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Public health implications of influenza B outbreaks in closed settings in the United Kingdom in the 2007/08 influenza season

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Several influenza B outbreaks occurred in closed settings late in the 2007/08 influenza season (October to mid-May) in the United Kingdom (UK), with implications for public health management. Influenza B viruses usually circulate late in the season and cause a milder disease than influenza A viruses [1]. Epidemics of influenza B usually occur every two to three years with the burden of disease falling predominantly on school-aged children [2].

The weekly Royal College of General Practitioners' (RCGP) incidence rate for influenza-like illness (ILI) remained at or near baseline levels (<30 new episodes per 100,000 population) for the duration of the 2007/8 season (Figure 1).

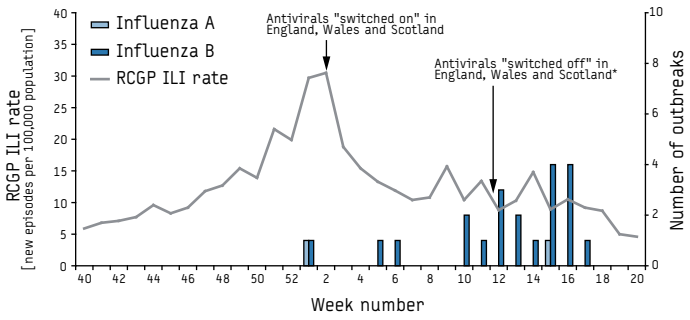
Influenza A (H1) and influenza B were the predominant virus types isolated from community samples throughout the UK this season. Influenza B detections peaked late, in week 10/08 (n=33), compared to influenza A (Figure 2).

All of the influenza B viruses analysed this season (n=194) belonged to the B/Yamagata lineage (B/Florida/4/2006-like viruses) and were distinct from the B/Victoria lineage virus (B/Malaysia/2506/2004-like virus) which was included in the 2007/08 northern hemisphere influenza vaccine.

Twenty-three outbreaks reported to the UK Health Protection Agency (HPA) Centre for Infections (CfI) from England (n=14), Wales (n=7) and Northern Ireland (n=2) during the 2007/08 influenza season were virologically confirmed as being due to influenza. Scotland reported no outbreaks during the 2007/8 season. Twenty-one outbreaks (91%) were due to influenza B and of these, 14 (67%) occurred in care homes for the elderly (Table). These influenza B outbreaks started in week 01/08 and continued until week 17/08 (Figure1), with their timing broadly consistent with the virological surveillance data (Figure 2).

Figure 1

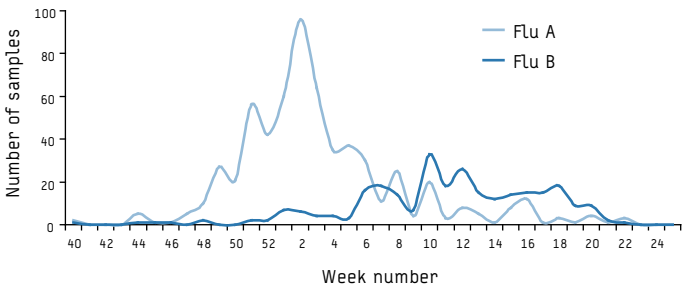
Reported outbreaks (by week of onset) of laboratory confirmed influenza during the 2007/08 season in the United Kingdom



* In Wales, recommendation for prescribing of antivirals was switched back on in week 17/08, lasting until week 22/08.
RCGP: Royal College of General Practitioners; ILI: influenza-like illness

Figure 2

Total (hospital and community) influenza detections 2007/08 season



Table

Outbreaks reported to the UK Centre for Infections during the 2007/08 influenza season

Outbreak Setting	Influenza A	Influenza B
Elderly Care Home	1	14
Schools	1	3
Hospital Ward	0	3
Prison	0	1
Total	2	21

The recommendations for the use of antivirals for the treatment and prevention of influenza in at-risk groups are made by the UK departments of health and are based on the National Institute for Health and Clinical Excellence (NICE) guidelines. In Wales, responsibility for this decision has been given to the National Public Health Service. In England, recommendation for the use of antivirals is triggered when the RCGP ILI incidence rate exceeds the baseline of 30 consultations per 100,000 practice population per week [3,4]. The trigger for the use of antivirals in the other UK countries is not necessarily coincident with that in England. The English trigger may, however, prompt a review of the national consultation rates for clinical general practitioners (GPs) and of virological data in the other UK countries, if a recommendation has not already been made.

During the 2007/08 season, antiviral prescribing in England was triggered between weeks 02/08 and 11/08, after the RCGP threshold was exceeded in week 01/08. Use of antivirals was also recommended during the same period in Wales and Scotland. During this period, five outbreaks of influenza B in closed settings were reported. However, once the prescribing of antivirals was switched off, a further 15 outbreaks of influenza B were reported (Figure 1). While the number of reported outbreaks was small, they do indicate that influenza B continued to circulate in the community in this period. When consulted concerning the management of influenza B outbreaks after week 11/08, the HPA continued to advise front-line staff in the use of antivirals for any exposed at-risk populations in closed setting outbreaks in order to mitigate any morbidity. In Wales, in light of the reported influenza B outbreaks , recommendation for prescribing of antivirals was switched back on in week 17/08, lasting until week 22/08. The epidemiological situation in Northern Ireland was different and , having reviewed sentinel GP consultation rates and virological data, the Department of Health in Belfast did not issue a recommendation that antivirals should be used during the 2007/08 season.

Virological surveillance showed that the majority (>50%) of influenza B isolates throughout the season were from individuals under the age of five years or from young adults aged 15 to 44 years. Less than 12% of influenza B isolates were from over 65 year-olds. However, most of the influenza B outbreaks reported to the HPA this season occurred in elderly care homes, despite a reported national influenza vaccine coverage of 74% this season in those over 65 years of age [5]. The apparent mismatch of the influenza B strain included in the 2007/08 northern hemisphere vaccine with the circulating influenza B strain may have had an impact on the clinical effectiveness of the vaccine in the targeted population. Indeed, recent work from the United States suggests a reduced influenza vaccine effectiveness for confirmed influenza B infections in the 2007/08 season [6].

The discrepancy in age distribution between virological surveillance and outbreak reports may reflect an outbreak ascertainment bias in favour of care homes compared to schools, particularly if the morbidity is milder in the latter. However, contrary to this suggestion, influenza B outbreaks during the 2005/06 season were readily and frequently ascertained in school age children rather than in the elderly in care homes [2]. During the 2005/06 season, however, the influenza B strain included in the vaccine was a better match for the circulating strain.

These observations support a surveillance strategy using multiple indicators of influenza activity in addition to clinical GP consultation rates to inform the prescribing of antivirals. Reliance on a single indicator of influenza activity may be misleading, particularly during seasons of vaccine mismatch, such as the 2007/08 season.

