed, 6 234 (77.4%) of which were urinary antigen detections. Of the 30 countries reporting cases, 11 reported more than one test per case, with an average of 1.3 tests per case. The distribution of tests varied greatly across countries (Table 8).

Culture confirmations were not reported by 13 countries, but accounted for 41.1% of diagnoses in Denmark and 83.3% in Estonia. Of the countries not reporting any culture confirmations in 2015, seven (Bulgaria, Croatia, Cyprus, Latvia, Lithuania, Malta, Romania) have never reported any culture confirmation. Some large reporting countries such as Italy or Spain relied almost exclusively on urinary antigen tests (UAT). Of 7 034 cases, 6 234 (88.6%) were UAT-positive, a proportion similar to 2014. Over the past five years, the proportion of PCR-diagnosed cases continuously increased from below 2.5% in 2010 to 10.5% in 2015. In 2015, the proportion of PCR-ascertained cases was at least 20% in five countries (the Czech Republic, Denmark, Luxembourg, Sweden, and the UK). In Denmark, this proportion was above 75%.

Table 8. Reported laboratory methods and proportion of cases reported for each method, by reporting country, EU/EEA, 2015

Country	Laboratory test method*												Total tests	Total cases
	Urinary antigen		Culture		PCR		Single high titre		Fourfold titre rise		Direct immune-fluorescence			
	n	(%)	n	(%)	n	(%)	n	(%)	n	(%)	n	(%)	n	n
Austria	122	(76.3)	30	(18.8)	5	(3.1)	3	(1.9)	0		0		160	160
Belgium	165	(84.2)	7	(3.6)	21	(10.7)	1	(0.5)	2	(1.0)	0		196	196
Bulgaria	1	(100)	0		0		0		0		0		1	1
Croatia	48	(100)	0		0		0		0		0		48	48
Cyprus	2	(100)	0		0		0		0		0		2	2
Czech Republic	104	(86.7)	28	(23.3)	41	(34.2)	3	(2.5)	0		0		176	120
Denmark	93	(50.3)	76	(41.1)	139	(75.1)	10	(5.4)	1	(0.5)	0		319	185
Estonia	1	(16.7)	5	(83.3)	0		0		0		0		6	6
Finland	16	(94.1)	0		1	(5.9)	0		0		0		17	17
France	1 324	(95.3)	345	(24.8)	125	(9.0)	4	(0.3)	4	(0.3)	0		1 802	1 389
Germany	598	(69.1)	64	(7.4)	139	(16.1)	51	(5.9)	13	(1.5)	0		865	865
Greece	27	(93.1)	3	(10.3)	0		3	(10.3)	0		0		33	29
Hungary	43	(74.1)	3	(5.2)	4	(6.9)	14	(24.1)	1	(1.7)	0		65	58
Iceland	1	(100)	0		0		0		0		0		1	1
Ireland	10	(90.9)	0		2	(18.2)	0		0		0		12	11
Italy	1 494	(96.0)	35	(2.2)	2	(0.1)	18	(1.2)	6	(0.4)	1	(0.1)	1 556	1 556
Latvia	18	(81.8)	0		0		4	(18.2)	0		0		22	22
Lithuania	5	(71.4)	0		0		2	(28.6)	0		0		7	7
Luxembourg	4	(80.0)	0		1	(20.0)	0		0		0		5	5
Malta	6	(100)	0		0		0		0		0		6	6
Netherlands	381	(90.9)	79	(18.9)	65	(15.5)	0		6	(1.4)	1	(0.2)	532	419
Norway	49	(81.7)	2	(3.3)	9	(15.0)	0	(0.0)	0		0		60	60
Poland	16	(69.6)	0	(0.0)	3	(13.0)	5	(21.7)	0		0		24	23
Portugal	126	(86.9)	18	(12.4)	0		0		1	(0.7)	0		145	145
Romania	5	(100)	0		0		0		0		0		5	5
Slovakia	14	(100)	0		0		0		0		0		14	14
Slovenia	79	(74.5)	26	(24.5)	1	(0.9)	0		0		0		106	106
Spain	995	(97.2)	59	(5.8)	1	(0.1)	7	(0.7)	13	(1.3)	0		1 075	1 024
Sweden	101	(71.1)	18	(12.7)	61	(43.0)	14	(9.9)	0		0		194	142
United Kingdom	386	(93.7)	92	(22.3)	117	(28.4)	0	(0.0)	3	(0.7)	0		598	412
Total	**6 234**	**(88.6)**	**890**	**(12.7)**	**737**	**(10.5)**	**139**	**(2.0)**	**50**	**(0.7)**	**2**	**(0.0)**	**8 052**	**7 034**

** More than one method per case possible*

Pathogens

Of 890 culture-confirmed cases, 855 (96.1%) were due to *L. pneumophila* (Table 9). Serogroup 1 accounted for 732 (85.6%) of 855 culture-confirmed cases with *L. pneumophila* (

Table 10). Four subtypes (Allentown/France, Benidorm, Knoxville and Philadelphia) accounted for 78.8% of the 170 *L. pneumophila* serogroup 1 isolates that were subtyped using monoclonal antibodies (MAb) (Table 11). In addition, three *L. pneumophila* serogroup 5 isolates were of Cambridge subtype and one *L. pneumophila* serogroup 4 isolate was of Portland subtype.

Table 9. Reported culture-confirmed cases of Legionnaires' disease and *Legionella* isolates, by species, EU/EEA, 2015

Species	Culture-confirmed cases	
	n	(%)
L. anisa	1	(0.1)
L. bozemanii	2	(0.2)
L. longbeachae	7	(0.8)

Species	Culture-confirmed cases	
	n	(%)
L. pneumophila	855	(96.1)
L. other species	13	(1.5)
L. species unknown	12	(1.3)
Total	**890**	**(100)**

Table 10. Reported culture-confirmed cases of Legionnaires' disease and *L. pneumophila* isolates by serogroup, EU/EEA, 2015

	Culture-confirmed cases with *L. pneumophila*	
Serogroup	n	(%)
1	732	(85.6)
2	3	(0.4)
3	18	(2.1)
4	7	(0.8)
5	5	(0.6)
6	11	(1.3)
7	3	(0.4)
8	1	(0.1)
10	4	(0.5)
12	1	(0.1)
14	1	(0.1)
15	5	(0.6)
L. pneumophila non serogroup 1	5	(0.6)
L. pneumophila serogroup mixed	5	(0.6)
L. pneumophila SG unknown	54	(6.3)
Total	**855**	**(100)**

Table 11. Reported monoclonal subtype for *L. pneumophila* serogroup 1 isolates, EU/EEA, 2015

Monoclonal subtype	n	(%)
Philadelphia	41	(24.1)
Allentown	1	(0.6)
Allentown/France	21	(12.4)
Benidorm	29	(17.1)
France	1	(0.6)
Knoxville	43	(25.3)
Subtotal MAb 3/1 positive [a]	**136**	**(80.0)**
OLDA	7	(4.1)
Oxford	1	(0.6)
OLDA/Oxford	18	(10.6)
Bellingham	8	(4.7)
Subtotal MAb 3/1 negative	**34**	**(20.0)**
Total	**170**	**(100)**

[a] Monoclonal types are grouped by the presence (or lack) of the virulence-associated epitope recognised by the MAb 3/1 (Dresden Panel).

