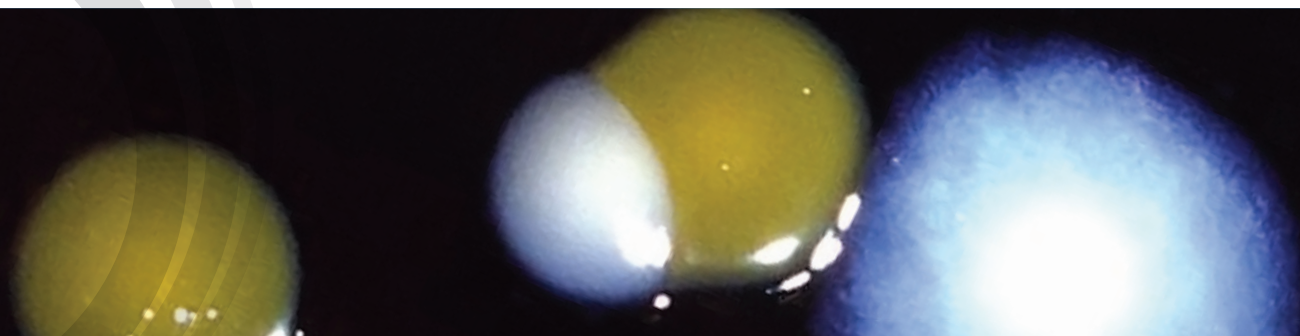




SURVEILLANCE REPORT



Legionnaires' disease in Europe

2010

ECDC SURVEILLANCE REPORT

Legionnaires' disease in Europe, 2010



This report of the European Centre for Disease Prevention and Control (ECDC) was coordinated by Julien Beauté and Birgitta de Jong.

Contributing authors

Andrew J. Amato-Gauci, Denis Coulombier, Lara Payne Hallström, Emmanuel Robesyn, Johanna Takkinen, Dana Ursut and Phillip Zucs.

Acknowledgements: We would like to thank all ELDSNet members for their hard work and dedication in reporting national Legionnaires' disease data and reviewing this report:

Gabriela El Belazi, Christine Hain, Robert Muchl, Daniela Schmid, Reinhild Strauss, Günthe Wewalka (Austria), Olivier Denis, Sophie Maes, Denis Piérard, Sophie Quoilin (Belgium); Lili Marinova, Iskra Tomova (Bulgaria); Ioanna Gregoriou, Avgi Hadjilouka, Despo Pieridou Bagatzouni (Cyprus); Vladimir Drasar, Irena Martinkova (Czech Republic); Kåre Mølbak, Søren Anker Uldum (Denmark); Irina Dontsenko, Rita Peetso (Estonia); Outi Lyytikäinen, Silja Mentula (Finland); Dounia Bitar, Christine Campese, Didier Che, Sophie Jarraud (France); Bonita Brodhun, Christian Lück (Germany); Georgia Spala, Emanuel Velonakis (Greece); Judit Krisztina Horváth, Katalin Kaszas, Ildikó Ferenczné Paluska (Hungary); Haraldur Briem, Guðrún Sigmundsdóttir, Olafur Steingrímsson (Iceland); Mary Hickey, Joan O'Donnell (Ireland); Maria Grazia Caporali, Maria Luisa Ricci, Maria Cristina Rota (Italy); Jelena Galajeva (Latvia); Migle Janulaitiene, Simona Zukauskaitė-Sarapajeviene (Lithuania); Paul Reichert (Luxembourg); Zahra Graziella, Jackie Maistre Melillo, Tanya Melillo Fenech (Malta); Petra Brandsema, Ed Ijzerman, Leslie Isken, Daan Notermans, Wim Van Der Hoek (Netherlands); Katrine Borgen, Dominique A. Caugant, Karin Ronning (Norway); Hanna Stypulkowska-Misiurewicz (Poland); Teresa Maria Alves Fernandes, Teresa Marques (Portugal); Daniela Badescu, Gratiiana Chicin (Romania); Danka Simonyova, Margita Spalekova (Slovak Republic); Darja Kese, Maja Sočan (Slovenia); Rosa Cano-Portero, Carmen Pelaz Antolin (Spain); Görel Allestam, Margareta Löfdahl (Sweden); Oliver Blatchford, Martin Donaghy, Giles Edwards, Tim Harrison, Nick Phin, Alison Potts, Brian Smyth (United Kingdom).

Suggested citation: European Centre for Disease Prevention and Control. Legionnaires disease in Europe, 2010. Stockholm: ECDC; 2012.

Stockholm, July 2012

ISBN 978-92-9193-381-5

doi 10.2900/62079

© European Centre for Disease Prevention and Control, 2012

Reproduction is authorised, provided the source is acknowledged.

Contents

Abbreviations	iv
Executive summary	1
All cases	1
Travel-associated Legionnaires' disease	1
Background	2
1 Methods	3
1.1 The European Legionnaires' Disease Surveillance Network	3
1.2 Data collection	3
1.3 Data analysis	4
2 Results	5
2.1 All Legionnaires' disease cases	5
2.2 Travel-associated Legionnaires' disease	21
3 Discussion	27
4 Conclusion	28
References	29

Abbreviations

CFR	Case fatality ratio
CI	Confidence interval
DE	Germany
DK	Denmark
ECDC	European Centre for Disease Prevention and Control
EEA	European Economic Area
ELDSNET	European Legionnaires' Disease Surveillance Network
ES	Spain
EWGLI/EWGLINET	European Working Group for Legionella Infections
EU	European Union
FR	France
IQR	Interquartile ranges
IT	Italy
LD	Legionnaires' disease
NL	Netherlands
PR	Prevalence ratios
PT	Portugal
SE	Sweden
TALD	Travel-associated Legionnaires' disease
TESSy	The European Surveillance System
UAT	Urinary antigen test
UK	United Kingdom

Executive summary

This surveillance report is based on Legionnaires' disease surveillance data collected for 2010. 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 nominated ELDSNet members for each European country and electronically transmitted to The European Surveillance System (TESSy) database.

The surveillance data are from two different schemes, the first scheme covers all cases reported from European Union (EU) Member States, Iceland and Norway; and the second scheme covers all travel-associated cases of Legionnaires' disease (TALD), both foreign and domestic travel, including reports from countries outside the EU. The aim of these two different schemes differs. The main aims and objectives of collecting data on all nationally reported cases under the annual enhanced surveillance of Legionnaires' disease (LD) scheme are:

- monitor trends in communicable diseases over time in order to assess the present situation and to compare LD trends across Member States in Europe, in order to respond to rises above warning thresholds and to facilitate appropriate evidence-based action
- contribute better quality public health evidence, based on more relevant and reliable data, that can be used for informing public health decisions and actions at the EU and/or Member State level, and for the evaluation and monitoring of prevention and control programmes targeted at LD at the national and European level
- identify population groups at risk and in need of targeted prevention measures
- contribute to the assessment of the burden of communicable diseases on the population using such data as disease prevalence, complications, hospitalisation, and mortality
- generate hypotheses on (new) sources, modes of transmission and groups most at risk and identify needs for research and development and for pilot projects.

The second scheme for the TALD data is aimed more at the identification of clusters of cases with Legionnaires' disease that may not have been identified at a national level, and to then initiate timely investigation and control measures at the accommodations sites associated with the cases.

All cases

In 2010, a total of 6 296 cases were notified by EU Member States, Iceland and Norway, yielding an overall notification number of 12.4 per million inhabitants. France, Italy and Spain accounted for 62.3% of all cases. Country-specific notification rates ranged from null in Estonia to 28.3 per million in Slovenia. Most cases were community-acquired (71.3%) while 20.1% were travel-associated and 7.6% were linked with healthcare facilities. People over 50 years old accounted for 78.1% of all cases. The overall male to female ratio was 2.8. About 60% of all cases had a date of onset during the warm season (from June to October). The crude mortality rate in 2010 was 0.9 per million and has been stable since 2005. Most cases were confirmed by urinary antigen test (81.9%). *L. pneumophila* and its serogroup 1 were the most commonly identified pathogens, accounting for 96.5% and 86.2% of culture-confirmed cases, respectively.

Important disparities in notification rates and laboratory practice were identified between countries, especially between those who joined the EU after 2000 and the older Member States. Certain national surveillance systems might benefit from a review to see how best to improve their comprehensiveness, while targeted training should be continued to raise all laboratories to the same diagnostic level. Studies at national or subnational level (cross-sectional, capture-recapture) should be encouraged to help understand the causes of under-ascertainment. This report would also benefit greatly from the collection of data on underlying conditions to improve our understanding of the disease.

Travel-associated Legionnaires' disease

In 2010, 864 cases of TALD were reported, of whom 24 were reported to have fatal outcome. As in previous years, a very low proportion of clinical isolates were obtained (45 cases, 5.2%). Males outnumbered females by 2.6:1 in the 2010 dataset and had a median age of 61 years compared with women, whose median age was 63 years. The network identified 100 new clusters in 2010, of which 44 (44%) involved only one case from each reporting country and would not have been detected by national surveillance schemes alone. The largest cluster (14 cases) was associated with a cruise ship. *Legionella* species was detected at 61 (61%) of the accommodation site clusters investigated. The names of five accommodation sites in Member States were published on the ECDC website.

Background

Legionnaires' disease is a multisystem disease involving pneumonia due to gram-negative bacteria, *Legionella* spp., which are found in freshwater environment worldwide [1]. The disease was named after a large outbreak among members of the American Legion in the late 1970s [2]. Humans are infected by inhalation of aerosols containing *Legionella* bacteria, most commonly *L. pneumophila* serogroup 1. Known risk factors for LD include increasing age, male gender, smoking, chronic lung disease, diabetes and various conditions associated with immunodeficiency [3, 4].

Diagnosis of LD relies on specific laboratory tests. Over the last decade, detection by urinary antigen test (UAT) has become the most widely used test for confirming LD, but culture remains the gold standard for identifying legionellae. A recent meta-analysis has confirmed the high specificity of UAT for *L. pneumophila* serogroup 1 [5]. The dissemination of the UAT may have improved the number of cases diagnosed, but without culture, other species and serogroups cannot be identified in most routine laboratories [6]. In addition, culture is fundamental for linking isolates from clinical and environmental samples.

Legionnaires' disease is thought to be underreported for two main reasons. Firstly, it is under diagnosed by clinicians, especially treating the milder forms of chest infection, since no test for LD is performed before empirically prescribing broad spectrum antibiotics that are likely to cover *Legionella* spp. Secondly, health professionals may fail to notify cases to health authorities due to the added administrative burden [1].

Since 1996, the European Working Group for *Legionella* Infections (EWGLI/EWGLINET) has collected aggregate data on LD cases in Europe regardless of their travel history [7]. Since April 2010, the surveillance of LD in Europe is coordinated by the European Centre for Disease Prevention and Control (ECDC) and carried out by the Member States' officially nominated disease specific experts making up the European Legionnaires' Disease Surveillance Network (ELDSNet). All cases are reported annually while TALD cases are also notified daily by ELDSNet members to ECDC.

This is the second annual report presenting the analysis of disaggregated LD surveillance data in Europe, however it is the first annual report with all cases of LD and TALD.

1 Methods

1.1 The European Legionnaires' Disease Surveillance Network

Coordinated by ECDC, ELDSNet involves all 27 EU Member States, Iceland and Norway. The network aims at identifying relevant public health risks, enhancing prevention of cases through the detection of clusters and monitoring epidemiological trends.

1.2 Data collection

1.2.1 All Legionnaires' disease cases

Data collected by nominated ELDSNet members in each European country were electronically transmitted to The European Surveillance System (TESSy) database following strict protocols. The deadline for 2010 data uploading was fixed on 15 June 2011. All LD cases in 2010 meeting the European case definition (see box below) were included [8]. TALD cases with a history of travelling abroad were to be reported only by their country of residence on a daily basis. Cases were to be classified as travel-associated if they had stayed at an accommodation site away from home during their incubation period of two to ten days prior to falling ill. Cases were to be reported as having formed part of a cluster if they had been exposed to the same source as at least one other case with their dates of onset no more than two years apart .

EU case definition of Legionnaires' disease

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
- *legionella pneumophila* serogroup 1 specific antibody response

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 a clinical specimen;
- *legionella pneumophila* non-serogroup 1 or other *Legionella* spp. specific antibody response;
- *legionella pneumophila* serogroup 1, other serogroups or other *Legionella* spp.: single high titre in specific serum antibody.