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'Chlamydia Monday' in Sweden

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The number of reported cases of *Chlamydia trachomatis* infections has increased in Sweden in the last decade, as in many other European countries [1]. After a temporary fall in the number of cases reported in Sweden in 2006, due to the spread of a new variant that was not detectable with some of the test methods used at the time, 2007 showed a record high of over 47,000 reported cases [2].

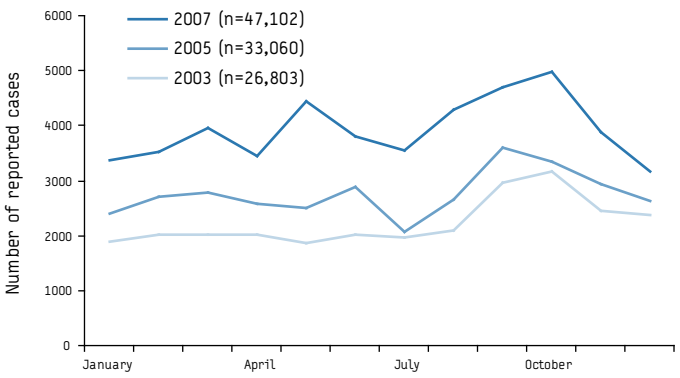
Chlamydia is often asymptomatic and therefore not diagnosed, which facilitates uninterrupted spread of the infection. If untreated, the infection can cause infertility in both men and women. Many diagnoses are made through opportunistic screening which mainly reaches women. Only 28% of all those tested for chlamydia in Sweden 2007 (536,484 people, positivity rate 10%) were men. It is therefore particularly important to reach more men for testing in order to find new cases.

During summer time people in general have more opportunities of finding a new sex partner, which increases the risk of getting infected with and spreading chlamydia. Consequently, the number of chlamydia cases reported in Sweden is higher in September and October compared to other months (Figure). Since 2003, the Stockholm county council has launched a yearly campaign in September in order to increase awareness of possible transmission of chlamydia infection and to encourage testing. Similar activities are also performed in other counties around the country. The campaign in Stockholm is called 'Chlamydia Monday' (Klamydiamåndag) and the main element is the opportunity of drop-in testing offered free of charge at a number of different clinics, such as youth clinics, primary health care centres and clinics for sexually transmitted diseases, on a particular Monday in September. Free condoms are also offered at this occasion to encourage condom use. Massive media advertising precedes the 'Chlamydia Monday' as a part of the campaign. Besides encouraging people to test for Chlamydia, the advertisements are also promoting condom use in order to prevent sexually transmitted infections. This year the 'Chlamydia Monday' in Stockholm happened on 15th September, with 106 clinics offering testing. How many people have been tested this year on the day has not yet been analysed.

Chlamydia testing and treatment is always free of charge in Sweden. However, the 'Chlamydia Monday' campaign increases the opportunities for testing since the clinics involved offer more drop-in hours than usual. With increased awareness and testing opportunities the campaign is aimed particularly at young men who do not seek test consultations to the same extent as young women. During the 'Chlamydia Mondays' in Stockholm county in 2006 and 2007 1,151 people (positivity rate 6,2%) and 1,480 (positivity rate 8,0%) were tested, respectively. 47% (2006) and 42% (2007) of them were men. 'Chlamydia Monday' thus seems to be an effective way of reaching both men and women for testing and keeping up the public awareness of sexually transmitted infections.

Figure

Number of reported chlamydia cases in Sweden per month



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A cluster of Legionnaires' disease linked to an industrial plant in southeast Norway, June-July 2008

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During June and July 2008, five cases of Legionnaires' disease (LD) were reported to the local health authorities and the Norwegian Institute of Public Health (NIPH). The patients all lived in the industrial twin cities Sarpsborg and Fredrikstad in southeast Norway. In the same area, a large outbreak of LD with 56 cases and 10 deaths had occurred in 2005. The source at the time had been traced to an industrial air scrubber at the factory of one of the world's leading suppliers of wood-based chemicals (company A). During this outbreak patients were infected up to 10km away from the source [1].

Outbreak investigation

The five patients in this cluster had a median age of 81 years (range 51-84). They were four males and one female. Their dates of onset of illness were between 12 June and 11 July. Two patients died; both were over 80 years-old and had severe underlying disease. None of the patients had stayed overnight outside the Fredrikstad and Sarpsborg area in the period ten days prior to onset of disease (incubation period). No obvious indoor common source was identified (such as whirlpool, restaurant, air humidifier etc). With only five patients and their dates of illness onset spanning one month, information about the patients' movements as well as meteorological data during the probable incubation period provided only limited clues to identify a possible outdoor common source. However, four of the five patients had been in the vicinity of the production plant of company A, at distances varying from 300 m to 3 km.

The environmental investigations performed at 16 companies with cooling towers and/or air scrubbers in the area revealed that routine cleaning and disinfection procedures were done according to the current legislations. Samples taken from a total of 19 cooling towers and 13 air scrubbers between 24 June and 16 July were analysed for *Legionella*, either by PCR or culture according to standard procedure, as well as for total bacterial count.

Laboratory results

Legionella pneumophila serogroup 1 was cultured from three of the patients. *Legionella* was identified in samples from four of the 16 companies (companies A-D) and *L. pneumophila* serogroup 1 could be cultured from samples of company A and company B. Samples from company C and company D were PCR-positive for *Legionella* sp., but it was not possible to isolate *Legionella* by culture.

Patient isolates and environmental samples were genotyped using sequence-based typing as previously described [2] and recommended by the European Working Group for *Legionella* Infections (EWGLI). The results showed the same sequence type (ST) of *L. pneumophila* serogroup 1 in samples from three patients and five routine samples taken on 24 and 25 June at company A. All these isolates were ST462. This genotype has been registered only once before in the EWGLI database which comprises, as of 17 September 2008, a total of 543 STs representing the genotypes of 2,023 *L. pneumophila* isolates.

The isolate from company B was identified as ST392.

Public health measures

Together with the municipality and with advice from NIPH, company A performed a thorough assessment of the cleaning and disinfection routines between autumn 2005 and the time of identification of the positive samples in June 2008. One of the *Legionella*-positive samples taken in June 2008 was from the industrial air scrubber that was identified as the source in the outbreak in 2005 [1]. This air scrubber was consequently shut down in early July 2008. Two other positive samples came from another air scrubber and a further two were from the aeration ponds of the biological treatment plant. In these aeration ponds *L. pneumophila* serogroup 1 was found in high concentrations (approximately 10^{10} cfu/L).

The purpose of these aeration ponds is degradation of organic material by means of microbiological decomposition. The temperature is around 37°C and 30,000 L air per hour are pumped into the ponds to provide optimal conditions for microbiological activity. It is known from previous investigations that the conditions in such ponds are favourable for the growth of *Legionella* [3-5].