Environment

Environmental investigation status was available for 2 601 (48.5%) of 5 359 cases known to not have travelled abroad within the incubation period (Table 12). An investigation was carried out in 910 (35.0%) of these 2 601 cases with known status. *Legionella* was detected in 430 (49.5%) of 868 investigations for which environmental findings were reported (Table 13), with 456 sampling sites testing positive: 411 samples from water systems (77 hot water systems, 26 cold water systems and 308 non-specified water systems), 22 cooling towers, 13 pools and 10 sampling sites reported as 'other' (Figure 6). In 42 (9.8%) of the 430 cases with positive environmental

findings, isolates could be matched to clinical isolates: 34 from water systems, four pools, two cooling towers, one site reported as 'other' and one unknown (Figure 7).

Table 12. Environmental follow-up status of reported domestic cases of Legionnaires' disease, by reporting country, EU/EEA, 2015*

Country	Cases without investigation		Cases with investigation		Status unknown		Total
	n	(%)	n	(%)	n	(%)	n
Austria	7	(5.6)	117	(92.9)	2	(1.6)	126
Belgium	0		0		37	(100)	37
Bulgaria	1	(100)	0		0		1
Croatia	0		0		48	(100)	48
Czech Republic	13	(12.7)	89	(87.3)	0		102
Denmark	0		24	(20.2)	95	(79.8)	119
Estonia	5	(100)	0		0		5
Finland	0		0		6	(100)	6
France	0		0		1 278	(100)	1 278
Germany	0		0		301	(100)	301
Greece	20	(87.0)	3	(13.0)	0		23
Hungary	3	(14.3)	18	(85.7)	0		21
Ireland	2	(25.0)	5	(62.5)	1	(12.5)	8
Italy	1 110	(72.5)	421	(27.5)	0		1 531
Latvia	2	(9.5)	19	(90.5)	0		21
Lithuania	0		3	(100)	0		3
Netherlands	223	(82.3)	39	(14.4)	9	(3.3)	271
Norway	0		19	(82.6)	4	(17.4)	23
Poland	0		2	(100)	0		2
Portugal	50	(50.0)	48	(48.0)	2	(2.0)	100
Slovakia	8	(72.7)	3	(27.3)	0		11
Slovenia	103	(100)	0		0		103
Spain	0	(0.0)	37	(3.7)	975	(96.3)	1 012
United Kingdom	144	(69.6)	63	(30.4)	0		207
Total	**1 691**	**(31.6)**	**910**	**(17.0)**	**2 758**	**(51.5)**	**5 359**

** Cases with settings reported as 'unknown' or 'travel abroad' were not included*

Table 13. Legionella findings of environmental investigations, by reporting country, EU/EEA, 2015*

Country	Legionella detected		Legionella not detected		Result unknown		Total
	n	(%)	n	(%)	n	(%)	n
Austria	48	(41.0)	69	(59.0)	0		117
Czech Republic	51	(57.3)	38	(42.7)	0		89
Denmark	19	(79.2)	5	(20.8)	0		24
Greece	2	(66.7)	1	(33.3)	0		3
Hungary	18	(100)	0		0		18
Ireland	1	(20.0)	4	(80.0)	0		5
Italy	167	(39.7)	251	(59.6)	3	(0.7)	421
Latvia	14	(73.7)	5	(26.3)	0		19
Lithuania	3	(100)	0		0		3
Netherlands	21	(53.8)	17	(43.6)	1	(2.6)	39
Norway	0		0		19	(100)	19
Poland	2	(100)	0		0		2
Portugal	26	(54.2)	21	(43.8)	1	(2.1)	48

Slovakia	2	(66.7)	1	(33.3)	0		3
Spain	25	(67.6)	0	(0.0)	12	(32.4)	37
United Kingdom	31	(49.2)	26	(41.3)	6	(9.5)	63
Total	**430**	**(47.3)**	**438**	**(48.1)**	**42**	**(4.6)**	**910**

** Cases with settings reported as 'unknown' or 'travel abroad' were not included*

Figure 6. Distribution of sampling sites testing positive for Legionella, EU/EEA, 2015

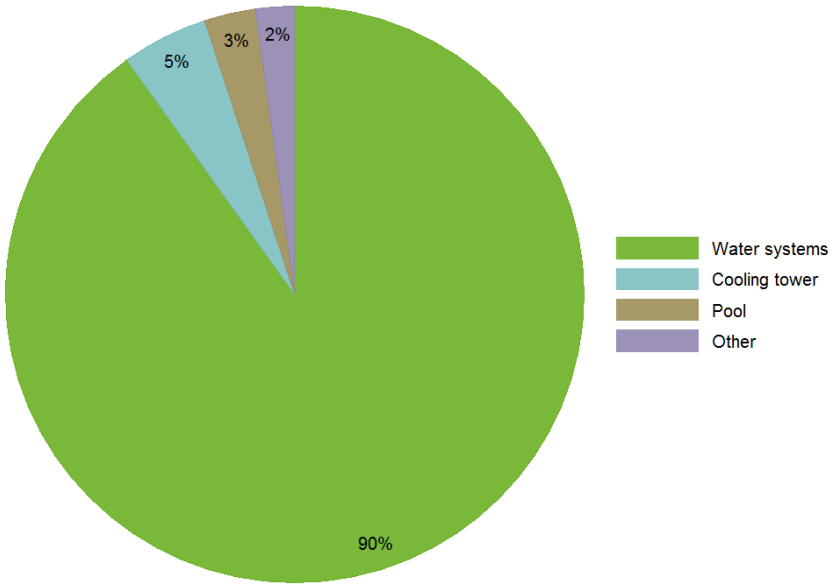
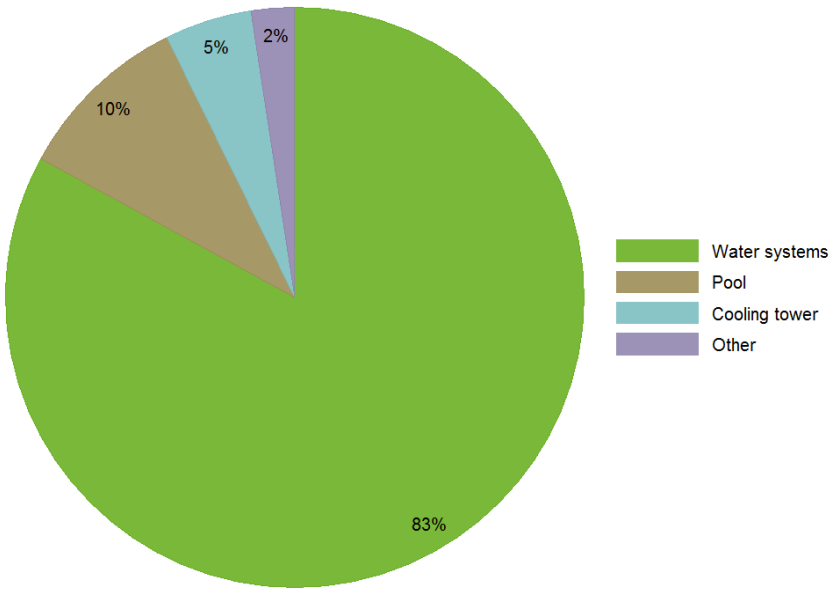