Epidemiological criteria:

At least one of the following two epidemiological links:

- environmental exposure;
- exposure to the same common source.

Case classification

- Possible case

N/A

- Probable case
any person meeting the clinical criteria AND at least one positive laboratory test for a probable case OR an epidemiological link.
- Confirmed case
any person meeting the clinical and the laboratory criteria for case confirmation.

1.2.2 Travel-associated Legionnaires' disease cases

Individual cases of travel-associated Legionnaires' disease are in most circumstances diagnosed and reported on a daily basis by the case's country of residence to The European Surveillance System (TESSy) at ECDC. Germany is not taking part in this reporting. Case reports include age, gender, date of onset of disease, method of diagnosis and travel information for the different places where the case had stayed from two to ten days prior to onset of disease. Only cases that have stayed in a commercial accommodation site are reported, therefore cases of LD that have visited relatives or friends are not reported here. After receiving the report, it is determined whether a new case should be classified as a single case or as part of a cluster, according to the definitions used by the network:

- a single case: a person who stayed at a public accommodation site in the two to ten days before onset of illness, and 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 public accommodation site in the two to ten days before onset of illness, and whose onsets were within the same two year period.

If there are three cases or more with onset of disease within the same three month period this is called a rapid evolving cluster and a notification is sent to all tour operators.

When a cluster is detected, a full investigation is required at the accommodation site and preliminary results from the risk assessment and start of control measures should be reported back to the coordinating centre within two weeks of the alert, using the standard operating procedures Form A.

A Form B is then used to report the results of environmental sampling, and the control measures applied to the site back to the coordinating centre in ECDC within a further four weeks, thus allowing six weeks in total for all investigations to be completed. If the forms are not returned within the time frames, or they report that actions and control measures are unsatisfactory, ELDSNet publishes the details of the sites associated with the cluster on its website, and tour operators are informed about the accommodation site being published. If a cluster is associated with more than one accommodation site, it is noted as a 'complex cluster' and all sites stayed at by the cluster cases are subject to the same investigation procedures as described above.

1.3 Data analysis

1.3.1 All Legionnaires' disease cases

Cases reported without any data on laboratory method or epidemiological link were excluded. 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 date used for statistics in 2010 were included in the analysis. Since environmental investigations are under the responsibility of Member States, we restricted the analysis to domestic cases for variables relating to these investigations.

Continuous variables were expressed as medians with interquartile ranges (IQRs [Q1–Q3]) and compared across strata by using the Mann-Whitney U test. Notification rates were presented with their 95% confidence intervals (CI) assuming a Poisson distribution. Age-standardised notification rates were calculated using direct standardisation and the European standard population¹. Any associations between independent and outcome variables were quantified by estimating prevalence ratios (PR) and calculating their CI by log-binomial regression. The distribution of all cases and the subset with a fatal outcome were described by relevant independent variables.

The 2009 report revealed important disparities between new and older Member States [9]. A special chapter was therefore dedicated to monitoring these differences.

1.3.2 Travel-associated Legionnaires' disease cases

Only cases with a date of onset in 2010 were included in the analysis. All TALD cases should also have been included in the annual data set for all LD cases. However since different identifiers are used in the two reporting systems it is not possible to identify which of the TALD cases in the annual data set of all LD cases are also included in the TALD data base. Analysis of the TALD data set focus on numbers of accommodation sites and clusters.

¹ As provided by the European Cancer Observatory (<http://eu-cancer.iarc.fr/5-glossary.html.en>)

2 Results

2.1 All Legionnaires' disease cases

2.1.1 Case validation and data completeness

In 2010, 6 348 cases were reported by 28 countries (Iceland had not reported). Fifty-two cases were excluded from the analysis because they did not meet the inclusion criteria. Among these 52 cases, 51 were reported with neither laboratory method nor epidemiological link (50 from Belgium and one from Germany). The remaining case was reported by Germany with a date used for statistics in 2009. Thus, 6 296 cases were included in this analysis.

Following decisions taken during the 2010 ELDSNet meeting, several validation rules have been introduced and reporting has been made mandatory for several key variables. Data completeness was only assessed for non-mandatory variables (Table 1). Of note, reporting for both environmental investigation and matching isolates has improved compared to 2009 with a 51.4% and 35.9% increase, respectively. Sequence-based typing remained very rare and similar to the previous year.

Table 1. Completeness of reporting in 28 countries by variable

Variable	Overall completeness %	2009–2010 difference %	Minimum		Maximum	
			Completeness %	Countries n	Completeness %	Countries n
Cluster Id ^a	82.6	-3.8	0	1	100	12
Probable country of infection ^b	95.7	-1.9	0	2	100	17
Sequence type	0.8	+2.1	0	21	41.9	1
Environmental investigation	60.6	+51.4	0	7	100	19
<i>Legionella</i> found ^c	94.3	+6.0			100	13
Positive sampling site ^d	84.8	-12.5	44.3	1	100	11
Matching isolates ^e	100	+35.9			100	7

^a Completeness determined in cases reported to have formed part of a cluster.

^b Completeness determined in cases reported to have been imported.

^c Completeness determined in cases reported to have prompted an environmental investigation.

^d Completeness determined in cases for which positive findings in an environmental investigation were reported.

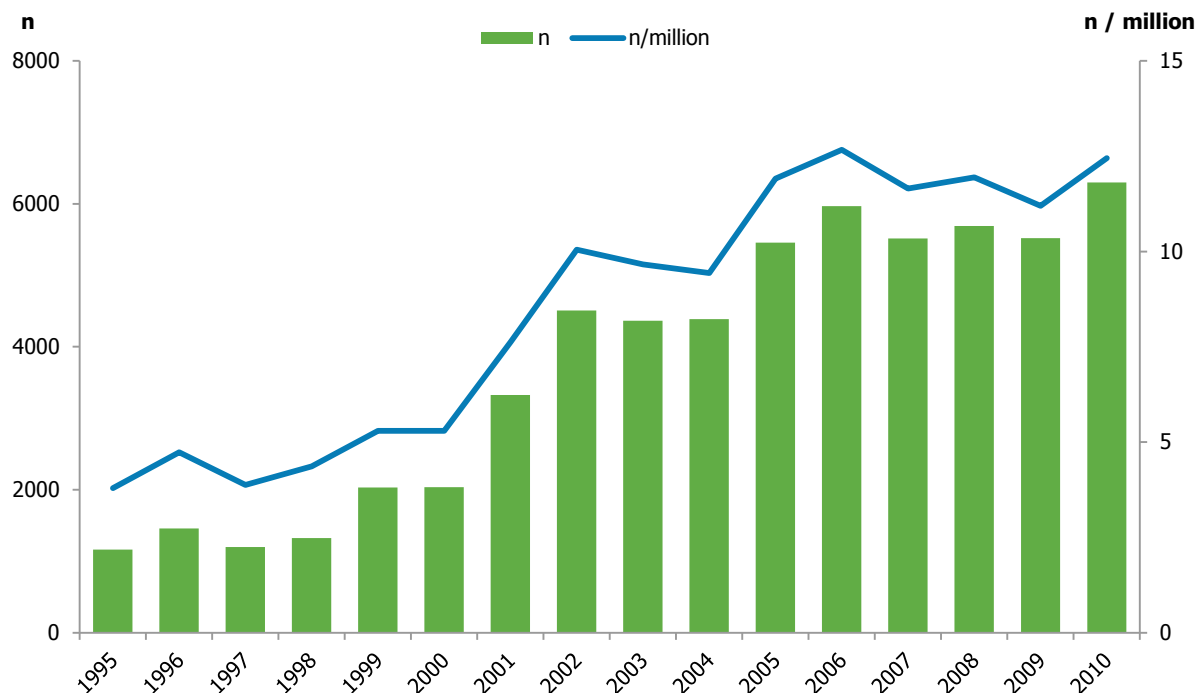
^e Completeness determined in cases reported to have prompted an environmental investigation.

2.2.2 Cases

Case classification and notification rate

Of the 6 296 notified cases, 5 843 (92.8%) were classified as confirmed and the remaining 453 (7.2%) as probable. Probable cases included 23 cases with epidemiological link only (21 cases from Poland and two from Germany). The number of notifications per million inhabitants was 12.4 in 2010 which represented an 11.1% increase compared to the previous year. This increase followed a short period of relatively stable notification numbers after 2006 (Figure 1).

Figure 1. Distribution of reported cases and notifications per million of Legionnaires' disease in the EU/EEA* by year of reporting, 1995–2010

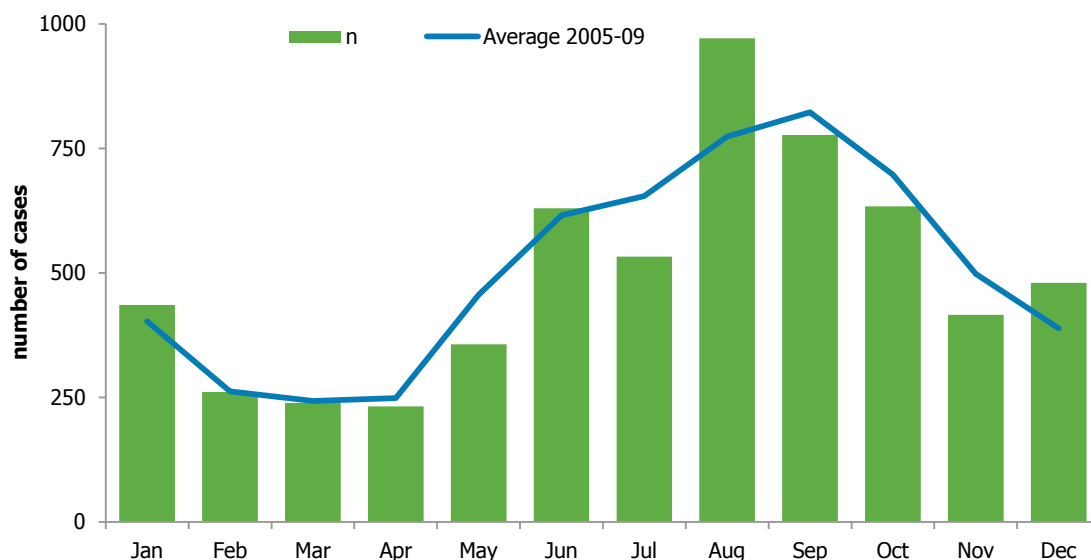


* EWGLINET member countries not belonging to the EU/EEA were excluded for 1995–2008.

Seasonality and geographical distribution

Date of onset was reported in 5 966 cases. Distribution of cases by month of onset showed a peak in August with 971 cases (Figure 2). In previous years, this peak occurred in September. Of all cases, 3 545 (59.1%) had a date of onset during the warm season (from June to October).

Figure 2. Distribution of reported cases of Legionnaires' disease by month of onset, EU/EEA, 2010 (n=5 966)



The number of notifications ranged from 0 per million inhabitants in Estonia to 28.3 per million in Slovenia (Table 2). The three largest reporters accounted for 62.3% of all cases (France, Italy and Spain) and the six largest for 86.6% (France, Italy, Spain, Germany, Netherlands and the United Kingdom). Most of the increase in notified cases between 2009 and 2010 occurred in France, Germany and the Netherlands which reported 734 (94.3%) of the 778 cases in excess of the number reported in 2009. Age-standardised notification rates did not differ substantially from crude notification rates.