Samples taken by company A from the recipient river Glomma in August 2008 showed high concentrations of *L. pneumophila* serogroup 1 at the outlet of the production plant and more than 10 km downstream. No *Legionella* could be cultured from samples taken upstream the outlet.

Based on the results of the outbreak investigation [6] and as a precautionary measure, the aeration ponds of the biological treatment plant at company A have been temporarily shut down and will not be restarted until further notice. This will increase the amount of organic content in the waste water released into the river Glomma, and permission for this has been obtained from the Norwegian Pollution Control Authority.

Discussion

The investigation concluded that there was a link between three of the five patients and the detection of *Legionella* at company A. However, it is at present not clear how the bacteria have spread from the production plant to the patients. The aeration ponds of the biological treatment plant most likely played an important role in the growth and spread of bacteria, either directly through the air or indirectly by contaminating the air scrubbers or the river.

Following the 2005 outbreak, new regulations were implemented in Norway to minimise the risk of spread of *Legionella* bacteria from aerosol-generating equipment. This legislation emphasises the owners' and operators' responsibility to inspect, maintain and monitor aerosol-generating equipment that has conditions suitable for the growth of *Legionella*.

Investigation of the present cluster did not reveal any breach of the regulations. Company A practised frequent maintenance and monitoring procedures of the air scrubbers. However, following this new outbreak of Legionnaires' disease linked to the same industrial plant as the large outbreak in 2005 [1], the Norwegian health authorities consider revising the present guidelines and regulations.

The outbreak investigation recognises that more studies and research are needed to increase the knowledge about the role of biological treatment plants and their potential for spread of *Legionella* to the environment. There is also a need for assessing whether the environmental conditions in treatment plants in the pulp and paper industry are especially favourable for the growth of *Legionella* bacteria.

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Survey on legislation regarding wet cooling systems in European countries

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Wet cooling systems are often associated with large outbreaks of Legionnaires' disease. Several European countries have legislation for registering such systems. The authors aimed to obtain an overview of the situation in Europe. A questionnaire survey was sent to 35 of the countries that collaborate in the European Working Group for *Legionella* Infections. In two countries it was passed to a regional level (to three regions in both Belgium and the United Kingdom), so that 39 countries or regions were sent the survey; 37 responded. Nine countries stated having legislation for the registration of wet cooling systems. Separate legislation exists at a regional level for two regions in Belgium and all three regions in the UK, giving a total of twelve countries/regions with legislation. In nine of these countries/regions, the legislation has been introduced since 2001. All of these countries/regions require periodic microbiological monitoring between twice a year and weekly; in nine, the legislation requires periodic inspection of the systems. Regulations for the registration of wet cooling systems should be required by public health authorities. During an outbreak of legionellosis, a register of wet cooling systems can speed up the investigation process considerably. The authors believe that the European Centre for Disease Prevention and Control (ECDC) should take the initiative to propose European Community (EC) regulations for all Member States.

Introduction

Legionnaires' disease is an atypical pneumonic infection, acquired by inhaling aerosols containing *Legionella* spp. The *legionella* bacteria are commonly found in the natural and man-made aquatic environment, and enter the atmosphere through aerosol-generating outlets such as showers and cooling towers [1]. The first recognised outbreak of Legionnaires' disease occurred in 1976 at a hotel in Philadelphia [2] and was probably attributable to a cooling tower. Since then, wet cooling systems (including cooling towers, evaporative condensers and fluid coolers) have been established as some of the most common sources for outbreaks of legionellosis worldwide [1]. Wet cooling systems are heat rejection devices that utilise the evaporation of water to provide cooling. Common features are the recirculation of water which is sprayed or otherwise broken up into droplets in a counter current of air that is then ejected into the atmosphere. Some droplets may thus escape and form an aerosol outside of the cooling device. The recirculation of water can create good conditions for growth of *legionellae*.

Wet cooling systems can favour the growth of *legionella* by maintaining water temperatures of up to 35°C (temperatures in the range of 20°C to 45°C favour the growth of *Legionella* spp.) and by containing high levels of organic material and protozoa. About 2% of the water used in wet cooling systems escapes as aerosol and can drift more than 500 metres, in a few cases up to several kilometres, from its source [3,4]. When combined with poor maintenance and under-dosing of biocide, these systems can foster extensive growth of bacteria including *Legionella pneumophila*.

Every year the European Working Group for *Legionella* Infections (EWGLI) collects an aggregated dataset of all cases and outbreaks of Legionnaires' disease that have occurred in Europe during the previous year. Between 2002 and 2007, 44 outbreaks with cooling towers as the suspected source were reported in 11 countries, involving 1,175 cases (Table 1) [5-7].

For community-acquired outbreaks of Legionnaires' disease it is important to identify and treat the source as quickly as possible in order to prevent further infections. This can be a lengthy process if no register of wet cooling systems exists. Several European countries, especially those which have already experienced large cooling tower outbreaks, are known to have legislation for registering such devices. To obtain an overview of the situation in Europe, the authors conducted a questionnaire survey among the countries that participate in EWGLI.

Methods

A questionnaire was approved by the steering committee for the European Surveillance Scheme for Travel Associated Legionnaires' disease (EWGLINET) and sent to 35 EWGLI collaborating countries; it was passed to a regional level in Belgium (Brussels, Flanders and Wallonie) and the UK (England and Wales, Northern Ireland and Scotland). Therefore, 39 countries or regions were asked to participate.

The questionnaire included the following questions, and allowed space for further comments:

- Does your country have legislation for registering wet cooling systems?
- If yes, is the legislation national or regional?
- Which ministry issued the legislation?
- In what year was the legislation introduced?

- Is there an official requirement for periodical inspection of wet cooling systems?
- Who is responsible for the periodic inspection of wet cooling systems?
- Is there an official requirement for microbiological monitoring?
- Are there penalties imposed for unregistered wet cooling systems?
- Does a register of wet cooling systems exist?
- Who holds the register?
- How does the authority get the information?
- Who is responsible for maintaining the information?

The initial results were presented at the 22nd EWGLI conference in Stockholm [8], and comment and interpretation was sought from the collaborating countries.

Results

Representatives from 37 collaborating countries or regions (94.9%) returned the questionnaire. Of these, 12 (32.4%) reported having legislation requiring the registration of wet cooling systems at a national level (Andorra, France, Malta, The Netherlands, Norway and Spain) or a regional level (Belgium: Wallonie and Flanders; UK: England and Wales, Northern Ireland and Scotland; and the Russian Federation) (Table 2). The countries or regions that returned the questionnaire and do not have such legislation are: Austria, Belgium (Brussels), Bulgaria, Croatia, Czech Republic, Denmark, Estonia, Finland, Germany, Greece, Hungary, Ireland, Israel, Italy, Latvia, Lithuania, Luxembourg, Poland, Portugal, Romania, Slovak Republic, Slovenia, Sweden, Switzerland, Turkey.