Figure 7. Distribution of sampling sites testing positive for Legionella and matching with clinical isolates, EU/EEA, 2015



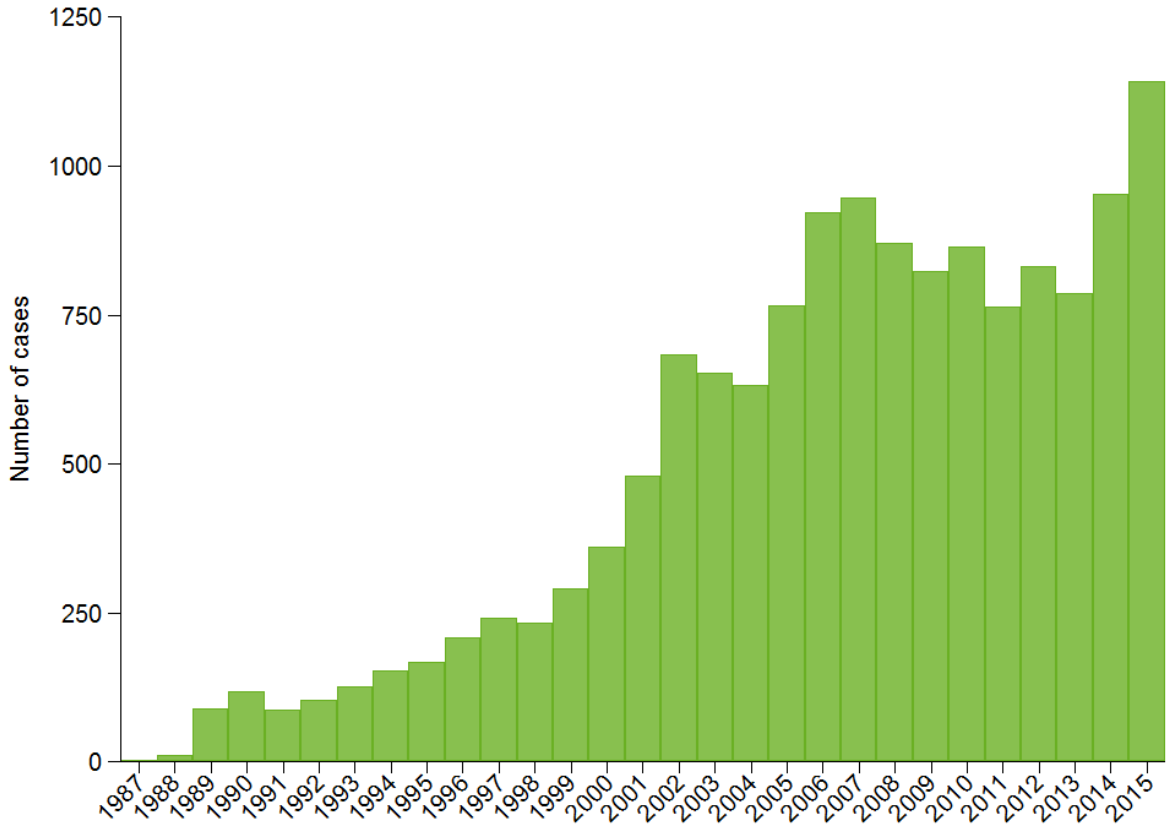
3.2 Travel-associated Legionnaires' disease

3.2.1 Cases

Notifications

ELDSNet received reports of 1 141 cases of TALD with date of onset in 2015, 20% more cases than in 2014, and the highest annual number of TALD cases ever reported to the network (Figure 8).

Figure 8. Number of travel-associated cases of Legionnaires' disease reported to ELDSNet, 1987–2015



Cases were reported from 25 countries: 22 EU/EEA Member States and three non-EU/EEA countries: Switzerland (30 cases), the USA (6 cases), and Australia (2 cases). Two-thirds (66.2%) of all TALD cases were reported by only four countries (in decreasing order of frequency): the United Kingdom, Italy, France, and the Netherlands (Table 14).

The median time from date of onset to ELDSNet reporting was 17 days, ranging from 10 days (France) to 42 days (Germany) (Table 15).

Table 14. Number of travel-associated cases of Legionnaires' disease reported to ELDSNet, by reporting country, 2010–2015

Reporting country	Number of reported cases											
	2010		2011		2012		2013		2014		2015	
	n	(%)	n	(%)	n	(%)	n	(%)	n	(%)	n	(%)
United Kingdom	154	(17.8)	116	(15.2)	135	(16.2)	115	(14.6)	160	(16.8)	213	(18.7)
Italy	142	(16.4)	154	(20.2)	156	(18.8)	141	(17.9)	151	(15.8)	202	(17.7)
France	191	(22.1)	162	(21.2)	170	(20.5)	161	(20.5)	186	(19.5)	200	(17.5)
Netherlands	148	(17.1)	120	(15.7)	113	(13.6)	109	(13.9)	132	(13.9)	142	(12.4)
Germany	0		0		1	(0.1)	34	(4.3)	54	(5.7)	76	(6.7)
Spain	67	(7.8)	67	(8.8)	68	(8.2)	55	(7.0)	55	(5.8)	51	(4.5)
Sweden	20	(2.3)	28	(3.7)	49	(5.9)	24	(3.0)	51	(5.4)	38	(3.3)
Norway	25	(2.9)	18	(2.4)	13	(1.6)	20	(2.5)	25	(2.6)	36	(3.2)
Denmark	32	(3.7)	32	(4.2)	41	(4.9)	25	(3.2)	37	(3.9)	32	(2.8)
Belgium	16	(1.9)	11	(1.4)	19	(2.3)	25	(3.2)	12	(1.3)	31	(2.7)
Switzerland	0		0		0		0		10	(1.0)	30	(2.6)
Austria	19	(2.2)	25	(3.3)	27	(3.2)	23	(2.9)	36	(3.8)	28	(2.5)
Portugal	3		0		2	(0.2)	0		7	(0.7)	14	(1.2)