Table 2. Reported cases and notifications per million of Legionnaires' disease by reporting country, EU/EEA, 2010

Country	Cases (n)	Population ² (n)	Notification rate (n/million)	2009-2010 difference %	Age-standardised notification rate (n/million)
Slovenia	58	2 046 976	28.3	-11.5	23.9
Netherlands	465	16 574 989	28.1	+84.6	23.3
Spain	1 150	45 989 016	25.0	-7.0	20.6
Denmark	133	5 534 738	24.0	+7.8	20.5
France	1 540	64 716 310	23.8	+27.3	19.5
Italy	1 232	60 340 328	20.4	+2.6	14.8
Luxembourg	10	502 066	19.9	+97.2	18.9
Malta	6	412 970	14.5	+49.8	12.5
Portugal	128	10 637 713	12.0	+33.7	10.6
Sweden	100	9 340 682	10.7	-13.0	8.3
Norway	48	4 858 199	9.9	+39.2	8.9
Austria	80	8 375 290	9.6	-13.2	7.8
Germany	688	81 802 257	8.4	+37.9	6.5
Belgium	89	10 839 905	8.2	+9.5	6.8
UK	376	62 008 048	6.1	-0.6	5.2
Hungary	60	10 014 324	6.0	-7.8	5.4
Finland	24	5 351 427	4.5	+9.4	3.5
Czech Republic	38	10 506 813	3.6		2.7
Latvia	6	2 248 374	2.7	+105.3	2.3
Cyprus	2	803 147	2.5		2.5
Ireland	11	4 467 854	2.5	+53.9	1.9
Poland	36	38 167 329	0.9	+214.4	1.7
Greece	9	11 305 118	0.8	-38.8	0.8
Slovakia	4	5 424 925	0.7	+84.3	0.7
Lithuania	1	3 329 039	0.3		0.7
Bulgaria	1	7 563 710	0.1	-73.6	0.3
Romania	1	21 462 186	0.0	-53.4	0.0
Estonia	0	1 339 993	0.0	-100.0	0.0
Total	6 296	505 963 726	12.4	+11.1	10.0

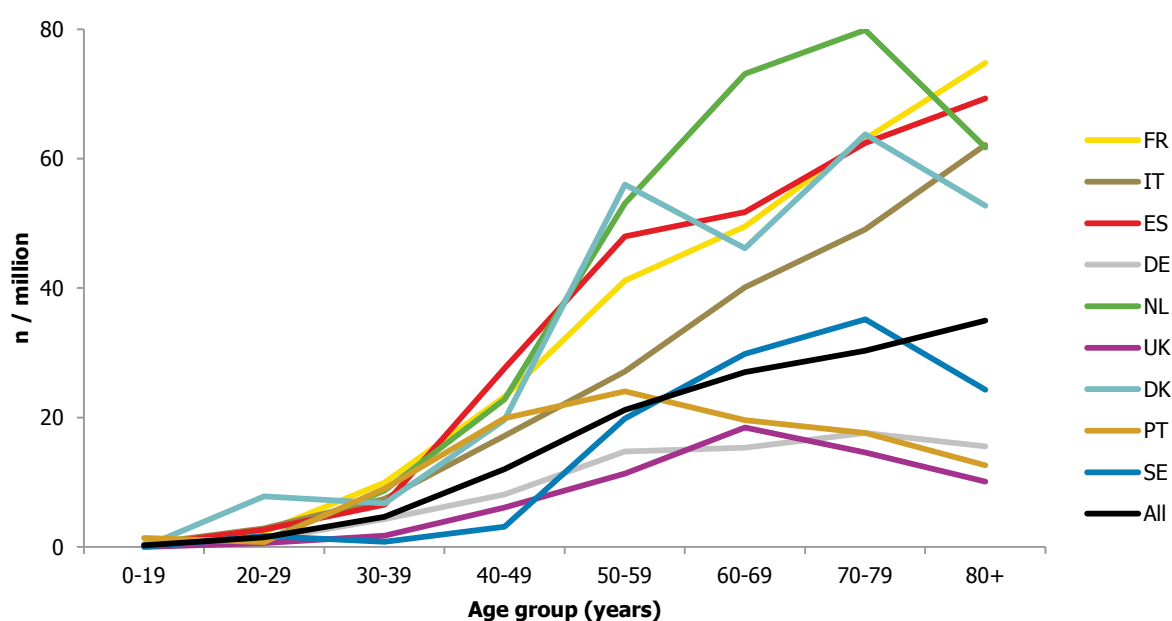
Age and gender

The median age at date of onset was 62 years (IQR 51–73). It was significantly higher in females (65 years, IQR 51–73) than in males (60 years, IQR 50–72) ($p < 0.0001$). The number of notifications per million increased with age (Table 3). People over 50 years old accounted for 4 907 (78.1%) of 6 280 cases with known age. France, Italy and Spain showed an uninterrupted increase of notifications per million with age (Figure 3). In other countries, notification numbers dropped in the eldest age group, especially in countries with higher rates such as the Netherlands, Denmark and Sweden. A similar pattern was observed in 2009 for the same countries. For all age groups over 19 years, LD was more common in males, with an overall male/female ratio of 2.8. The male/female ratio peaked in 40–49 year-olds at 3.4.

² Eurostat (<http://epp.eurostat.ec.europa.eu/portal/page/portal/eurostat/home/>)

Table 3. Distribution of reported cases and notifications per million of Legionnaires' disease by gender and age group, EU/EEA, 2010

Age (years)	Males		Females		Total		Sex ratio (male/female)
	Cases (n)	Notif. rate (n/million)	Cases (n)	Notif. rate (n/million)	Cases (n)	Notif. rate (n/million)	
0-19	13	0.2	16	0.3	29	0.3	0.8
20-29	72	2.1	27	0.8	99	1.5	2.6
30-39	267	7.4	68	1.9	335	4.7	3.8
40-49	733	19.4	177	4.7	910	12.0	4.1
50-59	1 093	33.2	330	9.6	1 423	21.2	3.4
60-69	1 051	41.3	394	14.1	1 445	27.0	2.9
70-79	837	48.1	378	16.7	1 215	30.4	2.9
80 or over	506	63.2	318	20.4	824	35.0	3.1
Total	4 572	18.5	1 708	6.6	6 280	12.4	2.8

Figure 3. Distribution of notifications per million of Legionnaires' disease by age group in EU/EEA countries with at least 100 cases reported, 2010

Settings

Of 5 602 cases with reported setting of infection, 3 993 (71.3%) were reported as community-acquired (Table 4). In 2010, TALD accounted for 20% of the total and less than 10% were linked to healthcare facilities. Across countries, this distribution varied highly, with a proportion of TALD ranging from near 0 to 100%. TALD showed a clear decreasing trend from northern to southern Europe. When restricting the analysis to community-acquired cases, northern countries ranked lower with the notable exceptions of Denmark and the Netherlands (Table 5). Denmark, France and Italy had relatively high notification rates for cases associated with healthcare facilities (nosocomial and other healthcare settings). Setting was fairly similar among age groups with the notable exception of cases aged above 70 which had a lower proportion of TALD and a higher percentage of healthcare related infections (Table 6).

Table 4. Distribution of reported cases of Legionnaires' disease by country and reported setting of infection, EU/EEA, 2010

Country	Community n (%)	Domestic travel n (%)	Travel abroad n (%)	Nosocomial n (%)	Other healthcare n (%)	Other n (%)	Total n (%)
Austria	53 (66.3)	3 (3.8)	14 (17.5)	7 (8.8)	0	3 (3.8)	80 (100)
Bulgaria	1 (100)	0	0	0	0	0	1 (100)
Germany	139 (41.2)	30 (8.9)	101 (30.1)	34 (10.1)	10 (3.0)	23 (6.8)	337 (100)
Denmark	65 (58.0)	3 (2.7)	34 (30.4)	6 (5.4)	4 (3.6)	0	112 (100)
Finland	0	0	12 (100)	0	0	0	12 (100)
France	1 082 (70.3)	222 (14.4)	41 (2.7)	101 (6.6)	81 (5.3)	13 (0.8)	1 540 (100)
Germany	139 (41.2)	30 (8.9)	101 (30.0)	34 (10.1)	10 (3.0)	23 (6.8)	337 (100)
Greece	5 (55.6)	2 (22.2)	0	1 (11.1)	0	1 (11.1)	9 (100)
Hungary	12 (40.0)	2 (6.7)	3 (10.0)	10 (33.3)	0	3 (10.0)	30 (100)
Ireland	2 (18.2)	2 (18.2)	7 (63.6)	0	0	0	11 (100)
Italy	998 (81.0)	111 (9.0)	14 (1.1)	64 (5.2)	41 (3.3)	4 (0.3)	1 232 (100)
Latvia	0	0	4 (100)	0	0	0	4 (100)
Luxembourg	0	0	3 (100)	0	0	0	3 (100)
Malta	6 (100)	0	0	0	0	0	6 (100)
Netherlands	284 (61.1)	26 (5.6)	144 (31.0)	2 (0.4)	7 (1.5)	2 (0.4)	465 (100)
Norway	0	0	32 (100)	0	0	0	32 (100)
Poland	24 (88.9)	0	0	3 (11.1)	0	0	27 (100)
Portugal	106 (91.4)	7 (6.0)	2 (1.7)	1 (0.9)	0	0	116 (100)
Romania	1 (100)	0	0	0	0	0	1 (100)
Slovenia	46 (80.7)	0	1 (1.8)	0	0	10 (17.5)	57 (100)
Slovakia	3 (75.0)	0	1 (25.0)	0	0	0	4 (100)
Spain	967 (84.1)	137 (11.9)	15 (1.3)	31 (2.7)	0	0	1 150 (100)
UK	199 (53.4)	26 (7.0)	129 (34.6)	19 (5.1)	0	0	373 (100)
Total	3 993 (71.3)	571 (10.2)	557 (9.9)	279 (5.0)	143 (2.6)	59 (1.1)	5 602 (100)

Table 5. Distribution of reported community-acquired and healthcare-associated cases and notifications per million of Legionnaires' disease by reporting country, EU/EEA, 2010

Country	Community-acquired		Healthcare-associated	
	Cases (n)	Notification rate (n/million)	Cases (n)	Notification rate (n/million)
Slovenia	46	22.5	0	0.0
Spain	967	21.0	31	0.7
Netherlands	284	17.1	9	0.5
France	1 082	16.7	182	2.8
Italy	998	16.5	105	1.7
Malta	6	14.5	0	0.0
Denmark	65	11.7	10	1.8
Portugal	106	10.0	1	0.1
Austria	53	6.3	7	0.8
UK	199	3.2	19	0.3
Germany	139	1.7	44	0.5
Hungary	12	1.2	10	1.0
Poland	24	0.6	3	0.1
Slovakia	3	0.6	0	0.0
Ireland	2	0.4	0	0.0
Greece	5	0.4	1	0.1
Bulgaria	1	0.1	0	0.0
Romania	1	0.0	0	0.0
Estonia	0	0.0	0	0.0
Finland	0	0.0	0	0.0
Luxembourg	0	0.0	0	0.0
Latvia	0	0.0	0	0.0
Norway	0	0.0	0	0.0
Total	3 993	7.9	422	0.8

Table 6. Distribution of reported cases of Legionnaires' disease by reported setting of infection and age group, EU/EEA, 2010

Age (years)	Community n (%)	Travel n (%)	Healthcare n (%)	Other n (%)	Total n (%)
0–19	13 (72.2)	4 (22.2)	1 (5.6)	0	18 (100)
20–29	58 (68.8)	19 (22.4)	5 (5.9)	3 (3.5)	85 (100)
30–39	218 (75.4)	50 (17.3)	14 (4.8)	7 (2.4)	289 (100)
40–49	617 (75.2)	157 (19.1)	40 (4.9)	7 (0.9)	821 (100)
50–59	873 (69.8)	289 (23.1)	68 (5.4)	21 (1.7)	1 251 (100)
60–69	861 (67.1)	315 (24.5)	98 (7.6)	10 (0.8)	1 284 (100)
70–79	785 (71.8)	203 (18.6)	99 (9.0)	7 (0.6)	1 094 (100)
80 or over	558 (74.6)	89 (11.9)	97 (13.0)	4 (0.5)	748 (100)
Total	3 983 (71.3)	1 126 (20.1)	422 (7.5)	59 (1.1)	5 590 (100)

* Denominator: known setting

Time to diagnosis

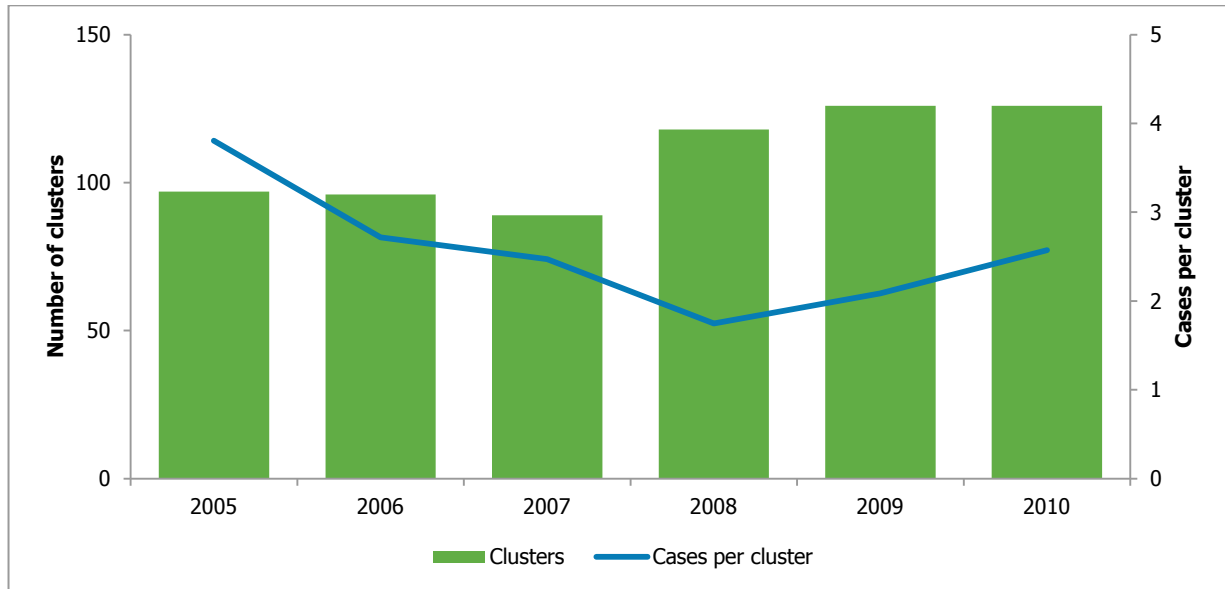
Both date of onset and date of diagnosis were available in only 25.2% of cases (1 589/6 296). The median time from onset of symptoms to diagnosis was six days (IQR 4–9).