In five countries or regions this legislation is issued by the Ministry of Public Health, in three by the Ministry or Department of the Environment, in two by the Ministry or Department of Trade and Industry, and in one by the Department of Industrial Construction. In the Netherlands, the registration is voluntary and is covered by environmental legislation; it is anticipated that legislation requiring the registration of new wet cooling systems will be introduced in 2009. In England and Wales, Scotland and Northern Ireland, legislation has existed since 1992 or 1994; in all other countries or regions the legislation has been introduced since 2001.

All countries or regions which have legislation require periodic microbiological monitoring between twice a year and weekly; 'microbiological monitoring' was not further specified in the questionnaire and the responses are likely to refer to dipstick tests rather than to full environmental sampling. In nine countries the legislation requires periodic inspection of the systems. In all twelve of the countries or regions which have legislation, a register of wet cooling systems exists. This register is held by national authorities (n=2), regional authorities (n=3) or local authorities (n=7), and in nine of these countries/regions, penalties are imposed for unregistered systems. In eight of the nine countries/regions where penalties can be imposed, the owner of the system is responsible for ensuring that the information on the register is correct.

Of the 25 (67.6%) countries or regions with no legislation for registering wet cooling systems (Table 3), five require microbiological monitoring and four stated that technical standards require periodic inspections; two will impose penalties for not following these

Table 3

Countries or regions without legislation on the registration of wet cooling systems, EWGLI survey, 2007

Number of countries or regions	Periodical inspections	Microbiological monitoring	Does register exist	Who holds register (authority)
25	21 no 4 yes	20 no 5 yes	23 no 2 yes	1 national 1 regional

Table 1

Outbreaks of Legionnaires' disease with wet cooling systems as the suspected source, as reported to the EWGLI annual dataset by collaborating countries, 2002-2007 (n=44 outbreaks)

Country (region) of outbreak	2002		2003		2004		2005		2006		2007	
	WCS outbreaks	Number of cases	WCS outbreaks	Number of cases	WCS outbreaks	Number of cases	WCS outbreaks	Number of cases	WCS outbreaks	Number of cases	WCS outbreaks	Number of cases
Austria											**1**	9
France	**2**	22;31	**3**	31;24;84			**1**	34	**3**	29;10;12	**1**	9
Italy			**1**	15								
Netherlands									**3**	31;9;10		
Norway	**1**	28					**1**	58				
Portgual									**2**	3;21		
Spain	**2**	108;9	**4**	11**;6;13;6	**2**	32;29	**4**	12;15;50;4	**1**	146	**1**	18
Sweden					**1**	32						
UK (England and Wales)	**2**	6;146	**1**	27	**1**	4	**2**	3;2				
UK (Northern Ireland)	**1**	3					**1**	3				
UK (Scotland)					**1**	7	**1**	3*				

WCS outbreaks = wet cooling system outbreaks
* Two Scottish cases and one English case
** Associated with an evaporative condenser
NB: These figures were provisional reports at the time of submission to EWGLI; subsequent reports may cite different case numbers. Some countries (Norway, Spain and Sweden) have provided updated data to reflect final case numbers for these outbreaks.

Table 2

Countries or regions in Europe with legislation on the registration of wet cooling systems, EWGLI survey, 2007

Country (region)	Legislation: national or regional	Which ministry issued legislation	Year of introduction	Content of legislation	Periodic inspections	Who is responsible?	Microbiological monitoring	Penalties for unregistered towers	Does register exist?	Who holds register (authority)	How does authority get information
Andorra	National	Ministry of public health	2002	Regulation for prevention and control of Legionellosis	Daily to annual	The owner; the local authority can verify at any time	Monthly	Yes	Yes	National authority	By periodic inspection
Belgium (Flanders)	Regional	Ministry of public health	2007	Regulation for prevention of Legionellosis in public places	No	[No response]	At least twice a year	No	Yes	Regional authority	Owner sends results
Belgium (Wallonie)	Regional	Ministry of the environment	2005	Regulation inbedded in the conditions for building permission	Yes, but not predefined	[No response]	Every two months; if negative, every three months	Yes	No	-	By the environmental permit
France	National	Ministry of the environment	2004	Concerns all cooling towers with evaporative cooling systems	Every two years by Ministry appointed company	Maintenance company ceritified by the Ministry of Health; the local authority can inspect	Monthly or bimonthly	Yes	Yes	Local authority	Owners sends results annualy
Malta	National	Ministry of public health	2006	Regulation for registration of cooling towers and evaporative condensers	Variable, according to checklist in regulation	The owner; the health authority can conduct their own monitoring if desired	Colony counts, monthly; Legionella every six months	Yes	Yes	National authority	Owner sends results, and audit inspections are conducted
The Netherlands	National	1. Ministry of Employment (if employee may be exposed to cooling tower aerosols) 2. Ministry of Environment (if the surrounding area [but not the employee] is exposed to cooling tower aerosols)	1.Ministery of Employment: 2004, amended 2007 2. Ministry of Environment: January 2009	1. Regulations for prevention are embedded in company risk analyses 2. Regulation for registration of new cooling towers. Also, local authorities may impose prevention legislation on cooling tower owners	Yes, but no period specified	1. The employer; inspection should ensure compliance. 2. The owner; local authorities should ensure compliance of the owner	Recommended; frequency depends on location of the tower (monthly, every three months or every six months)	No	Partly	Local authority	Owners are requested to register by the local authority
Norway	National	Ministry of public health	2005	Regulation to minimise the risk of spread of Legionella from aerosol generating equipment	Every six months	The owner	Colony counts, monthly;	Yes	Yes	Local authority	Owner sends results
Russia	Regional	Dept. of industrial construction	Not stated	Regulation for cooling towers and evaporative condensers of public objects	No	[No response]	Yes, planed ministry of public health	Not known	Yes	Local authority	Not stated
Spain	National	Ministry of public health	2001, amended 2003	Regulation for prevention and control of Legionellosis	No official inspections	The owner should have a maintenance programme in place.	Colony counts monthly ; *Legionella* every three months	Yes	Yes	Regional authority	Owners have to inform authority
UK (England and Wales)	National	Department of Employment	1992	Regulation for registration of cooling towers and evaporative condensers	No, but other legislation require inspection by the owners	The owner; enforcing authorities should ensure compliance of the owner	No, but other legislation require monitoring; colony counts, weekly; *Legionella* every three months	Yes	Yes	Local authority	Owners have to inform authority
UK (Northern Ireland)	National	Department of Enterprise, Trade and Investment	1994	Regulation for registration of cooling towers and evaporative condensers	Twice a year	The owner; enforcing authorities should ensure compliance of the owner	Colony counts, weekly; *Legionella* every three months	Yes	Yes	Local authority	Owner sends results
UK (Scotland)	National	Department of Trade and Industry	1992	Regulation for registration of cooling towers and evaporative condensers	Periodic inspection	The owner should have a management system in place	Depends on level of compliance with code of practice	Yes	Yes	Local authority	Business occupier is requested to register with local authority

standards. Of these 25 countries or regions, only one country (Luxembourg) and one region (Brussels) have a register of wet cooling systems, and because Brussels' register includes only new systems, it is not comprehensive.