Reporting country	Number of reported cases											
	2010		2011		2012		2013		2014		2015	
	n	(%)	n	(%)	n	(%)	n	(%)	n	(%)	n	(%)
Czech Republic	5	(0.6)	7	(0.9)	5	(0.6)	5	(0.6)	14	(1.5)	11	(1.0)
Finland	8	(0.9)	5	(0.7)	6	(0.7)	9	(1.1)	2	(0.2)	9	(0.8)
United States of America	11	(1.3)	5	(0.7)	6	(0.7)	9	(1.1)	3	(0.3)	6	(0.5)
Slovenia	1	(0.1)	1	(0.1)	2	(0.2)	5	(0.6)	3	(0.3)	5	(0.4)
Ireland	7	(0.8)	4	(0.5)	7	(0.8)	8	(1.0)	1	(0.1)	5	(0.4)
Greece	0		4	(0.5)	1	(0.1)	8	(1.0)	4	(0.4)	4	(0.4)
Luxembourg	3		0		1	(0.1)	1	(0.1)	0		2	(0.2)
Australia	0		0		0		0		0		2	(0.2)
Latvia	1	(0.1)	1	(0.1)	0		1	(0.1)	0		1	(0.1)
Bulgaria	0		0		0		0		0		1	(0.1)
Lithuania	0		0		0		0		0		1	(0.1)
Romania	0		0		0		0		0		1	(0.1)
Israel	0		0		0		1	(0.1)	4	(0.4)	0	
Malta	5	(0.6)	1	(0.1)	0		1	(0.1)	2	(0.2)	0	
Turkey	0		0		0		3	(0.4)	1	(0.1)	0	
Thailand	0		0		0		1	(0.1)	1	(0.1)	0	
Andorra	0		0		0		0		1	(0.1)	0	
New Zealand	0		0		0		0		1	(0.1)	0	
Canada	0		0		0		2	(0.3)	0		0	
Cyprus	0		0		1	(0.1)	1	(0.1)	0		0	
Hungary	2	(0.2)	2	(0.3)	4	(0.5)	0		0		0	
Croatia	2		0		4	(0.5)	0		0		0	
Others	2	(1.2)	0		0		0		0		0	
Total	**864**	**(100)**	**763**	**(100)**	**831**	**(100)**	**787**	**(100)**	**953**	**(100)**	**1 141**	**(100)**

[a] *The reporting country is generally the country where the case is diagnosed. The reporting country is not necessarily identical with the country of residence.*

Table 15. Time to reporting (days between date of onset and reporting to ELDSNet), by reporting country, 2015

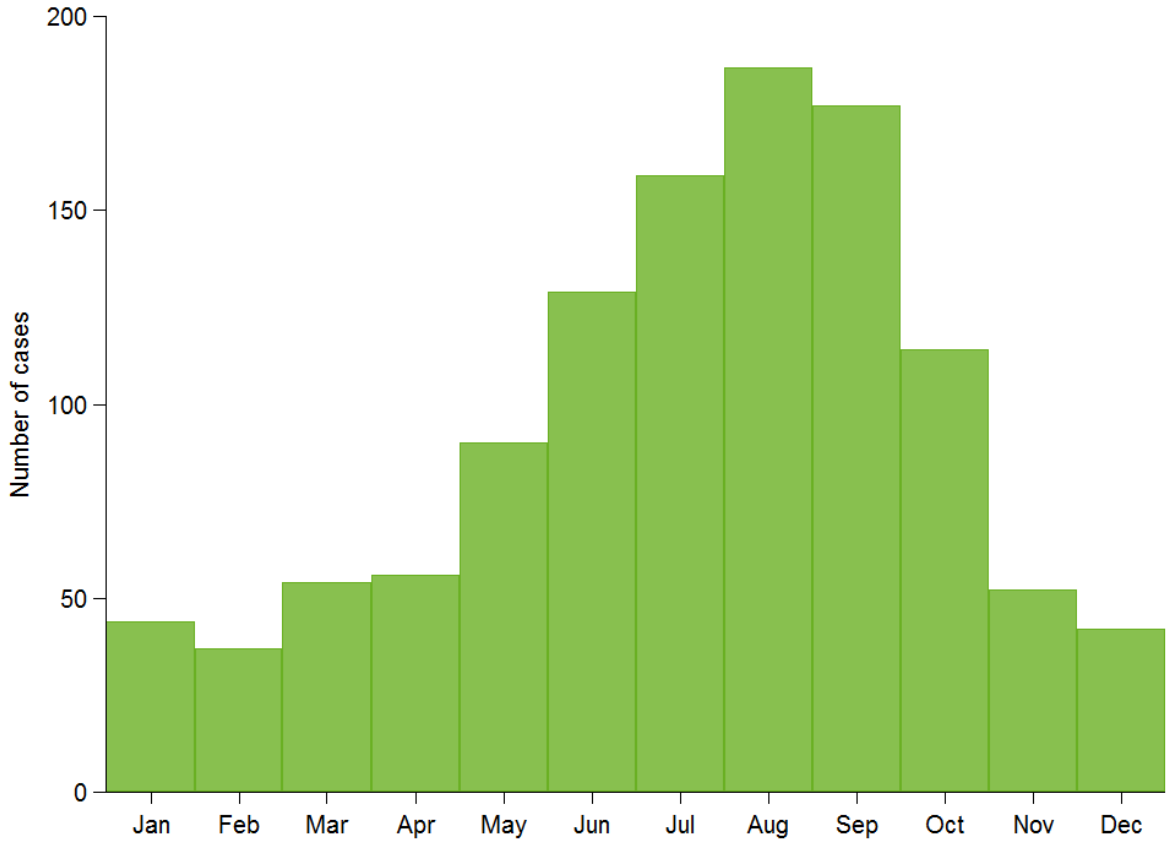
Reporting country	Number of cases	Time to reporting (days)			
		Mean	Median	25th quantile	75th quantile
France	200	15	10	8	15
Greece	4	22	11	10	23
Norway	36	17	11	8	16
Austria	28	15	13	8	20
Romania	1	13	13	13	13
Ireland	5	19	14	8	22
Netherlands	142	22	14	10	22
Slovenia	5	18	14	14	22
United Kingdom	213	23	14	10	22
Latvia	1	15	15	15	15
United States of America	6	28	16	14	29
Belgium	31	24	18	12	26
Finland	9	33	20	14	41
Lithuania	1	22	22	22	22
Switzerland	30	32	22	15	40
Bulgaria	1	25	25	25	25
Luxembourg	2	25	25	16	34
Denmark	32	45	29	20	42
Italy	202	57	30	16	65
Sweden	38	31	30	19	43
Australia	2	35	35	26	44
Spain	51	45	35	16	53
Czech Republic	11	79	38	36	104
Portugal	14	51	41	24	80
Germany	76	49	42	24	62
Total	**1 141**	**30**	**22**	**16**	**36**

The reported TALD cases came from a total of 36 countries. The majority of cases resided in those countries that reported the most cases, but according to ELDSNet data, 52 (4.6 %) cases were non-EU/EEA residents who came from Switzerland (29), the USA (6), Australia (5), Canada (2), China (2), New Caledonia (2), Argentina (1), Brazil (1), Guernsey (1), Guinea-Bissau (1), Israel (1), and Sri Lanka (1).

Seasonality

In 2015, two thirds of the cases fell ill between June and October, which is in line with the known seasonality of Legionnaires' disease (Figure 9).