2.1.3 Clusters

Frequency and size

Of 3 957 cases with known cluster status, 397 (10.0%) were reported as part of a cluster. A cluster identifier was provided for 324 cases forming 126 clusters which resulted in an average size of 2.6 cases per cluster (Figure 4). After a steady decrease from 2005 to 2008, cluster size increased from 2008 onwards. The largest cluster reported in 2010 occurred in Spain with 51 cases reported.

Figure 4. Distribution of reported clusters of Legionnaires' disease and average number of cases per cluster, by year of reporting, EU/EEA, 2005–2010 (n= 643)



Time and location

The proportion of clustered cases was lower during winter (November to March) although the difference was not statistically significant (PR 0.82, 95%CI 0.66–1.01) (Figure 5). The percentage of clustered cases was moderately correlated to the number of cases (Pearson coefficient = 0.54). The percentage of clustered cases was on average 8.4% with important differences among countries, ranging from 0 to 66.7% in Poland (Table 7). Cluster status was missing in nearly 40% of all cases.

Figure 5. Distribution of reported clustering of Legionnaires' disease by month of onset, EU/EEA, 2010 (n=3 885)

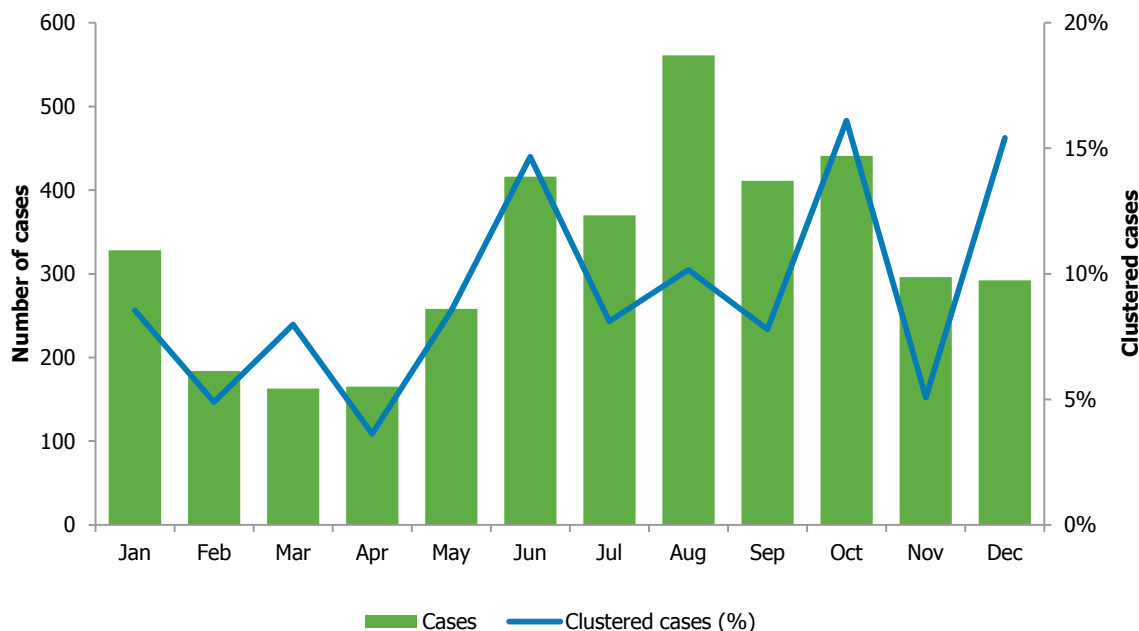


Table 7. Distribution of reported clustering of Legionnaires' disease by reporting country, EU/EEA, 2010

Country	Clusters n	Clustered n (%)	Sporadic n (%)	Unknown n (%)	Total n	Cluster ratio ^a %
Austria	1	1 (1.3)	79 (98.7)	0	80	1.3
Belgium	0	0	0	89 (100)	89	NA
Bulgaria	0	0	1 (100)	0	1	0
Cyprus	0	0	0	2 (100)	2	NA
Czech Republic	0	0	38 (100)	0	38	0
Denmark	6	7 (5.3)	0	126 (94.7)	133	NA ^b
Finland	0	0	0	24 (100)	24	NA
France	0	0	0	1 540 (100)	1 540	NA
Germany	Unknown	69 (10.0)	619 (90.0)	0	688	10.0
Greece	0	0	9 (100)	0	9	0
Hungary	1	2 (3.3)	58 (96.7)	0	60	3.3
Ireland	5	5 (45.5)	5 (45.5)	1 (9.0)	11	50.0
Italy	23	33 (2.7)	1 199 (97.3)	0	1 232	2.7
Latvia	0	0	6 (100)	0	6	0
Lithuania	0	0	1 (100)	0	1	0
Luxembourg	2	2 (20.0)	8 (80.0)	0	10	20.0
Malta	0	0	6 (100)	0	6	0
Netherlands	37	58 (12.5)	0	407 (87.5)	465	NA
Norway	0	0	48 (100)	0	48	0
Poland	3	24 (66.7)	12 (33.3)	0	36	66.7
Portugal	2	10 (7.8)	90 (70.3)	28 (21.9)	128	10.0
Romania	0	0	1 (100)	0	1	0
Slovenia	1	10 (17.2)	47 (81.0)	1 (1.7)	58	17.5
Slovakia	0	0	2 (50.0)	2 (50.0)	4	NA
Spain	21	109 (9.5)	1 041 (90.5)	0	1 150	9.5
Sweden	0	0	0	100 (100)	100	NA
UK	28	67 (17.8)	291 (77.4)	18 (4.8)	376	18.7
Total	130	397 (6.3)	3 561 (56.6)	2 338 (37.1)	6 296	NA
Subtotal^c	87	332 (8.4)	3 559 (90.4)	48 (1.2)	3 939	8.5

^a Denominator: known status

^b Not applicable where > 25% of cluster status unknown

^c Includes only countries where < 25% of cluster status unknown.

Setting of infection

The proportion of cases reported as part of a cluster was the highest in domestic travellers followed by those travelling abroad (Table 8). Travel-associated cases (domestic and abroad) were three times more likely to be part of a cluster than cases occurring in other settings (PR 3.6, 95%CI 3.0–4.4).

Table 8. Distribution of reported clustering of Legionnaires' disease, by setting, EU/EEA, 2010

Setting	Total cases reported		Clusters n	Clustered cases		cluster size (cases/cluster)
	n	%		n	%	
Community	2 405	76.0	25	151	6.3	6.0
Domestic travel	240	7.6	53	87	36.3	1.6
Travel abroad	281	8.9	50	69	24.6	1.3
Nosocomial	154	4.9	8	16	10.4	2.0
Other healthcare	51	1.6	1	2	3.9	2.0
Other	34	1.1	1	10	29.4	10.0
Total	3 165	100	138	335	10.6	2.4

2.1.4 Mortality

Time and location

The reported mortality rate of LD in 2010 was 0.9 per million inhabitants and has been stable since 2005. Of 4 339 cases with a known outcome, 438 were reported to have died, giving a case fatality ratio (CFR) of 10.1%. In countries reporting at least 10 cases and with less than 25% of cases with unknown outcome, the average CFR was 8.2%, ranging from 0% (Ireland, Norway and Poland) to 22.5% in Austria (Table 9). Confirmed cases were twice as likely to be reported with a fatal outcome compared to probable ones (PR 2.0, 95% CI 1.3–3.0). Culture-confirmed cases were more than twice as likely to be reported with a fatal outcome compared to other cases (PR 2.1, 95% CI 1.7–2.6). Cases with a date of onset during the winter period were more likely to have died (PR 1.4, 95% CI 1.2–1.7). Case fatality ratios ranged from 6.9% in June to 13.8% in November (Figure 6).

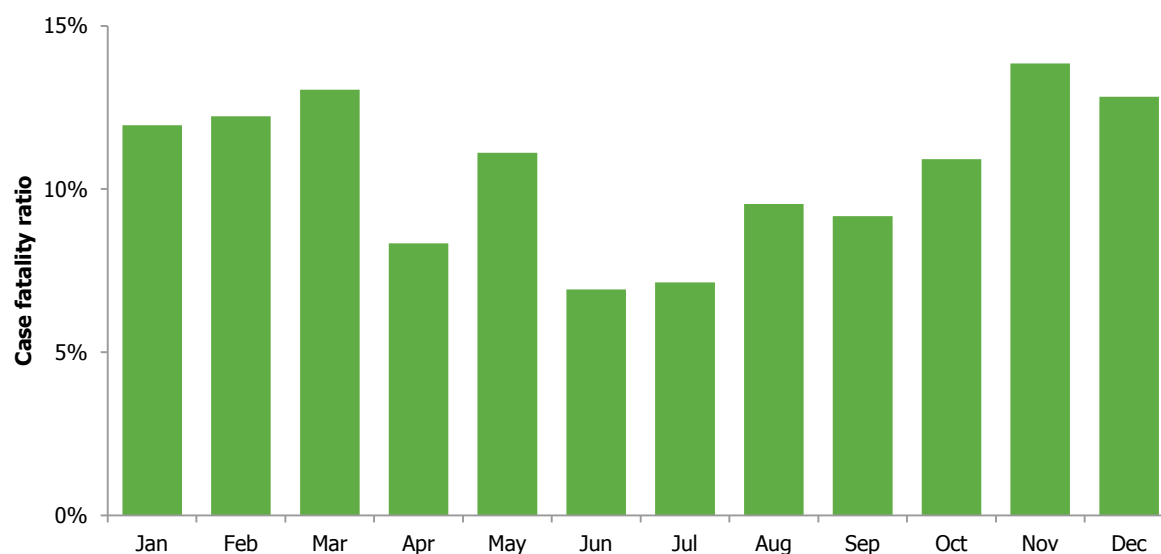
Table 9. Reported outcomes of Legionnaires' disease and case fatality by reporting country, EU/EEA, 2010

Country	Survival n (%)	Dead n (%)	Unknown n (%)	Total n	CFR ^a %
Austria	62 (77.5)	18 (22.5)	0	80	22.5
Belgium	0	0	89 (100)	89	NA ^b
Bulgaria	1 (100)	0	0	1	0
Cyprus	2 (100)	0	0	2	0
Czech Republic	33 (86.8)	5 (13.2)	0	38	13.2
Denmark	124 (93.2)	9 (6.8)	0	133	6.8
Finland	23 (95.8)	1 (4.2)	0	24	4.2
France	1 194 (77.5)	158 (10.3)	188 (12.2)	1 540	11.7
Germany	634 (92.2)	50 (7.3)	4 (0.6)	688	7.3
Greece	9 (100)	0	0	9	0
Hungary	49 (81.7)	11 (18.3)	0	60	18.3
Ireland	11 (100)	0	0	11	0
Italy	387 (31.4)	75 (6.1)	770 (62.5)	1 232	NA
Lithuania	0	1 (100)	0	1	100
Luxembourg	9 (90.0)	1 (10.0)	0	10	10.0
Latvia	6 (100)	0	0	6	0
Malta	6 (100)	0	0	6	0
Netherlands	446 (95.9)	17 (3.7)	2 (0.4)	465	3.7
Norway	42 (87.5)	0	6 (12.5)	48	0
Poland	34 (94.4)	0	2 (5.6)	36	0
Portugal	100 (78.1)	3 (2.3)	25 (19.5)	128	2.9
Romania	1 (100)	0	0	1	0
Slovenia	56 (96.6)	2 (3.4)	0	58	3.4
Slovakia	4 (100)	0	0	4	0
Spain	657 (57.1)	51 (4.4)	442 (38.4)	1 150	NA
Sweden	0	0	100 (100)	100	NA
UK	11 (2.9)	36 (9.6)	329 (76.6)	376	NA
Total	3 901 (62.0)	438 (7.0)	1 957 (31.0)	6 296	NA
Subtotal^c	2 846 (85.0)	276 (8.2)	227 (6.8)	3 349	8.2

^a Denominator: known outcomes (survivals and deaths)

^b Not applicable where >25% of outcomes unknown.