Discussion

Minimising the number of cases of legionellosis caused by wet cooling systems should be an important target for public health authorities1. A preliminary risk assessment by Ambroise et al. [9] showed that exposure through cooling towers led to more cases of Legionnaires' disease (by a factor of 100-130) than exposure during showering, whilst Lock et al. detailed the high cost of an outbreak of Legionnaires' disease caused by a cooling tower [10]. The EWGLI annual dataset (Table 1) shows that between 2002 and 2007 there were an average of 7.3 outbreaks caused by wet cooling systems each year, involving 1,175 cases (an average of 195.8 cases per year and 26.7 per outbreak). In comparison, 215 outbreaks (35.8 per year) with 784 cases were associated with water systems (an average of 130.7 cases per year and 3.6 per outbreak) [6,7]. It should be noted that a large number of outbreaks are never properly attributed to sources [7], and that the larger ones (often associated with wet cooling systems) are more likely to be attributed to a source than smaller outbreaks [3,11,12].

In most of the countries or regions that have regulations for the registration of wet cooling systems, these were introduced following the recognition of outbreaks caused by such devices. Regulations were introduced in England, Wales and Scotland in 1992 [13] following Public Enquiries resulting from the Stafford hospital outbreak [14] and the BBC outbreak [15], both of which were caused by cooling towers. After a big outbreak in a town near Madrid in 1997 [16], the first regional law was issued in Spain. This was followed by laws in many other regions of Spain and by a national law in 2001 (later revised in 2003). In France a number of outbreaks, including the 2003 outbreak in Lens [3], led to specific regulations in 2004; in Norway regulations to minimise the risk of spread of *legionella* from aerosolizing equipment followed an outbreak caused by an air washer [4]. In the Netherlands a cooling tower related outbreak in Amsterdam in 2006 [17] was the impetus for the introduction of specific rules.

Of those eleven countries or regions that experienced wet cooling system outbreaks which were reported to EWGLI between 2002 and 2007 (Table 1), three reported having no legislation for registering wet cooling systems (Italy, Portugal and Sweden). However, the three countries or regions that have reported the most outbreaks over this period (Spain, France and England and Wales) all have legislation. These three countries or regions require frequent microbiological monitoring, keep a register of towers and impose penalties for unregistered systems. The only area where they may have less rigid legislation than countries or regions with fewer outbreaks is in regards to periodic monitoring. Spain suffers from the highest number of outbreaks and does not require periodic official inspection of systems, but there are different levels of response following positive *Legionella* spp. counts depending upon how infected the system is. France only requires inspections every two years, and England and Wales do not have a set frequency for inspections by local authorities (however the obligation to monitor rests with the wet cooling system owners and the enforcing authorities should ensure that they fulfil this obligation) [18].

It is difficult to draw solid conclusions from this data because there are many differences in ascertainment, data collection, and reporting systems between countries. Nevertheless, there is enough evidence to suggest that developing water safety plans for wet cooling systems, including system assessment, monitoring and management, is the preferred approach for managing the health risks associated with exposure to *Legionella* spp. [19,20]. Specific legislation is needed to ensure that authorities responsible for the safety of water systems or buildings develop and follow water safety plans. Most outbreaks associated with wet cooling systems are preventable, and such legislation could therefore lead to a substantial reduction in morbidity and mortality from Legionnaires' disease.

Regulations for the registration of wet cooling systems should also be required by health systems. During an outbreak of legionellosis, identifying and containing the source as quickly as possible should be one of the initial aims of an outbreak control team. In order to achieve this, improving surveillance to ensure the rapid detection of cases and clusters is important, but a register of wet cooling systems can also be an invaluable starting point and speed up the process considerably [21]. At present only 12 European countries or regions have specific legislation for this. Several EWGLI collaborating countries that do not currently have such legislation have suggested that European Community (EC) regulations for the registration of wet cooling systems and the prevention of legionellosis are required, and that the European Centre for Disease Prevention and Control (ECDC) should take the initiative to propose such regulations.

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Changes in prevention and outbreak management of Legionnaires' disease in the Netherlands between two large outbreaks in 1999 and 2006

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We describe an outbreak of Legionnaires' disease in 2006 in Amsterdam, the Netherlands. Comparisons with the outbreak that took place in 1999 are made to evaluate changes in legionella prevention and outbreak management. The 2006 outbreak was caused by a wet cooling tower. Thirty-one patients were reported. The outbreak was detected two days after the first patient was admitted to hospital, and the source was eliminated five days later. The 1999 outbreak was caused by a whirlpool at a flower show, and 188 patients were reported. This outbreak was detected 14 days after the first patient was admitted to hospital, and two days later the source was traced. Since 1999, the awareness of legionellosis among physicians, the availability of a urinary antigen tests and more efficient early warning and communication systems improved the efficiency of legionellosis outbreak management. For prevention, extensive legislation with clear responsibilities has been put in place. For wet cooling towers, however, legislation regarding responsibility and supervision of maintenance needs to be improved.

Introduction

Legionnaires' disease (LD) is an acute pneumonia caused by infection with bacteria of the genus Legionella. Inhalation of aerosolized water containing the bacteria is the primary mode of acquisition. Although cases of LD are often sporadic, large outbreaks can be caused by communal sources, such as 'hot tubs' or 'spa pools' [1,2] and hospital or hotel showers [3,4]. Wet cooling towers can emit contaminated aerosols, with dispersal over long distances, sometimes causing major outbreaks [5-15].

In the Netherlands, the first large LD outbreak occurred in 1999; it affected 188 patients of whom 23 died. This epidemic was caused by aerosol transmission from a display whirlpool at a flower show, and was not recognized as an LD outbreak until 14 days after the first patient was diagnosed with pneumonia of unknown origin. The source was identified within a week after the epidemic was detected as an LD outbreak; 10 days after the show had ended, when already 71 patients had been admitted to various hospitals throughout the country. The 1999 outbreak was evaluated extensively [16] and this has led to changes in prevention policies, legislation and outbreak management strategies.

Here we describe the second large outbreak of LD in the Netherlands in 2006, and evaluate the effectiveness of changes in legislation, prevention management and outbreak management implemented after the first large outbreaks in 1999.

Methods

In the Netherlands, LD has been a reportable disease since 1987. Every diagnosed case has to be reported to the local Public Health Service (PHS), and is registered nationally by the Centre for Infectious Disease Control (CIb). Since 2002, the local PHSs report to CIb by the internet.

A confirmed LD case is a patient with pneumonia, confirmed by a positive laboratory test (urinary antigen test, positive culture, positive polymerase chain reaction (PCR), positive IgM antibody or a significant increase in IgG antibody ELISA test). After a case of LD has been reported to the PHS, patient information is gathered including demographics, diagnosis, underlying disease, domestic risk factors, risk factors at work, travel, and leisure activities in the 21 days before onset of disease, using a standardised questionnaire [17].