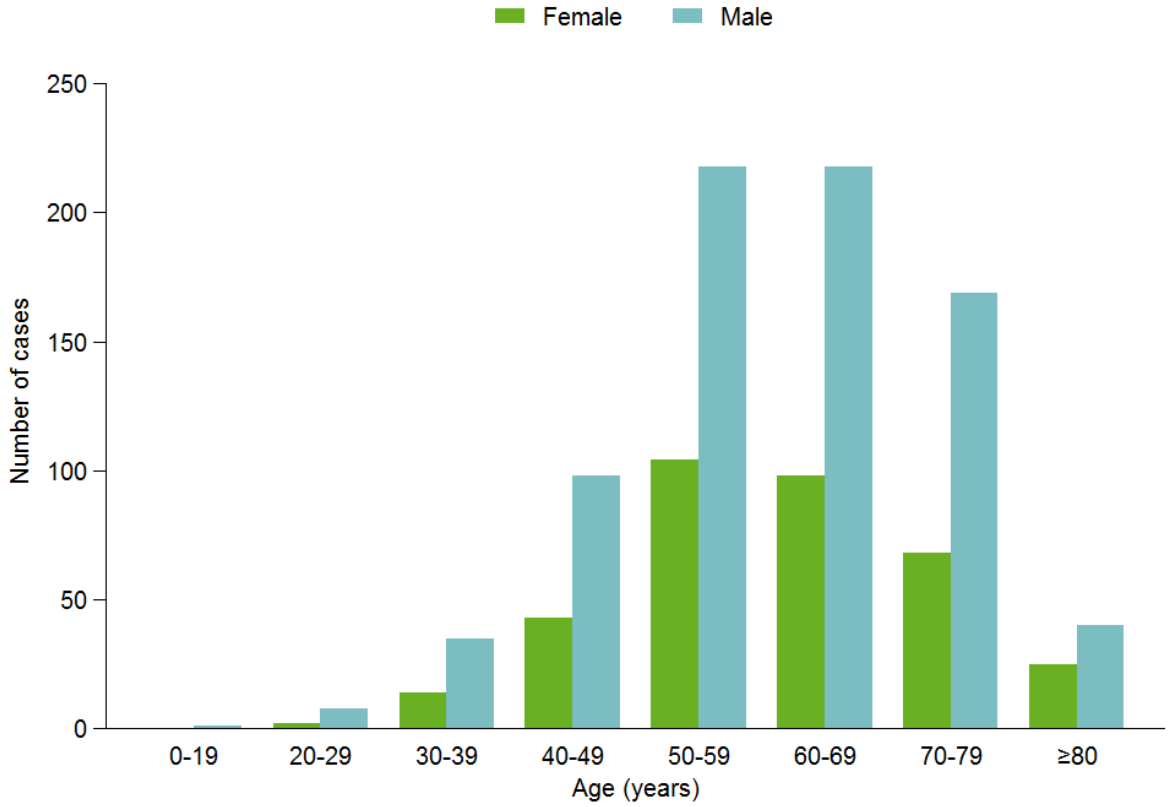
Figure 9. Number of travel-associated cases of Legionnaires' disease by month of disease onset, 2015



Age and sex

Similar to previous years and the overall distribution of Legionnaires' disease, over two thirds (69%) of the reported TALD cases were male. Cases had a median age of 62 (IQR 53-71); 82% of cases occurred in people 50 years and older (Figure 10).

Figure 10. Number of travel-associated cases of Legionnaires' disease, by age group and sex, 2015



Outcome

Outcome was provided for 611 (54%) TALD cases. Of these, 26 (4%) had died by the time of reporting. They were between 59 and 90 years old, and 21 were male.

3.2.2 Clinical microbiology

A total of 1 092 TALD cases (96%) were classified as confirmed; 49 (4%) were probable cases. Of 1 215 laboratory tests used, 89% were UATs, 8% were PCRs and 4% were cultures (Table 16).

Table 16. Reported diagnostic methods in travel-associated cases of Legionnaires' disease, 2015

Laboratory method	n	%
Urinary antigen test (UAT)	1 059	87.2
Nucleic acid amplification e.g. PCR	94	7.7
Culture	48	4.0
Single high titre	11	0.9
Fourfold titre rise	3	0.2
Total	**1 215**	**100**

Note: More than one method per case possible

L. pneumophila serogroup 1 was reported as the causative microorganism in 770 (67%) TALD cases, whereas in 362 (32%) cases the causative microorganism was unknown or not reported (Table 17). Monoclonal subtyping results were reported for cases with *L. pneumophila serogroup 1* (14 cases, 1%): Benidorm (6 cases), Knoxville (4 cases), Allentown/France (2 cases), and Philadelphia (2 cases). The sequence type was reported for 17 cases (1%) from four countries: United Kingdom (6), Denmark (5), Sweden (4), and Germany (2). Three of the reported sequence types were ST 42, two were ST 23, and the others were a variety of single sequence types.

Table 17. Reported species or *L. pneumophila* serogroup in travel-associated cases of Legionnaires' disease, 2015

L. pneumophila serogroup / *L.* species	Number / proportion of TALD cases	
	n	%
1	770	67.5
3	2	0.2
6	2	0.2
Mix of serogroups	1	0.1
L. Longbeachae	4	0.4
Pathogen unknown or not reported	362	31.7
Total	**1 141**	**100**

3.2.3 Travel: visits and sites

The 1 141 TALD cases had made a total of 1 606 international journeys. Of these visits, 1 221 (76%) were within the EU/EEA, 353 (22%) were outside the EU/EEA (

Figure 11 and Figure 12), and 32 journeys were on ships. The three destination countries with most TALD-associated travel visits were Italy (n=417, 26% of 1 606 visits), France (n=290, 18%), and Spain (n=130, 8%). For 17 visits, the accommodation type was not reported, which represents a 35% reduction in missing information compared with the previous year. Of the 1 589 visits for which the accommodation type was reported: 78% of the overnight stays were in hotels, 9% were on camping sites, 5% in apartments, 2% were on ships, and 2% were reported as other types of accommodation.