^c Includes only countries where < 25% of outcomes unknown.

Figure 6. Case-fatality ratio by month of onset, EU/EEA, 2010 (n=4 241)

Age and gender

The case fatality ratio increased steadily with age in males, whereas it reached a plateau from age 40 up to 69 in females (Table 10). Interestingly, the CFR in females was almost twice the CFR in males between 30 and 59. Overall, male gender was not significantly associated with a lower fatality (PR 0.8, 95% CI 0.7-1.0).

Table 10. Reported case-fatality of Legionnaires' disease by gender and age group, EU/EEA, 2010

Age group (yrs)	Males			Females			Total		
	Deaths n	Total n	CFR %	Deaths n	Total n	CFR %	Deaths n	Total n	CFR %
0-19	1	11	9.1	1	11	9.1	2	22	9.1
20-29	1	53	1.9	0	20	0	1	73	1.4
30-39	7	186	3.8	4	56	7.1	11	242	4.5
40-49	23	501	4.6	10	123	8.1	33	624	5.3
50-59	41	768	5.3	19	233	8.2	60	1 001	6.0
60-69	62	709	8.7	22	259	8.5	84	968	8.7
70-79	73	561	13.0	31	258	12.0	104	819	12.7
80 +	93	353	26.3	50	229	21.8	143	582	24.6
Total	301	3 142	9.6	137	1 189	11.5	438	4 331	10.1

Setting of infection

The case fatality ratio was higher in healthcare-associated cases than in community-acquired cases (Table 11). Travel-associated cases had the lowest CFR.

Table 11. Reported case-fatality of Legionnaires' disease by setting, EU/EEA, 2010

Setting	Deaths n	Total n	CFR %
Nosocomial	50	2 682	24.5
Other healthcare	17	204	15.9
Community	266	107	9.9
Domestic travel	35	411	8.9
Travel abroad	22	393	5.4
Other	8	55	14.5
Total	398	3 852	10.3

Time to diagnosis

Cases with a diagnosis made within two days were more likely to die than those with a longer time to diagnosis (PR 1.6, 95%CI 1.1-2.4).

2.1.5 Laboratory, pathogens and environment

Laboratory methods

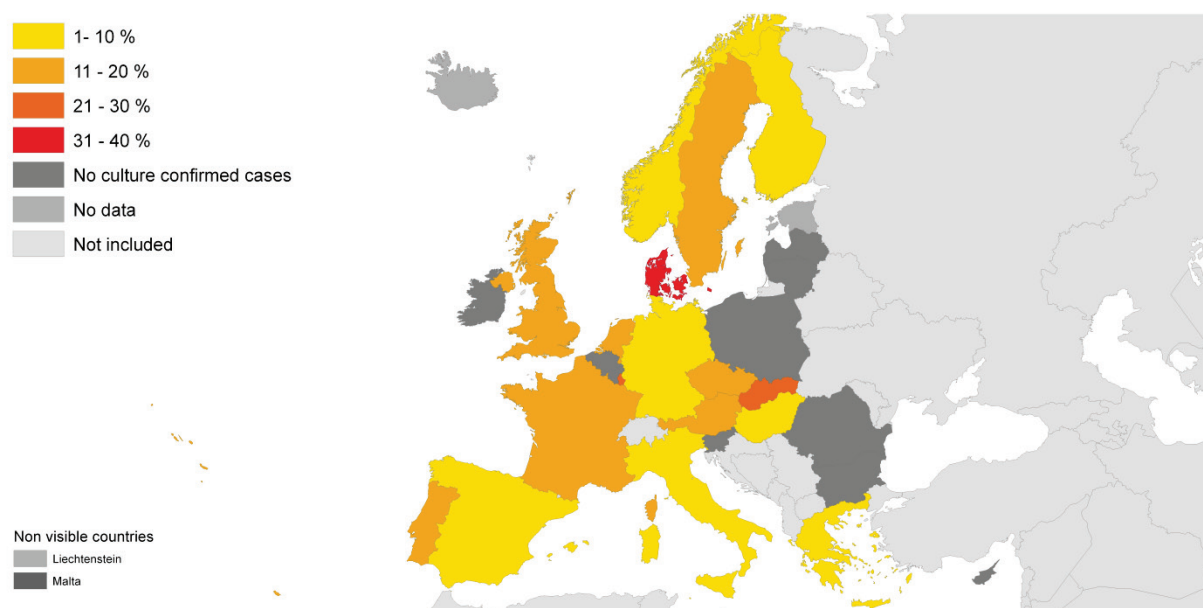
Of the 6 296 cases notified, 6 273 were ascertained by laboratory tests (99.6%). For these 6 273 cases, 6 323 tests were performed of which 81.9% were urinary antigen detections (Table 12). While the distribution of tests was similar to previous years, it varied highly across countries (Table 13). Culture-confirmed cases were not reported by some countries, but accounted for 40% of all tests in Denmark (Figure 7).

Table 12. Reported diagnostic laboratory methods, EU/EEA, 2010 (more than one method per case possible)

Laboratory method	n	%
Urinary antigen	5 180	81.9
Culture	652	10.3
Fourfold titre rise	251	4.0
Nucleic acid amplification e.g. PCR	167	2.6
Fourfold titre rise	70	1.1
Direct immuno-fluorescence	3	0.0
Total	6 323	100

Table 13. Reported laboratory methods by reporting country, EU/EEA, 2010 (more than one method per case possible)

Country	Laboratory method						Total n
	Culture n (%)	Fourfold titre rise n (%)	Direct immuno-fluorescence n (%)	PCR n (%)	Single high titre n (%)	Urinary antigen n (%)	
Austria	11 (13.8)	2 (2.5)	0	1 (1.3)	1 (1.3)	65 (81.3)	80
Belgium	0	0	0	0	0	89 (100)	89
Bulgaria	0	0	0	0	0	1 (100)	1
Cyprus	0	0	0	0	0	2 (100)	2
Czech Republic	7 (14.3)	4 (8.2)	2 (4.1)	8 (16.3)	5 (10.2)	23 (46.9)	49
Denmark	53 (39.8)	3 (2.3)	0	26 (19.5)	8 (6.0)	43 (32.3)	133
Finland	2 (8.3)	0	0	2 (50.0)	12 (50.0)	8 (33.3)	24
France	282 (18.3)	7 (0.5)	1 (0.1)	3 (1.5)	23 (1.5)	1 224 (79.5)	1 540
Germany	29 (4.0)	11 (1.5)	0	85 (11.8)	61 (8.5)	535 (74.2)	721
Greece	1 (10.0)	0	0	0	0	9 (90.0)	10
Hungary	1 (1.6)	0	0	2 (3.2)	41 (65.1)	19 (30.2)	63
Ireland	0	0	0	0	0	11 (100)	11
Italy	12 (1.0)	6 (0.5)	0	1 (0.1)	49 (4.0)	1 164 (94.5)	1 232
Lithuania	0	0	0	0	0	1 (100)	1
Luxembourg	3 (30.0)	0	0	0	0	7 (70.0)	10
Latvia	0	0	0	0	0	6 (100)	6
Malta	0	0	0	0	0	6 (100)	6
Netherlands	92 (19.8)	15 (3.2)	0	18 (3.9)	20 (4.3)	320 (68.8)	465
Norway	2 (4.2)	0	0	5 (10.4)	0	41 (85.4)	48
Poland	0	3 (20.0)	0	0	6 (40.0)	6 (40.0)	15
Portugal	14 (10.9)	0	0	0	3 (2.3)	111 (86.7)	128
Romania	0	0	0	0	1 (100)	0	1
Slovenia	0	4 (6.9)	0	4 (6.9)	4 (6.9)	46 (79.3)	58
Slovakia	1 (25.0)	1 (25.0)	0	0	0	2 (50.0)	4
Spain	55 (4.8)	10 (0.9)	0	0	8 (0.7)	1 077 (93.7)	1 150
Sweden	19 (19.0)	3 (3.0)	0	8 (8.0)	4 (4.0)	66 (66.0)	100
UK	68 (18.1)	1 (0.3)	0	4 (1.1)	5 (1.3)	298 (79.3)	376
Total	652 (10.3)	70 (1.1)	3 (0.0)	167 (2.6)	251 (4.0)	5 180 (81.9)	6 323

Figure 7. Percentage of culture-confirmed cases by country, EU/EEA, 2010 (n=6 296)

©EuroGeographics for the administrative boundaries

Pathogens

L. pneumophila accounted for the vast majority of reported species in all cases, but also in confirmed and culture-confirmed cases (Table 14). Its serogroup 1 represented 562 (86.2%) of 652 culture-confirmed cases. The sequence type was reported for only 49 cases (39 from Denmark, 5 from Portugal, 3 from Austria and 2 from Slovenia). Monoclonal subtype was reported for 103 (18%) of 562 culture-confirmed cases with a *L. pneumophila* serogroup 1 isolate. More than half of these isolates were Allentown/France and Philadelphia subtypes (Table 15).

Table 14. Reported culture-confirmed cases of Legionnaires' disease and Legionella isolates by species and serogroup, EU/EEA, 2010

Species and serogroup	Culture-confirmed cases	
	n	%
<i>L. pneumophila</i>	629	96.5
Serogroup		
1	562	86.2
2	5	0.8
3	17	2.6
4	3	0.5
5	2	0.3
6	9	1.4
7	1	0.2
8	4	0.6
Mixed	2	0.3
Unknown	24	3.7
<i>L. longbeachae</i>	3	0.5
<i>L. bozemanii</i>	3	0.5
<i>L. dumoffii</i>	2	0.3
<i>L. micdadei</i>	1	0.2
<i>L. species unknown</i>	7	1.1
Unknown	7	1.1
Total	652	100

Table 15. Reported monoclonal subtype for *Legionella pneumophila* serogroup 1 isolates, EU/EEA, 2010

Monoclonal subtype	n	%
Philadelphia	28	27.2
Allentown/France	26	25.2
Knoxville	20	19.4
Benidorm	16	15.5
Oxford/Olda	7	6.8
Bellingham	3	2.9
Olda	3	2.9
Total	103	100

Environment

Environmental investigation status was reported in 1 909 (37.8%) of 5 045 cases known not to have travelled abroad within the incubation period (Table 16). An investigation was carried out in 435 (22.8%) of 1 909 cases with known status. Such investigations were more likely in culture-confirmed (PR 3.1, 95% CI 2.7–3.7) and in fatal cases (PR 1.4, 95% CI 1.1–1.8). *Legionella* was detected in 331 (76.1%) of 435 cases for which environmental findings were reported (Table 17). Since *Legionella* was found in two different sampling sites for two cases, these 331 cases yielded a total of 333 investigations. Of those 333 investigations with positive findings, 180 (54.1%) isolated the pathogen from water systems (55 from the hot water system, 7 from the cold water system and 118 from non-specified water systems), 51 (15.3%) from a cooling tower, 8 (2.4%) from a whirlpool or a spa and 11 (3.3%) from other sampling sites. For 83 (24.9%) of those 333 investigations with positive findings, the sampling site was missing or unknown. In 21 (6.3%) of the 331 cases with positive environmental findings, isolates could be matched to clinical isolates.