Any unusual number of reported cases in time or place will lead to an outbreak investigation as to a common source. In case an outbreak is suspected, depending on the suspected source, active case-finding is initiated by the PHS in order to detect and eliminate the source as soon as possible. Depending on the magnitude of the outbreak, active case-finding comprises alerting general practitioners and hospitals in the PHS area, other PHS branches and international early warning systems. Since 2002, in case an outbreak is suspected that is not confined to one PHS area, the CIb informs the other PHSs and other physicians by email service, which makes it possible to notify them instantly. The public can be warned by local or national press and television.

To strengthen local efforts to identify sources, a specialized team from the Regional Public Health Laboratory of Haarlem has offered sampling services to all public health services in the Netherlands since 2002, and serves as a reference laboratory where both human

and environmental strains are genotyped. The laboratory keeps a national register of sampled potential sources.

For the 2006 outbreak investigation, the following case definition was made: confirmed cases were patients with clinical signs of pneumonia, with fever > 380C, cough and shortness of breath, who had been to the eastern part of Amsterdam (with zip codes 1011 and 1018) between 8 June and 11 July and with a confirmed laboratory test (positive urinary antigen test; positive culture; fourfold increase in antibody titer or seroconversion in a paired sample).

All hospital laboratories were asked to send available cultures to the reference laboratory in Haarlem for genotyping, where Amplified Fragment Length Polymorphism (AFLP) was used for DNA fingerprinting.

Although wet cooling towers are a common source of LD outbreaks, in the Netherlands registration of these towers is not addressed in the law (Table 1). As soon as a cooling tower was suspected as the source of the outbreak, for tracing of this source wind directions were used as published by the Dutch National Meteorological Institute KNMI. [www.knmi.nl/klimatologie/daggegevens/index.cgi] All environmental samples were obtained by the department of Infectious Diseases of the PHS Amsterdam in cooperation with the Public Health Laboratory Haarlem

Results

Source tracing

On Thursday 6 July 2006, three cases of LD were reported to the PHS in Amsterdam, all diagnosed on the same day by a urine test indicating type I infection. On Friday 7 July, the second day when five cases were reported, the PHS Amsterdam continued the source tracing and started active case-finding by emailing all general practitioners who were on call that weekend (8 and 9 July). All six Amsterdam hospitals were called to alert and inform the microbiologists about the outbreak. Also, all other PHS branches in the Netherlands were notified by CIb email service and requested to report any unusual number of LD cases or cases that could be related to a recent visit to Amsterdam. During the weekend, nine additional cases were reported. Extensive interviewing did not suggest a common source for these infections. None of the patients had traveled recently. The majority of patients were living in the city centre, in an area about 500 meters east of the central railway station with zip codes 1011 or 1018, which is an area with a 2,5-3 km in diameter. Most of these patients reported onset of disease on the first of July (Figure 1).

On 8 July, the first sample was taken from a possible source, a newly installed display fountain, because most patients reported by then were living in the fountain area. This fountain was immediately closed.

Because it was possible that the outbreak was not confined to Amsterdam, on Monday 10 July, a national outbreak team was established, with participants from the PHS Amsterdam, the CIb and the Public Health Laboratory of Haarlem. The CIb started enhanced national active case-finding by contacting all infectious disease control physicians at PHS facilities in the regions surrounding Amsterdam. They were asked to telephone all hospitals in their region and ask if there had been any LD patients admitted. Also on 10 July, all general practitioners, microbiologists and infectiologists in Amsterdam were alerted by post. In order to alert as many people in the Netherlands as possible, a press release was issued on Monday announcing the unusual number of LD patients in Amsterdam.

Table 1

Legislation and supervision of preventive legionella source cleansing in the Netherlands, 2007

Laws		Supervisor	Location	Object/source
Law on drinking water	Chapter IIIC	Inspectorate of VROM	Hospitals, housing, camping sites, asylum seekers' centers, yacht-basins	Drinking water installations
	Chapter IIIC articles 17j, 17o, 17p, 17q	Inspectorate of VROM	Drinking water companies (waterworks)	Drinking water delivery
Law on occupational health and safety	Policy regulation* document 4.87-1	Labor Inspectorate SZW	Locations in companies with exposure risk for employees	***Cooling towers*** Humidifiers Industrial water installations**
		Food and Consumer product safety authority	Locations in companies with public exposure risk	
		Labor Inspectorate	Inland shipping	Drinking water installations Humidifiers Industrial water installations
		Inspectorate of Transport, Public Works and Water Management	Ocean shipping	
		Inspectorate of Transport, Public Works and Water Management	Airplanes	
Law on hygiene and safety public baths and swimming pools	Articles 2a-2d	Provinces	Public baths and swimming pools	Swimming and bathing water
Law on collective prevention in public health		Municipalities	Large-scale events	All atomizing installations

VROM: Ministry of Housing, Spatial planning and the Environment
SZW: Ministry of Social Affairs and Employment
* A policy regulation is not a law but a guideline; it describes best practice but does not have to be obeyed.
** Atomizing installations outside companies (such as fountains on squares or in shopping malls) are not part of this, or any other law.

In the ten days preceding the outbreak, the wind appeared to be mainly west and north-west (Figure 1). Therefore, the team started to look for fountains and wet cooling towers north-west of the affected area. Subsequently a second display fountain in this area was sampled and immediately closed. Since registration of wet cooling towers is not mandatory, a register of these cooling towers was not available. However, in 2003, a list of wet cooling towers was made in Amsterdam for a study on the prevalence of legionellae, but had not since been updated. With the help of Google Earth, we looked for new, not registered cooling towers, and also inspected the area. As a result, every cooling tower in the outbreak area was inspected and sampled. At the end of the day on 10 July, we detected one (previously not listed) wet cooling tower on ground floor level, a few meters east of a construction site just east of the central station. This cooling tower was installed on 10 June and was visibly not well maintained. Samples were taken from the tower and as a precautionary measure the tower was closed as soon as possible in the early morning of Tuesday 11 July. The next day, the laboratory results showed positive culture and revealed a concentration of 5 million colony-forming units per liter. In a follow-up press release issued on the same day, it was announced that most patients affected lived in or had recently visited the area east of Amsterdam Central Station, and that a cooling tower in this area was the probable source of the outbreak.

Active case-finding

On 10 July, all public health physicians in the country were updated about the outbreak by CIb email service and asked to query all LD patients about visits to Amsterdam, including specific locations visited. In total, active case-finding yielded seven LD patients who lived outside Amsterdam but all of them worked in or very near the construction site adjacent to the questionable cooling tower. These findings confirmed our suspicion that it was the source of the outbreak.