Figure 11. Number of accommodation site visits and clusters of travel-associated cases of Legionnaires' disease, by destination country, EU/EEA and neighbouring countries, 2015

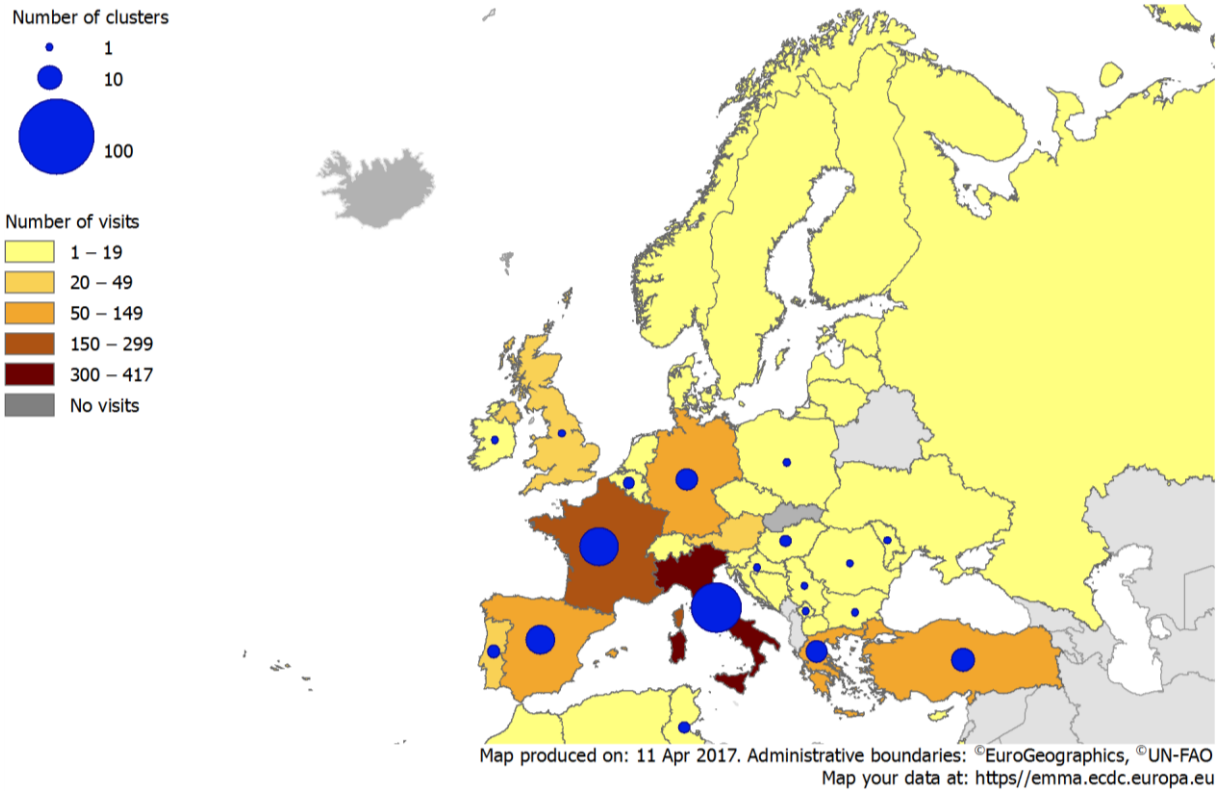
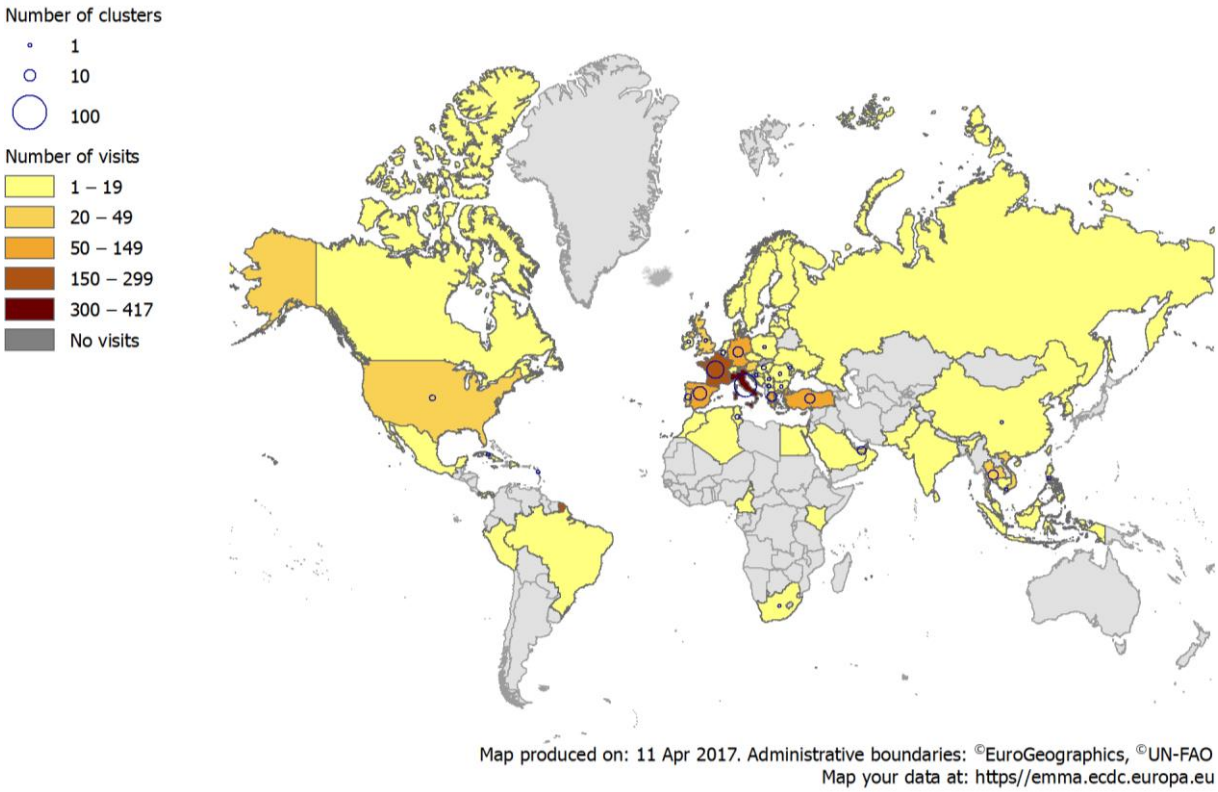


Figure 12. Number of accommodation site visits and clusters of travel-associated cases of Legionnaires' disease, by destination country, worldwide, 2015

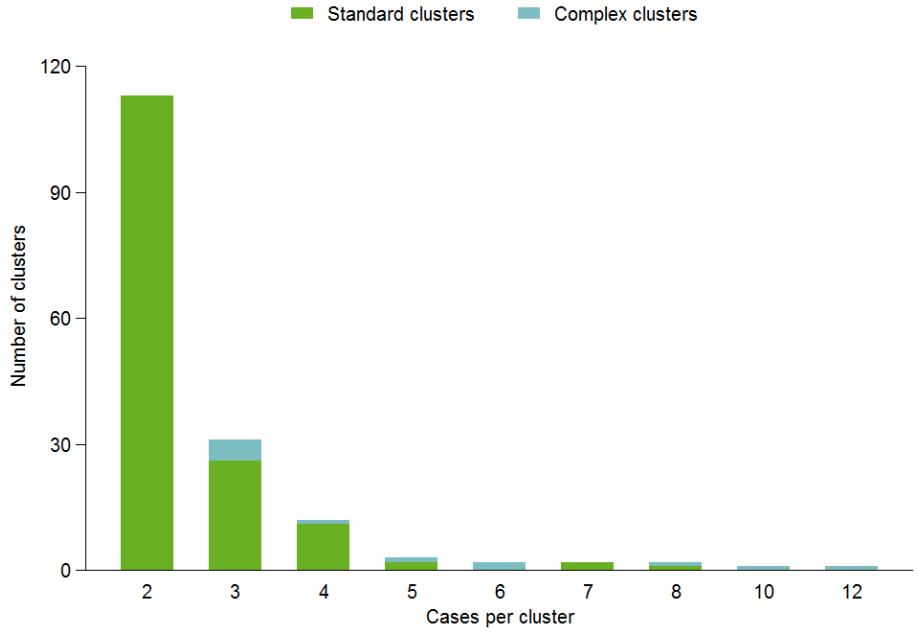


3.2.4 Clusters

In 2015, ELDSNet detected 167 new TALD clusters, 155 of which were standard clusters and 12 were complex clusters. The clusters were associated with accommodations in 32 countries (including ships) worldwide. There were four clusters on board ships, with a total of ten cases.