Table 16. Environmental follow-up status of reported cases of Legionnaires' disease by reporting country, EU/EEA, 2010*

Country	Investigation		No investigation		Status unknown		Total
	n	%	n	%	n	%	n
Austria	56	84.8	10	15.2	0		66
Bulgaria	0		1	100	0		1
Denmark	10	12.8	0		68	87.2	78
France	0		0		1 499	100	1 499
Germany	0		0		236	100	236
Greece	0		0		9	100	9
Hungary	11	40.7	16	59.3	0		27
Ireland	3	75.0	0		1	25.0	4
Italy	54	4.4	1 164	95.6	0		1 218
Malta	6	100	0		0		6
Netherlands	93	29.0	210	65.4	18	5.6	321
Poland	26	96.3	1	3.7	0		27
Portugal	14	12.3	5	4.4	95	83.3	114
Romania	0		0		1	100	1
Slovenia	10	17.9	46	82.1	0		56
Slovakia	0		3	100	0		3
Spain	98	8.6	17	1.5	1 020	89.9	1 135
UK	54	22.1	1	0.4	189	77.5	244
Total	435	8.6	1 474	29.2	3 136	62.2	5 045

* Cases with setting reported as unknown or travel abroad were not included.

Table 17. Legionella findings of environmental investigations by reporting country, EU/EEA, 2010*

Country	Detection		No detection		Result unknown		Total
	n	%	n	%	n	%	n
Austria	23	41.1	33	58.9	0		56
Denmark	10	100	0		0		10
Hungary	11	100	0		0		11
Ireland	1	33.3	2	66.7	0		3
Italy	30	55.6	17	31.5	7	13.0	54
Malta	5	83.3	1	16.7	0		6
Netherlands	93	100	0		0		93
Poland	25	96.2	1	3.8	0		26
Portugal	3	21.4	11	78.6	0		14
Slovenia	10	100	0		0		10
Spain	98	100	0		0		98
UK	22	40.7	23	42.6	9	16.7	54
Total	331	76.1	88	20.2	16	3.7	435

* Cases with setting reported as unknown or travel abroad were not included.

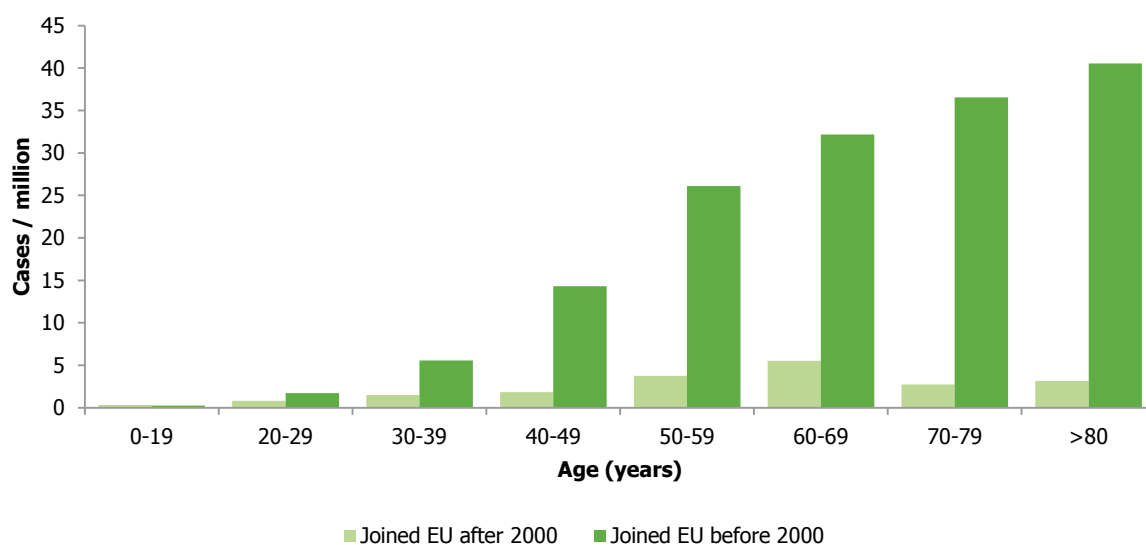
2.1.6 Comparison between Members States

Notification rate

Age-standardised notification rate was six times higher in countries that joined the EU/EEA before 2000 compared to those that joined later on³ (12.0/million, 95% CI 9.9–14.3. vs. 1.9/million, 95% CI 1.1–3.0).

In countries that joined after 2000, the increase of the notification rate with age was not as pronounced as in older Members States (Figure 8). It peaked in those aged 60–69 years (5.5 cases / million).

Figure 8. Age-specific notification rate of Legionnaires' disease in EU/EEA countries according to their date of EU/EEA accession, 2010 (n=6 280)



³ EU Member States that joined after 2000: Bulgaria, Cyprus, Czech Republic, Estonia, Hungary, Latvia, Lithuania, Malta, Poland, Romania, Slovakia, Slovenia

Seasonality and geographical distribution

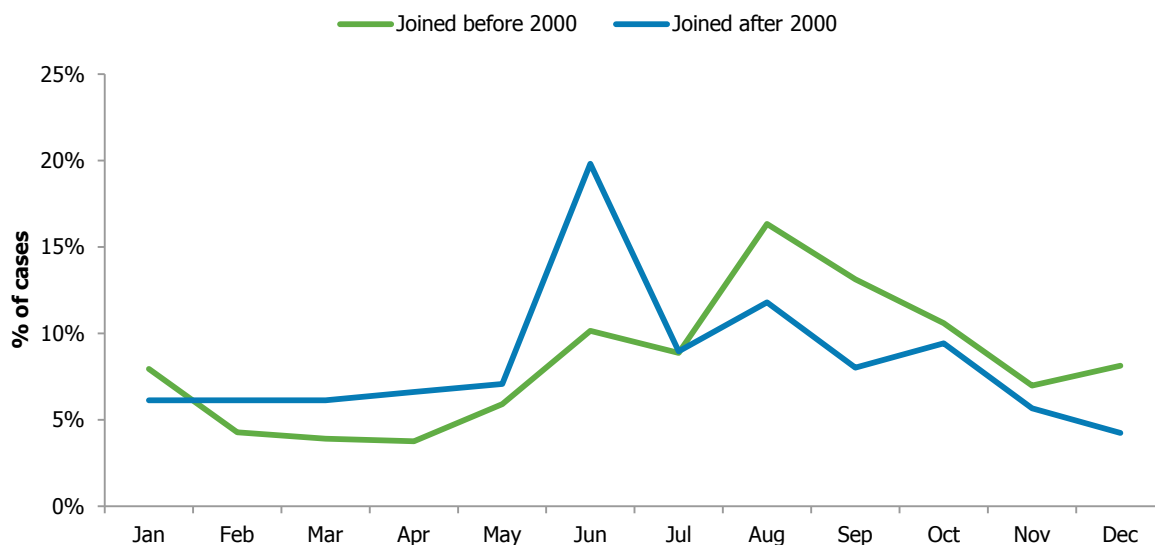
When excluding the peak in June due to a known outbreak in Poland (16 cases reported with a date of onset in June and three in July), the distribution of cases over the year was similar in new and older Member States (Figure 9).

The data on setting of infection was four times more likely to be missing or unknown in countries that joined after 2000 (PR 3.9, 95% CI 3.2–4.7). The proportion of cases reported to have been community-acquired was similar among the two groups. However, TALD cases and especially cases with a history of domestic travel were less frequent in countries that joined the EU after 2000 (Table 18).

Table 18. Reported cases of Legionnaires' disease by setting in EU/EEA countries according to their date of EU/EEA accession, 2010

Setting	EU/EEA accession		Total n (%)
	before 2010 n (%)	after 2010 n (%)	
Community	3 900 (71.3)	93 (71.5)	3 993 (71.3)
Domestic travel	569 (10.4)	2 (1.5)	571 (10.2)
Travel abroad	548 (10.0)	9 (6.9)	557 (9.9)
Nosocomial	266 (4.9)	13 (10.0)	279 (5.0)
Other healthcare	143 (2.6)	0	143 (2.6)
Other	46 (0.8)	13 (10.0)	59 (1.1)
Total	5 472 (100)	130 (100)	5 602 (100)

Figure 9. Percentage of reported cases of Legionnaires' disease by month of onset in EU/EEA countries according to their date of EU/EEA accession, 2010 (n=6 003)



Mortality

The probability of a fatal outcome was similar in all countries, regardless if they joined the EU before or after 2000 (PR 0.9, CI95% 0.6–1.4).

Laboratory and environmental investigations

Countries which joined the EU after 2000 were less likely to perform culture (PR 0.4, 95% CI 0.2–0.8), but more likely to rely on single high titre (PR 8.4, 95% CI 6.5–10.9).

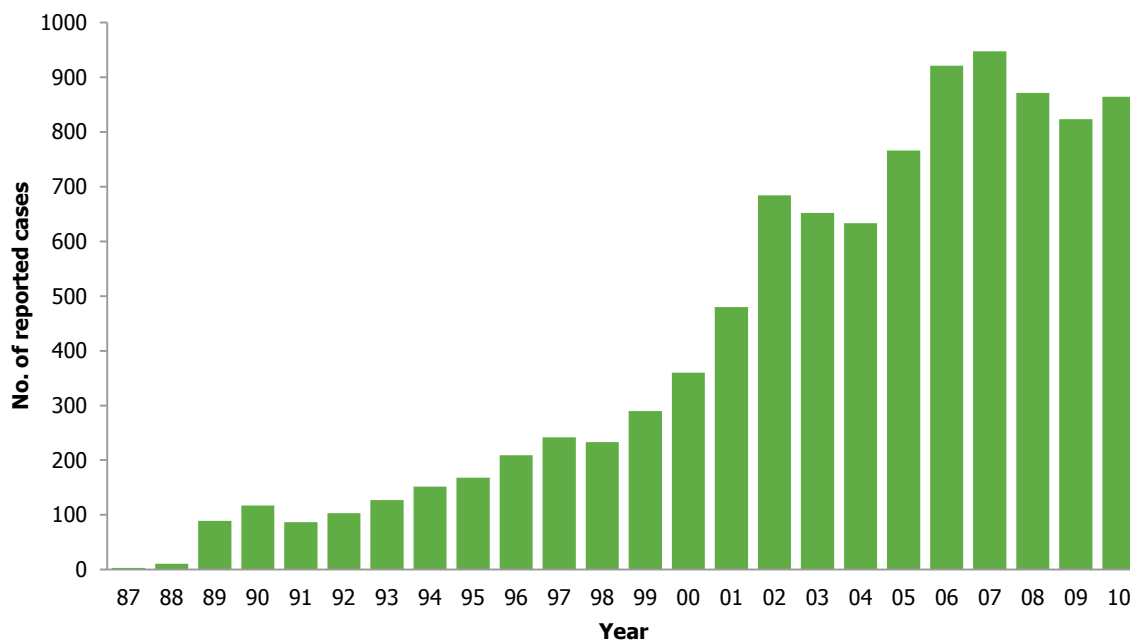
Environmental investigations were two times more likely to be performed in countries which joined EU after 2000 (PR 2.1, 95% CI 1.7–2.6).

2.2 Travel-associated Legionnaires' disease

2.2.1 Cases

A total of 864 cases of TALD with onset of infection in 2010 were reported to EWGLINET/ELDSNet. This is an increase (+ 5.6 %) compared with the 818 cases reported in 2009, but does not reach the peak of 947 cases observed in 2007 (Figure 10).

Figure 10. Number of reported travel-associated cases of Legionnaires' disease, 1987–2010



Cases were reported from 19 Member States (United Kingdom counted as one country) and two countries outside the EU (United States 11 cases and Croatia 2 cases, as associated with accommodation sites in the EU). The countries that reported the most cases were France (n= 191), the United Kingdom (n=154), the Netherlands (n=148) and Italy (n=142), (Table 19).

Table 19. Number of travel-associated cases of Legionnaires' disease by reporting country, 2009–10.

Reporting country	Number of reported cases	
	2009	2010
France	163	191
United Kingdom	173	154
Netherlands	109	148
Italy	169	142
Spain	65	67
Denmark	34	32
Norway	21	25
Sweden	21	20
Austria	16	19
Belgium	12	16
United States	10	11
Finland	6	8
Ireland	2	7
Czech Republic	5	5
Malta	0	5
Luxembourg	2	3
Portugal	4	3
Hungary	2	2
Croatia	1	2
Latvia	0	1
Slovenia	2	1
Bulgaria	1	0
Others	0	2
Total	818	864

Among the reported cases, 624 (72.2%) were males and 240 (27.7%) were females resulting in a male to female ratio of 2.6:1 which is almost identical with the ratio for 2009, 2.7:1.