Active case finding within the Occupational Health Services of the construction companies working near the cooling tower revealed that one construction worker had died on 6 July from pneumonia. He fell ill on 4 July and refused admittance to hospital for further testing. A post-mortem lung specimen was tested and legionella bacteria could be detected by DNA isolation.

In July, many tourists visit Amsterdam. Because the LD source was so close to Amsterdam Central Station, the fear arose that international visitors could have been exposed, perhaps in large numbers. Therefore, on 12 July, the European Surveillance Scheme for Travel-Associated Legionnaires' Disease issued a community cluster alert to its participants [18] and a preliminary report was published in Eurosurveillance [19]. On 13 July, information on the outbreak appeared in ProMed [20]. No cases in tourists or visitors to Amsterdam were reported.

Characteristics of patients

In total, 31 patients with LD were reported in this outbreak: their characteristics are shown in Table 2. Seventy-four percent were men, and the case fatality rate was 10%. Sixty-five percent reported possible risk factors associated with developing LD.

Cultures and DNA fingerprinting

From seven patients epidemiologically linked to the contaminated cooling tower, cultures were available for DNA fingerprinting, enabling comparison with the bacteria obtained from the cooling tower. All seven matched. In Figure 3, three of these seven samples are shown (patient 2, 3 and 4) in comparison to another patient not related to this outbreak (patient 1) and samples from the cooling tower (samples 5,6,7 and 8). At the same time, at a routine control, legionellae were found in another wet cooling tower in Amsterdam, five kilometers south-west of Central Station. However, the strain found in this tower (samples 9 and 10) was evidently different from the strain found in the outbreak patients.

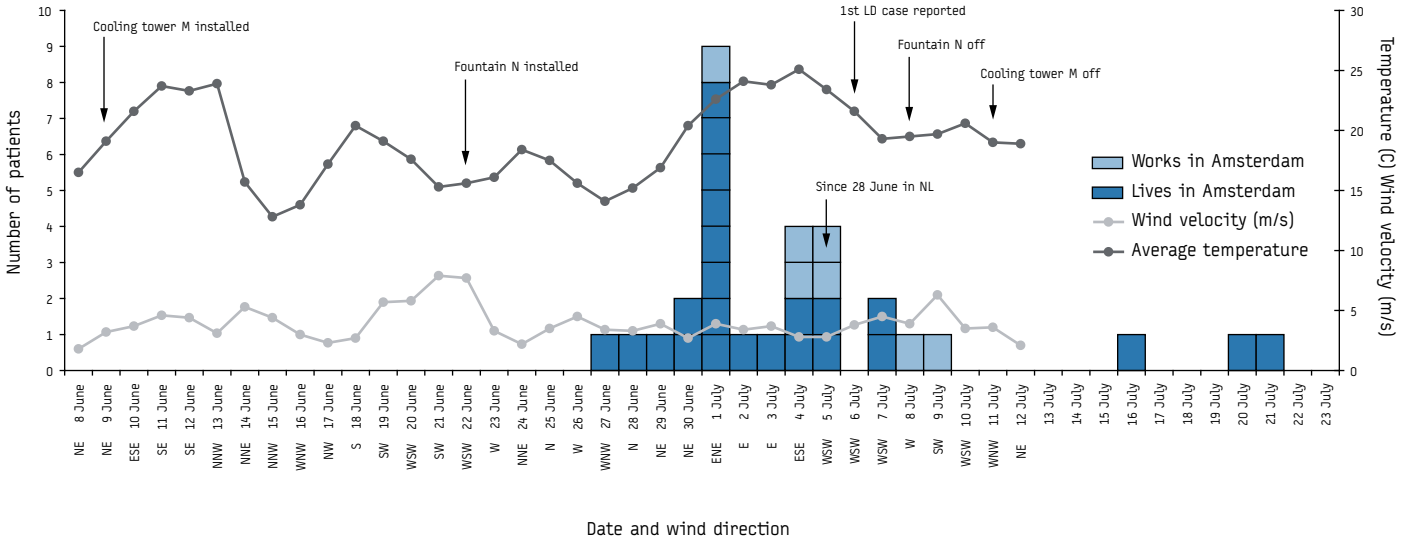
Discussion

Outbreak management

The most important development since the 1999 outbreak is that urinary antigen tests have become widely available and physicians more aware of LD. The 1999 outbreak was not recognized as an

Figure 1

Legionnaires' Disease (LD) patients in Amsterdam linked to a cooling tower, by date of onset of disease, June – July 2006 (n=31)



LD outbreak until 14 days after the first patient was hospitalized and diagnosed as a case of pneumonia of unknown origin. Hospital physicians were not aware that LD was a notifiable disease; they contacted the PHS because of the unusual number of pneumonia patients. In 2006, the first patient was diagnosed with LD within two days after hospital admission and reported to the PHS the same day the diagnosis was confirmed.

In the Amsterdam outbreak in which standardized questionnaires were used, the likelihood of a source outside a building (i.e. a cooling tower or a fountain) became clear after two days, by exclusion of communal sources. The actual source, a cooling tower, was located within four days after the first patient was diagnosed. In contrast, in 1999, a case control-study showed that it was likely that the source of the outbreak was situated at a flower show. Subsequent environmental risk assessment led to the most likely source, a whirlpool, and sampling revealed abundant legionella growth six weeks after the outbreak was recognized. [21]

Until 2002, national registration of reported LD cases was done by post from PHSs to CIb, where cases were subsequently entered in a database. This procedure resulted in delays in the 'early warning system'. Since 2002, national registration is done by internet reporting, which is much faster. Especially outbreaks in different PHS districts can now be detected faster than in 1999. Also, communication from the CIb to PHSs has improved by the installation of a CIb email service in 2002. The service makes it possible to notify public health and other physicians instantly. In 1999, this was done by telephone and facsimile, which was much slower. Also, internationally, early warning systems have been put in place. [28,20]

The work of the reference laboratory has also proven successful; in the first two years of the project, the lab discovered 17 LD clusters, 12 of which would not have been identified in a timely manner without this outbreak detection program. [22] Because the

Table 2

Characteristics of patients with Legionnaires' disease associated with cooling tower as most likely source of infection, Amsterdam, June – July 2006 (n=31)

Total number of patients	31	100%
Sex		
Male	23	74%
Female	8	26%
Age		
Average age (range) in years	56 (32-81)	
Age distribution in years		
30-39	3	10%
40-49	8	26%
50-59	7	23%
60-69	9	29%
70-79	3	10%
80-89	1	3%
Diagnosis		
Urinary test	31	100%
Urinary test + culture	7	23%
History taken in acute stage		
Patient	17	55%
Relative/proxy	14	45%
Deceased		
Number of deaths, case fatality rate	3	10%
Associated factors		
Diabetes type II	5	16%
Immune deficiency	2	6%
COPD	3	10%
Other lung disease	1	3%
Hypertension	2	6%
Smoker	11	35%
Alcoholism	2	6%
Any associated factor	20	65%