Of the 167 clusters, 113 (68%) were comprised of two cases (Figure 13). The remaining clusters ranged between three and 12 cases.

Figure 13. Number of cases of travel-associated Legionnaires' disease per cluster, 2015

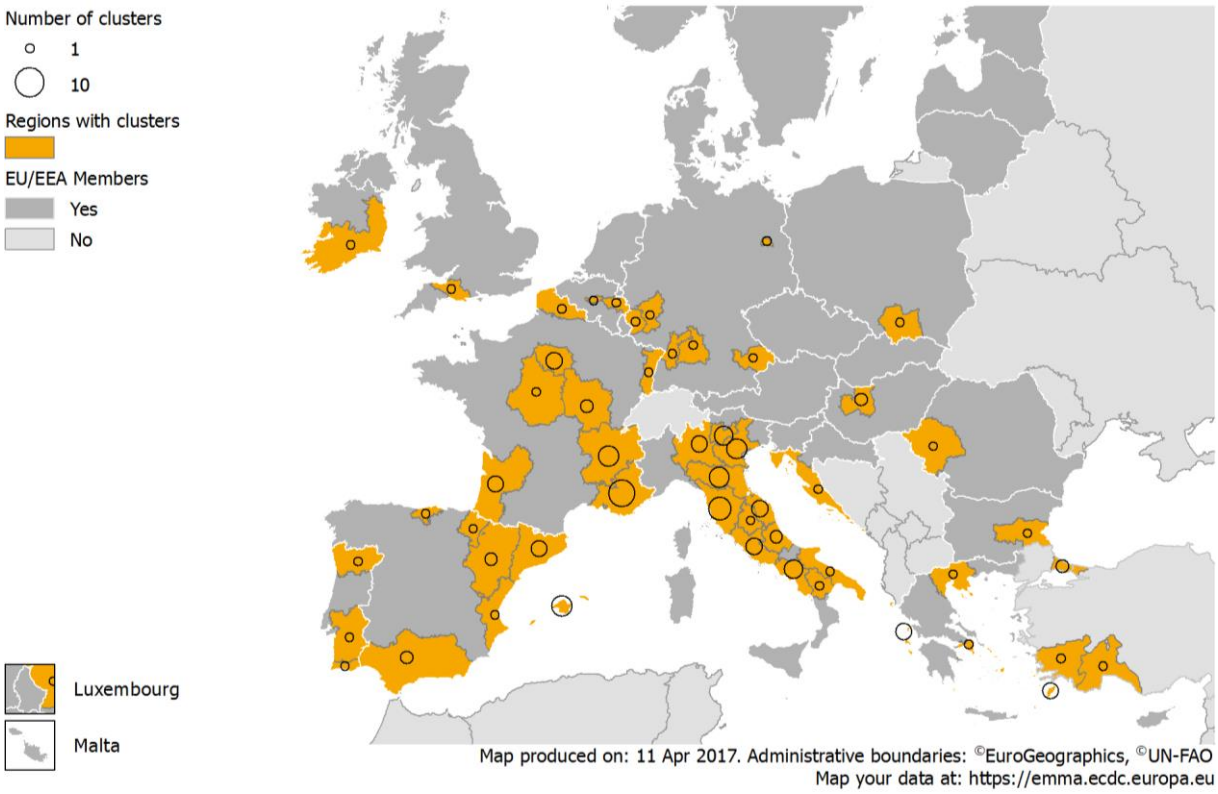


In 60% of the clusters, the first two reported cases originated in different countries. Most of these clusters would probably not have been detected had it not been for the international surveillance of the ELDSNet network.

The number of TALD clusters at subnational (NUTS2) level is shown in Figure 14.

Based on the TALD surveillance scheme in 2015, 14 new and eight updates for rapidly evolving clusters were reported to tour operators.

Figure 14. Number of standard clusters of travel-associated Legionnaires' disease per destination area (NUTS2), EU/EEA, 2015



3.2.5 Investigations and publication of accommodation sites

For all 167 clusters, we received a preliminary (environmental) assessment report within two weeks of notification, followed by a final assessment report within six weeks of notification. *Legionella* was found in 60% (78/129) of all cluster sites where environmental water sampling results were reported.

In 2015, the names of eight accommodation sites were published on the ECDC website, because assessment reports stated that satisfactory control measures were not implemented in a timely manner.

3.3 Outbreaks (not travel-associated)

In the new reporting scheme for community or healthcare-associated outbreaks, eleven countries reported between one and 20 outbreaks of two or more cases (54 in total). Of the 559 reported outbreak cases, 20 (3.6%) were reported to have died. Thirteen countries reported not having had any outbreak in 2015: Bulgaria, Cyprus, the Czech Republic, Greece, Malta, Latvia, Lithuania, Luxembourg, Norway, Slovakia, Ireland, Poland and Sweden. Six EU/EEA countries did not report.

Nine countries reported 35 outbreaks of at least three cases: United Kingdom (10), Spain (9), France (4), Netherlands (3), Portugal (3), Hungary (2), Italy (2), Denmark (1), and Germany (1). One outbreak involved 304 cases, six outbreaks with between 10 and 20 cases, and 28 with between three and nine cases.

The three largest outbreaks occurred in Spain, Germany, and Portugal.

Spain reported the largest outbreak with 304 cases, 278 of which were confirmed; 26 outbreaks were probable. Four cases died. Most cases occurred during two weeks in December in one town, Manzanares. The source could not be determined. Another outbreak in Spain involved 14 cases and was caused by a contaminated cooling tower.

Germany experienced a large outbreak involving 19 cases, including one death (Bremen, November and December 2015). *Legionella pneumophila* serogroup 1 subtype Benidorm ST 2151 was detected in two patients.

This outbreak had a second wave at the beginning of 2016. Despite extensive epidemiological investigations, the source of infection was not found.

Portugal reported an outbreak involving 17 cases, one of whom died, in an area close to a shopping centre in Porto with six cooling towers. No source could be identified.