Cases were reported in all age groups except the youngest one, the median age being 61 years (range 21–96 years) in males, and 63 years (12–95 years) in females. For both males (183 cases) and females (82 cases) the highest numbers and proportions of cases were in the 60–69 year age group.

Outcome of illness was reported for 514 (59.5%) cases. Of these cases, 24 (4.7%) were reported to have died, almost the same proportion that was reported in 2009. Of the four females that died, one was aged 58 and the other three were aged 82. The fatal cases among males were from 38 years up to 90 years old, the majority of male cases with fatal outcome were in the age group 60–69.

There is seasonal variation in the onset of TALD: with more cases appearing during late summer. In 2010, cases peaked in August with 156 cases and were followed by September with 136 cases. January, February, March, April and December were the months when the lowest number of cases, approximately 30 per month, had their onset of disease.

2.2.2 Microbiological analysis

According to the European case definition [8], 809 (93.6%) cases were reported as confirmed cases in 2010. Of these, 45 (5.6%) were diagnosed by culture of the organism, a decrease from 10% in 2009. Of the culture-confirmed cases, 27 were also diagnosed by urinary antigen detection and a further 762 (94.2%) cases were diagnosed by detection of urinary antigen alone. A total of 10 cases (1.2%) were confirmed as being due to *Legionella pneumophila* serogroup 1 by specific antibody response.

The remaining 55 (6.4%) cases were classified as probable following presumptive diagnosis by single high titre (n=28, 3.2%), PCR (n=19, 2.2%) and antibody response specific for *L. pneumophila* non-serogroup 1 or other *Legionella* spp. (n=8, 1.0%). Altogether, 672 (78%) cases were reported as *L. pneumophila* serogroup 1, three as *L. pneumophila* serogroup 3, two as *L. pneumophila* serogroup 6, one as *L. pneumophila* serogroup 12 and three as *L. pneumophila* mixed serogroups. Furthermore, 158 cases were reported as *L. pneumophila* serogroup unknown, one as *Legionella bozemannii* and ten as *Legionella* species unknown. For 14 cases, *Legionella* species was not reported. Sequence types were reported for 13 cases, eight from Denmark, four from the United Kingdom and one from Austria.

2.2.3 Travel

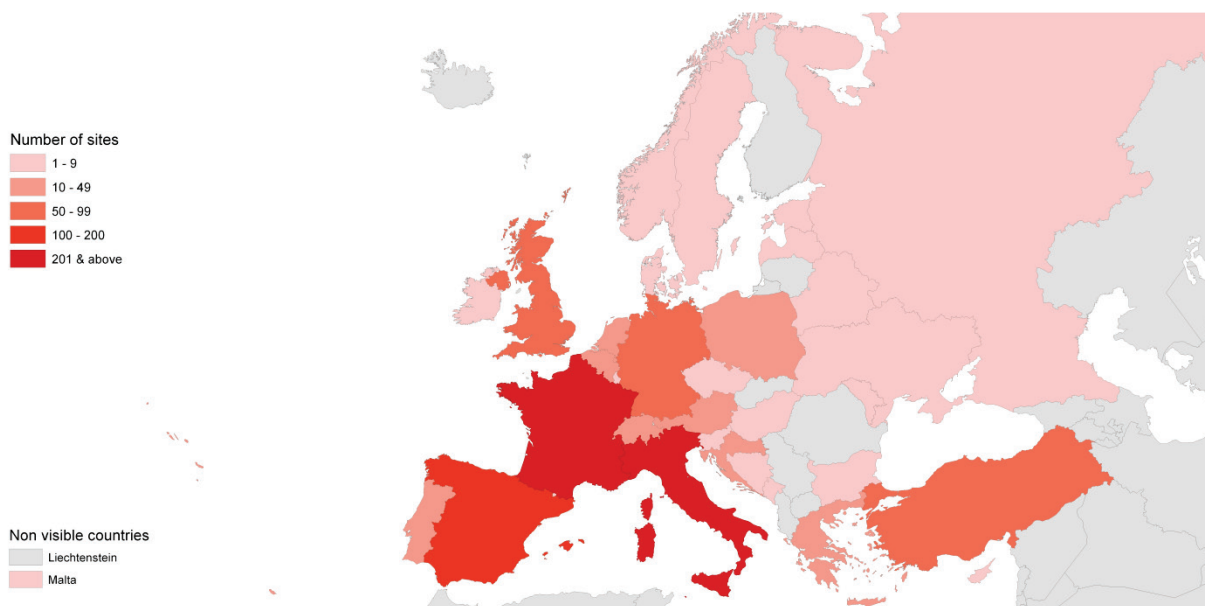
The 864 reported cases had made 1 279 visits to accommodation sites around the world.

Cases visited a total of 66 countries in the 2–10 days before onset of disease. A total of 654 (76%) cases travelled within the EU, where 621 cases visited only one Member State, and 33 more than one Member State. One hundred and seventy five (20%) cases travelled outside the EU, 166 to a single destination and nine to more than one non-EU country. Thirty cases (3%) went to both EU and non-EU destinations and 32 cases were associated with cruise ships.

Italy was the country associated with the most cases (n=209) followed by Spain (177 cases), France (172 cases) and Turkey (48 cases). In the 2010 data, there are 169 cases that are French residents and 105 (62%) of them visited accommodation sites in France. Likewise, of the 119 Italian residents reported with Legionnaires' disease, 105 (88%) had visited accommodation sites in Italy.

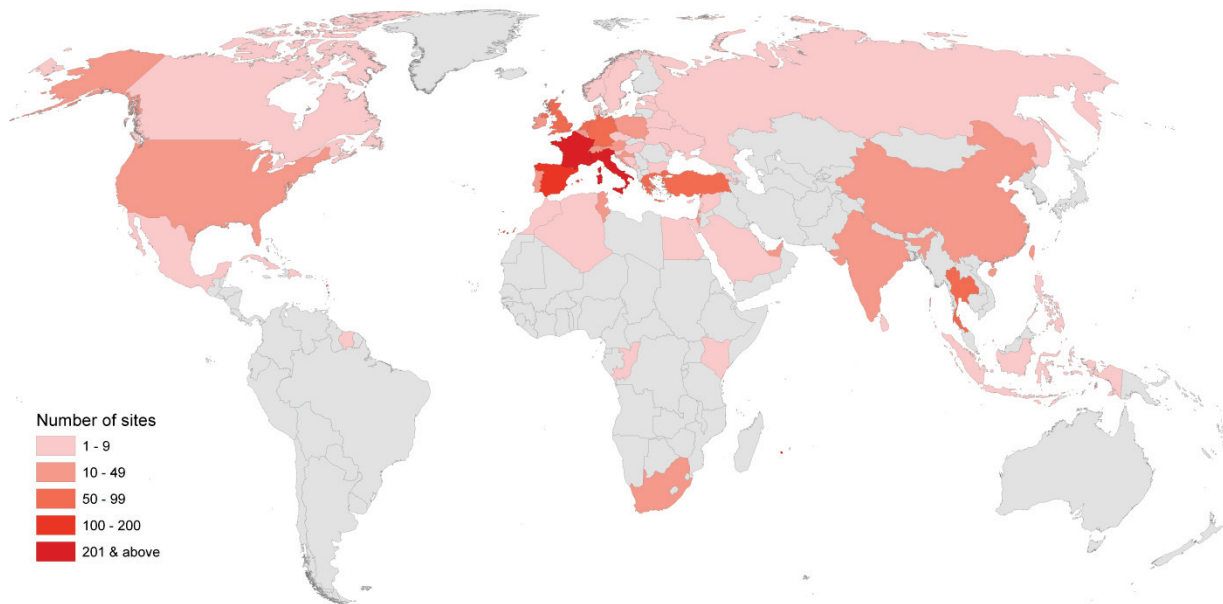
The number of accommodation sites per country associated with TALD is shown in figures 11 and 12.

Figure 11. Number of accommodation sites per destination country associated with travel-associated cases of Legionnaires' disease in EU Member States and neighbouring countries, 2010.



©EuroGeographics for the administrative boundaries

Figure 12. Number of accommodation sites per destination country associated with travel-associated cases of Legionnaires' disease worldwide, 2010.



©EuroGeographics for the administrative boundaries

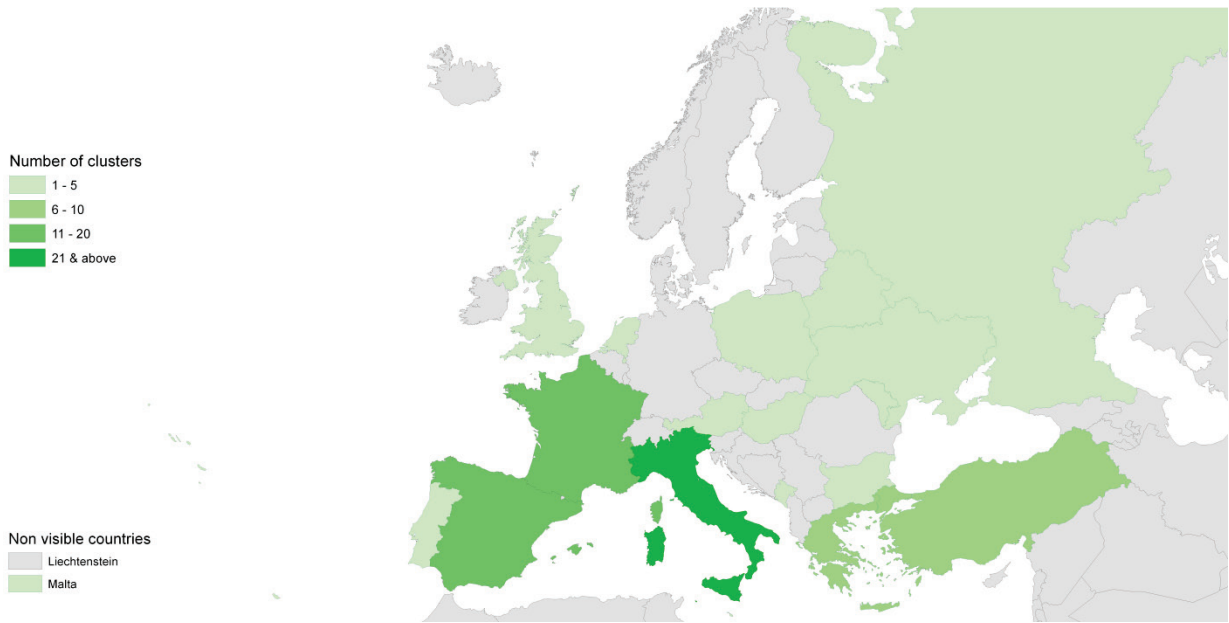
2.2.4 Clusters

A total of 100 new clusters (74 in EU Member States and 26 outside the EU) were detected in 2010, involving 213 associated cases. The largest cluster was associated with a cruise ship and involved 14 associated cases. Italy was associated with the highest number of clusters (24) followed by Spain (14), France (12) and Turkey (10). Altogether clusters in the EU occurred in 13 different Member States and on two cruise ships. Outside the EU, 26 clusters occurred in 16 countries and on one cruise ship.

A total of 44 clusters (44%) comprised a single case reported from two or more countries and would probably not have been detected without the European surveillance network. More than 50% of the clusters were detected between July and September.