Figure 2

The annual number of reported cases of Legionnaires' disease in The Netherlands, 1987-2006

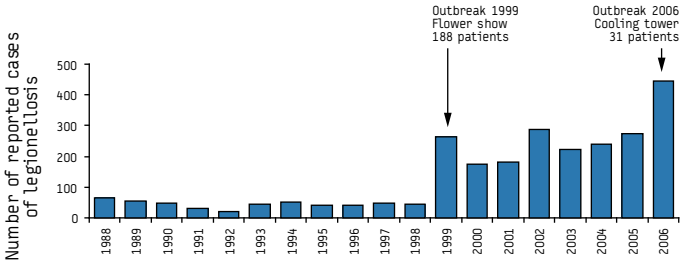
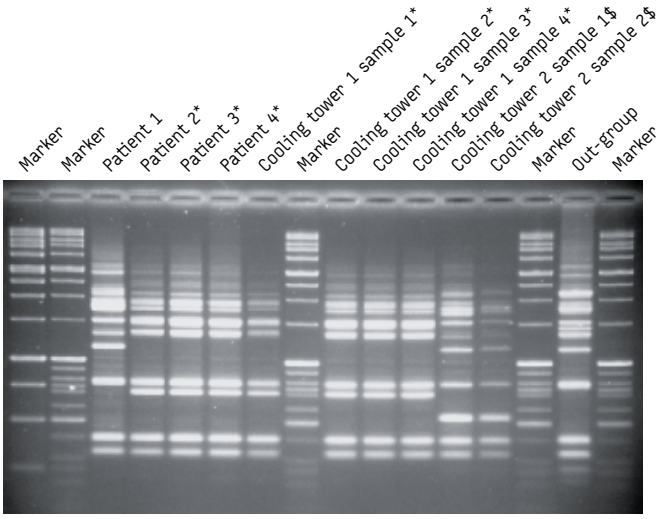


Figure 3

Results of DNA fingerprinting of four Legionnaires' disease patients and two cooling towers in Amsterdam, 2006



* Patients and cooling tower 1 match
$ cooling tower 2 was located 5 kilometers south-west of cooling tower 1

project was so successful, it was implemented in routine outbreak control and is coordinated by CIb since 2006. [23]

Because of their experience with sampling of possible legionella sources, in the 2006 outbreak the Regional Public Health Laboratory of Haarlem could take the first samples of suspected sources immediately after they were identified, starting on Saturday evening. Four days after the first patient was diagnosed, the actual source was sampled and one day later closed.

Increased awareness and availability of antigen tests are probably the reason why since the 1999 outbreak, the number of reported LD cases in the Netherlands has increased steadily (Figure 2). In 2006, the incidence of LD in the Netherlands was higher than in previous years. This increase cannot be explained only by the Amsterdam outbreak or increased awareness. The same trend was seen in the United Kingdom. [24] In both countries many sporadic cases spread all over the country were reported, which may be associated with certain weather conditions. In a recent study, warm and wet weather patterns, but not the hottest ones, were found to be associated with a higher incidence of LD in The Netherlands between 2003 and 2007 [25]

Legionella prevention and legislation

After the 1999 outbreak, the Dutch government launched a plan to combat Legionnaires' disease [26] which has resulted in the report 'Controlling Legionnaires' Disease', published by the Health Council in 2003 [27]. The report targets four areas in which the risk of infection could be reduced at acceptable cost: 1) European-wide agreement on guidelines (since about half of the patients are infected abroad); 2) rapid diagnosis and treatment; 3) modification of water fittings and implementation of management plans; and 4) stimulation of research to further rationalize prevention policies. The report states that some water atomizers (those used at large scale events, by residential properties, by small companies, and atomizers that are not connected to the main water system), and wet cooling towers used for comfort cooling need better maintenance.

New preventive legislation about control of legionella in water has been put in place, with clear responsibilities. In March 2005, the Ministry of Housing, Spatial Planning and the Environment (VROM) published a summary on the prevention and the legislation concerning the control of legionella in water. LD prevention is divided into pro-active and reactive source cleansing. For preventive pro-active cleansing, four laws are in place that apply to different water sources (see summary in Table 1). By law, samples to monitor the effectiveness of the preventive measures must be taken at regular intervals from all drinking water sources. Positive tests are reported to the VROM inspectorate. The local Public Health Service is notified in case of a positive culture with more than 1,000 colony-forming units per litre, so that it can give information to the users of the contaminated water installation and, if possible and applicable, communicate with reported patients.

Because the vast majority of cooling towers in the Netherlands are installed at company buildings, the Ministry of Social Affairs and Employment (SZW) is made responsible for the legionella control in cooling towers, as far as its risk for employees is concerned. It is assumed that this will also protect the general population. Registration of these towers in the Netherlands is not addressed by law.

As for preventive reactive legionella source cleansing, the infectious disease law is in place, stating that every physician must report LD patients to the local PHS within 24 hours of the diagnosis after which source tracing and elimination can take place as described above in the 'Methods' section [28].

Next steps

Although the Ministry of Social Affairs and Employment is responsible for legionella control in wet cooling towers, their actual supervision, so far, is limited. Registration of these towers is not addressed in the law but in a policy regulation, which is a guideline that describes 'best practice'. In response to the Amsterdam outbreak, the minister of Social Affairs and Employment stated that the responsibility for registration of cooling towers lay with the municipalities, and that voluntary registration was expected to be sufficient.

As for drinking water, it is urgently needed that wet cooling towers are sampled at regular intervals, and that these cooling towers, together with their test results, are registered nationally. Positive cultures should be fingerprinted and the results entered in the national database. This way, prevention will improve because maintenance will be monitored, and matches with patients' cultures can be made as soon as possible.

In 2007, a register of wet cooling towers was still not in place. In 2003, 30 wet cooling towers were registered in Amsterdam as part of a study. During the 2006 outbreak 14 new wet cooling towers were found. Although registration of cooling towers is not officially their task, in the beginning of the summer of 2007, the PHS Amsterdam decided to make a start with an updated list of wet cooling towers. At the end of the summer, 73 of such cooling towers were registered, more than twice as many as in 2003. Possibly, with a larger database that also includes cooling tower test results, more sources of such outbreaks as described in this paper can be found and prevented or eliminated faster in the future.

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News

New animal health strategy for the European Union

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An action plan for a new animal health strategy for the European Union (2007-2013), where "prevention is better than cure", was recently published by the European Commission and is now available online. The new strategy was formulated in close consultation with the various stakeholders concerned.

Animal health is of concern to all European citizens since it is closely linked to areas such as food safety, animal welfare, sustainable development and research as well as to public health.

The plan's underlying principles are partnership and communication.

The action plan is based on four pillars that target well-defined outcomes: prioritisation of EU intervention; introduction of a single regulatory animal health framework; enhanced prevention, surveillance and crisis preparedness; and science, innovation and research.

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