In fifteen of the outbreaks, the source was reported to have been found, and in another fourteen, a source was suspected. The suspected or confirmed source for seventeen outbreaks was reported to be the hot/cold water system, four outbreaks were connected to a cooling tower, and a further three could be linked to a spa pool. Ten different sequence types were reported. Sequence type 37 was found in two outbreaks, while all other sequence types were found only once. In eleven outbreaks, human and environmental isolates could be matched.

4 Discussion

With 7 034 cases reported, the notification rate of LD in the EU/EEA in 2015 was 1.37 cases per 100 000 population, the highest ever observed. The overall notification rate increased over the 2011−2015 period.

Four countries (France, Germany, Italy, and Spain) accounted for 69% of all notified cases although their combined populations only represent approximately 50% of the EU/EEA population. Many countries had a notification rate below 0.5 cases per 100 000 population, a situation unchanged over the past five years and unlikely to reflect the true incidence of LD in these countries. ECDC gives special attention to Bulgaria and Romania which only reported one and five cases in 2014 for populations of seven and 20 million, respectively.

The main characteristics of the cases reported in 2015 were very similar to those reported in previous years: most cases were sporadic and community-acquired, and the disease affected mostly older males.

Healthcare-associated cases were more likely to die most probably because they were more likely to have underlying conditions. Cases with a history of travel abroad had the lowest CFR. It is likely that people able to travel are overall in a better physical condition compared to those who cannot travel ('healthy traveller effect').

Over the past five years, the proportion of cases reported to have been diagnosed by PCR has continuously increased from less than 2% in 2008 to 10% in 2015. PCR is increasingly recognised as an accurate and reliable diagnostic test for LD, possibility superior to UAT [17]. However, culture remains the gold standard, and the proportion of cases for which culture is performed remains low overall and varies substantially across countries.

In 2015, 1 141 travel-associated cases of LD were reported, an increase of 20% for the second year in a row. This is in line with the increased overall Legionnaires' disease notification rate. Further analyses may provide a better insight into the factors driving this year's increase.

A hundred fifty-five new standard travel-associated clusters were identified, over 50% more than only three years earlier. Sixty percent of the TALD clusters would most probably not have been detected without international collaboration, confirming the added value of ELDSNet's daily TALD surveillance in protecting the health of travellers in the EU/EEA and other collaborating countries.

5 Conclusion

Legionnaires' disease remains an important cause of preventable morbidity and mortality in Europe. Large outbreaks such as the one that occurred in Spain remind us of the challenges we face in preventing and controlling Legionnaires' disease.

ECDC gives priority assistance to countries with notification rates below one per million inhabitants in order to improve clinical awareness, laboratory diagnosis, and reporting of Legionnaires' disease.

In 2015, ELDSNET continued to demonstrate the effectiveness of daily TALD surveillance, the value of early detection, and the importance of following up on clusters.

Regular checks for the presence of *Legionella* bacteria and appropriate control measures applied to man-made water systems may prevent cases of Legionnaires' disease at tourist accommodation sites, in hospitals, in long-term healthcare facilities or other settings where sizeable populations at higher risk may be exposed.

References

1. Fields BS, Benson RF, Besser RE. Legionella and Legionnaires' disease: 25 years of investigation. Clin Microbiol Rev. 2002 Jul;15(3):506–526.
2. Fraser DW, Tsai TR, Orenstein W, Parkin WE, Beecham HJ, Sharrar RG, et al. Legionnaires' disease: description of an epidemic of pneumonia. N Engl J Med. 1977 Dec;297(22):1189–1197.
3. Correia AM, Ferreira JS, Borges V, Nunes A, Gomes B, Capucho R, et al. Probable Person-to-Person Transmission of Legionnaires' Disease. N Engl J Med. 2016 Feb 4;374(5):497–8.
4. Phin N, Parry-Ford F, Harrison T, Stagg HR, Zhang N, Kumar K, et al. Epidemiology and clinical management of Legionnaires' disease. Lancet Infect Dis. 2014 Jun;
5. Beauté J, Zucs P, de Jong B, European Legionnaires' Disease Surveillance Network. Legionnaires' disease in Europe, 2009-2010. Eurosurveillance. 2013;18(10):20417.
6. Beauté J, Sandin S, Uldum SA, Rota MC, Brandsema P, Giesecke J, et al. Short-term effects of atmospheric pressure, temperature, and rainfall on notification rate of community-acquired Legionnaires' disease in four European countries. Epidemiol Infect. 2016 Aug 30;1–11.
7. Sakamoto R. Legionnaire's disease, weather and climate. Bull World Health Organ. 2015 Mar;93:435–436.
8. Van Hest NAH, Hoebe CJPA, Den Boer JW, Vermunt JK, Ijzerman EPF, Boersma WG, et al. Incidence and completeness of notification of Legionnaires' disease in The Netherlands: covariate capture-recapture analysis acknowledging regional differences. Epidemiol Infect. 2008 Apr;136(4):540–550.
9. Rota MC, Cawthorne A, Bella A, Caporali MG, Filia A, D'Ancona F. Capture-recapture estimation of underreporting of legionellosis cases to the National Legionellosis Register: Italy 2002. Epidemiol Infect. 2007 Aug;135(6):1030–1036.
10. Campese C, Jarraud S, Sommen C, Maine C, Che D. Legionnaires' disease in France: sensitivity of the mandatory notification has improved over the last decade. Epidemiol Infect. 2013 Mar;1–6.
11. Beauté J, Zucs P, de Jong B. Risk for Travel-associated Legionnaires' Disease, Europe, 2009. Emerg Infect Dis. 2012 Nov;18(11):1811–1816.
12. Tomova I, Marinov R, Maeva I. First cluster of travel-associated legionnaires' disease detected in Bulgarian citizens. Eurosurveillance. 2007 Apr 12;12(4):E070412.2.
13. Stypułkowska-Misiurewicz H, Czerwiński M. Legionellosis in Poland in 2014. Przegl Epidemiol. 2016;70(2):203–7.
14. European Centre for Disease Prevention and Control. Legionnaires' disease surveillance in Europe, 2013 [Internet]. Stockholm: ECDC; 2015. Available from: http://ecdc.europa.eu/en/publications/Publications/legionnaires-disease-2015.pdf
15. Commission Implementing Decision 2012/506/EU of 8 August 2012 amending Decision 2002/253/EC laying down case definitions for reporting communicable diseases to the Community network under Decision No 2119/98/EC of the European Parliament and of the Council [Internet]. [cited 2011 Dec 6]. Available from: http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2012:262:0001:0057:EN:PDF
16. European Centre for Disease Prevention and Control. Epidemic intelligence. [Internet]. 2014 [cited 2016 Mar 27]. Available from: http://ecdc.europa.eu/en/activities/epidemicintelligence/Pages/Activities_EpidemicIntelligence.aspx
17. Avni T, Bieber A, Green H, Steinmetz T, Leibovici L, Paul M. Diagnostic Accuracy of PCR Alone and Compared to Urinary Antigen Testing for Detection of *Legionella* spp.: a Systematic Review. J Clin Microbiol. 2016 Feb;54(2):401–11.

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