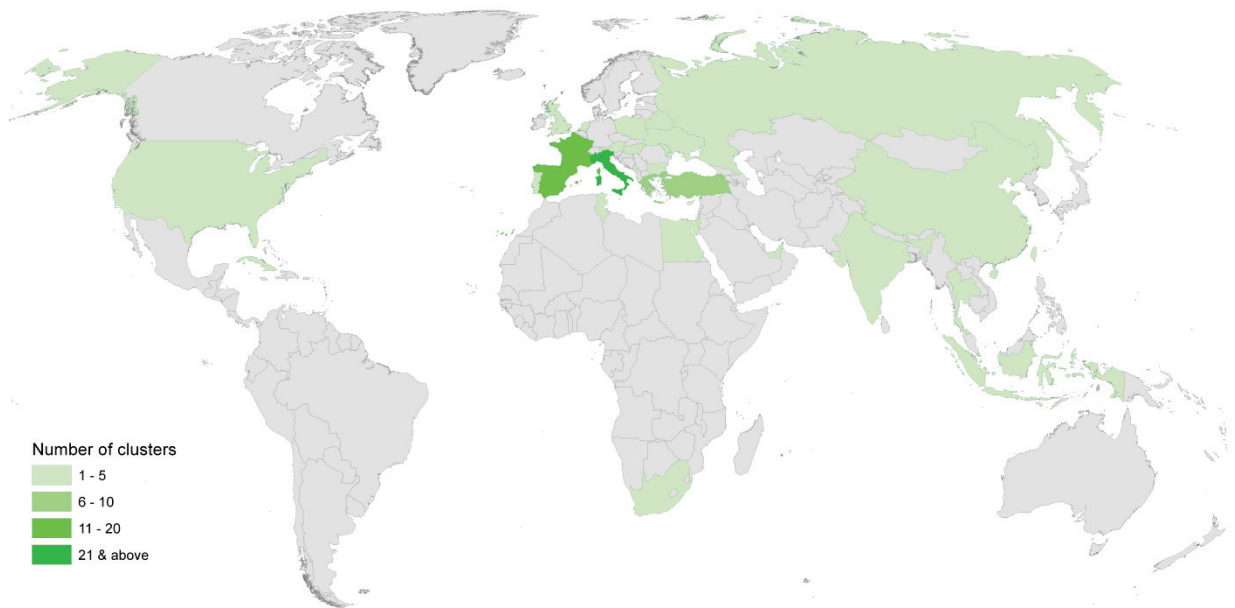
During 2010, six rapidly evolving clusters were detected (Greece 2, Italy 2, Spain 1, and cruise ship 1). Complex clusters were more associated with accommodation sites in countries where organised tours to several tourist sites took place, such as China, India, South Africa and Thailand. The number of TALD clusters per country is shown in figures 13 and 14.

Figure 13. Number of clusters of travel-associated cases of Legionnaires' disease per destination country in EU Member States and neighbouring countries, 2010.



©EuroGeographics for the administrative boundaries

Figure 14. Number of clusters of travel-associated cases of Legionnaires' disease per destination country worldwide, 2010.



©EuroGeographics for the administrative boundaries

2.2.5 Investigations and publication

All accommodation sites situated within an EU Member State should conduct an investigation on the associated accommodation site as described under methods. In 2010, a total of 100 forms B were returned to EWGLINET/ELDSNet, reporting detection of Legionella bacteria in 61 accommodation sites. Forms B were not only returned by Member States but also by several non-EU countries on a voluntary basis. However, for five sites, form B was not received or stated uncertainty regarding the control measures taken, so the names and locations of these sites were published on the ECDC public website.

3 Discussion

With an 11% increase from 2009, the rate of all notified cases of LD (internal as well as travel associated) in the EU/EEA in 2010 reached one of the highest recorded levels so far (12.7 per million inhabitants in 2006). However, this rate still remains far below what would be expected based on estimations (100 per million inhabitants) [9]. The increase was mainly driven by the few countries reporting most cases, while seven countries reported less than one case per million. As observed in 2009, countries that joined the EU after 2000 still appear to have significantly lower notification rates than older Member States. This is particularly striking in south-eastern European countries such as Bulgaria, Greece and Romania where climate conditions are optimal for the growth of *Legionellae* and despite their populations exceeding 10 million inhabitants, their LD notification rates continue to be below one per million.

Under-ascertainment of LD is likely to differ between countries in terms of both magnitude and underlying causes. Differences in the use of laboratory tests suggest that there may be more limited laboratory capacities in certain countries that joined the EU more recently. Under-notification to national authorities may also play a role as suggested by a capture-recapture study that was conducted in northern Portugal during 2004–2008, and estimated a true LD incidence rate of 24 cases per million, twice as many as currently notified [10]. Similar results were reported in the Netherlands nearly a decade ago [11]. Interestingly, the average notification rate in Europe in 2010 (12.4 per million) was very similar to the crude national notification rate observed in the United States of America (USA) in 2009 (11.5 per million) [12].

The results presented in this European LD surveillance report confirm some well-established epidemiological features of LD. As expected, higher notification rates were observed with increasing age and in males [1]. Decreasing notification rates in the eldest age group in Northern countries confirm similar findings first described in 2009 [9]. Since an important proportion of cases are travel-related in those countries, a lower disease incidence could be explained by less mobility in this age group, especially travel abroad. Indeed, the proportion of TALD was lower in cases above 70 years old. The notification rates peaked during the warm season, consistent with previous findings suggesting an association between warm and wet weather and LD [13].

The vast majority of reported cases were confirmed, providing a sound basis for data analysis. The possibility of reporting cases without any positive laboratory result (epidemiological link) was marginally used, mostly by Poland. The proportion of cases confirmed by UAT has remained fairly stable at around 80% over the past years. Only 10% of all cases were culture-confirmed with important differences between countries. Of note, this proportion was twice the proportion reported in the USA during 2005–2009 [12]. Nevertheless, culture should be promoted, especially in cluster investigation as it is the gold standard in matching clinical and environmental isolates.

Community-acquired cases accounted for 62% of all cases notified in 2008 [14]. These figures rose to 68% in 2009 [9] and 71% in 2010. The extent of under-ascertainment is probably higher in these cases for many reasons. Firstly, the surveillance initiated by EWGLI/EWGLINET had focused more on TALD cases. Secondly, physicians are probably more likely to order a relevant laboratory test in patients returning from travel abroad or suspected to have contracted a nosocomial infection. Thirdly, countries with higher notification rates are also those with a higher proportion of TALD cases.

Nearly 40% of all LD cases were reported with unknown cluster status. In addition, several clustered cases could not be linked to a cluster due to the cluster identifier missing. Results from analysing European LD cluster data should therefore be treated with caution. Travel-associated Legionnaires' disease cases were probably more likely to be reported as clustered because they are under daily ELDSNet surveillance.

At around 10%, the CFR has been fairly stable over the past five years. This ratio is difficult to interpret, however, since nearly a third of all cases had an unknown outcome. Two of the main reporting countries (Italy and Spain) had low levels of reported outcome in 2010. Newly implemented surveillance systems are likely to collect data on the most severe cases, hence a higher CFR. This was observed in France and Spain [15, 16]. As for 2009, cases with a date of onset during winter were associated with a higher fatality [9]. Since underlying conditions were not reported, this last result has to be treated with caution. As reported previously, a diagnosis made within the two first days of the disease were associated with a worse outcome, probably as a proxy for a greater severity.

As in previous years, *L. pneumophila* and its serogroup 1 were the most commonly identified pathogens [7, 13]. When conducted and reported, environmental investigations found *Legionella* in nearly 75% of cases. This result is not surprising knowing the ubiquity of *Legionella* while the very low proportion of matching isolates underlines the difficulty of linking cases with environmental findings.

The total of 864 travel-associated cases with a reported onset of disease in 2010 is higher compared with the 818 cases reported in 2009 [17]. However, during the years 2006–2008, the number of cases reported per year had varied from 866 up to 947 cases [18–20]. The lower number of cases reported since could be due to economic instability in the EU negatively affecting both business and private travel.

The added European value of ELDSNet is easier to quantify than for other similar surveillance networks, in that 44% of the TALD clusters reported would most probably not have been detected without international collaboration. Some countries do take actions when a single TALD case is reported to be associated with an accommodation site in that country, but in most countries, actions are only taken after a cluster notification. Therefore, ELDSNet cluster notifications help identifying accommodation sites that might pose a risk to human health, thereby targeting effective control measures to prevent further cases of Legionnaires' disease. This is demonstrated by the fact that in 61 of the 100 accommodation sites reported to be sampled, *Legionella* were identified.

4 Conclusion

Legionnaires' disease is an important and under-reported cause of morbidity and mortality. The European Legionnaires' Disease Surveillance Network is unique and provides one of the largest LD databases worldwide. Following the recommendations made in the 2009 report, the network should continue its efforts on improving notification in Eastern and South-Eastern Europe where under-ascertainment probably remains quite high. Such efforts should include awareness raising, laboratory support, and training, in addition to evaluations of the surveillance systems in place. Travel-associated Legionnaires' disease risk estimates obtained through daily surveillance could provide a basis for estimating the extent of under-ascertainment in some countries. Local studies (cross-sectional, capture-recapture) could help understand the causes of under-ascertainment of LD. To provide sound evidence on risk factors for fatal outcome, it is essential to add variable capturing underlying conditions.

Despite the challenges and changes in reporting systems with transition of the network to a new co-ordination centre in April 2010, network members have continued to report cases in a timely way and undertake cluster management in response to notifications. This highlights the dedication and considered added value of this network for public health in Europe.

References

1. Fields BS, Benson RF, Besser RE. Legionella and Legionnaires' disease: 25 years of investigation. *Clin. Microbiol. Rev.* 2002;15(3):506–26.
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;297(22):1189–97.
3. Marston BJ, Lipman HB, Breiman RF. Surveillance for Legionnaires' disease. Risk factors for morbidity and mortality. *Arch. Intern. Med.* 1994;154(21):2417–22.
4. Ginevra C, Duclos A, Vanhems P, Campès C, Forey F, Lina G, et al. Host-related risk factors and clinical features of community-acquired legionnaires disease due to the Paris and Lorraine endemic strains, 1998–2007, France. *Clin. Infect. Dis.* 2009;49(2):184–91.
5. Shimada T, Noguchi Y, Jackson JL, Miyashita J, Hayashino Y, Kamiya T, et al. Systematic review and metaanalysis: urinary antigen tests for Legionellosis. *Chest.* 2009;136(6):1576–85.
6. Alvarez J, Domínguez A, Sabrià M, Ruiz L, Torner N, Cayla J, et al. Impact of the Legionella urinary antigen test on epidemiological trends in community outbreaks of legionellosis in Catalonia, Spain, 1990–2004. *Int. J. Infect. Dis.* 2009;13(6):e365–70.
7. Legionnaires' disease in Europe, 1996. *Bull. World Health Organ.* 1998;76(2):213–7.
8. Commission Decision of 28 April 2008 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.
9. European Centre for Disease Prevention and Control. Legionnaires' disease surveillance in Europe, 2009. Stockholm: European Centre for Disease Prevention and Control; 2011.
10. Carvalho C. Legionnaires' Disease in Northern Portugal 2004–2008 Completeness of notification systems. 2010 Nov 11; ESCAIDE 2010 meeting
11. Van Hest NA, Hoebe CJ, Den Boer JW, Vermunt JK, Ijzerman EP, 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;136(4):540–50.
12. Legionellosis - United States, 2000–2009. *MMWR Morb. Mortal. Wkly. Rep.* 2011;60:1083–6.
13. Karagiannis I, Brandsema P, van der Sande M. Warm, wet weather associated with increased Legionnaires' disease incidence in The Netherlands. *Epidemiol. Infect.* 2009;137(2):181–7.
14. Joseph CA, Ricketts KD. Legionnaires' disease in Europe 2007–2008. *Euro Surveill.* 2010 ;15(8):19493.
15. Campese C, Bitar D, Jarraud S, Maine C, Forey F, Etienne J, et al. Progress in the surveillance and control of Legionella infection in France, 1998–2008. *Int. J. Infect. Dis.* 2011;15(1):e30–7.
16. Dominguez A, Alvarez J, Sabria M, Carmona G, Torner N, Oviedo M, et al. Factors influencing the case-fatality rate of Legionnaires' disease. *Int. J. Tuberc. Lung Dis.* 2009;13(3):407–12.
17. Joseph CA, Ricketts KD, Yadav R, Patel S, on behalf of the European Working Group for Legionella Infections. Travel-associated Legionnaires' disease in Europe in 2009. *Euro Surveill.* 2010;15(41):pii=19683. Available online: <http://www.eurosurveillance.org/ViewArticle.aspx?ArticleId=19683>
18. Ricketts K, Joseph CA, Yadav R, on behalf of the European Working Group for Legionella Infections. Travel-associated Legionnaires' disease in Europe in 2008. *Euro Surveill.* 2010;15(21):pii=19578. Available online: <http://www.eurosurveillance.org/ViewArticle.aspx?ArticleId=19578>
19. Joseph CA, Yadav R, Ricketts KD, on behalf of the European Working Group for Legionella Infections. Travel-associated Legionnaires' disease in Europe in 2007. *Euro Surveill.* 2009;14(18):pii=19196. Available online: <http://www.eurosurveillance.org/ViewArticle.aspx?ArticleId=19196>
20. Ricketts KD, Yadav R, Joseph CA. Travel-associated Legionnaires' disease in Europe: 2006. *Euro Surveill.* 2008;13(29):pii=18930. Available online: <http://www.eurosurveillance.org/ViewArticle.aspx?ArticleId=18930>