

A cluster of leptospirosis cases in canoeists following a competition on the River Liffey

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SUMMARY

On 6 November 2001, a possible case of leptospirosis was notified in a canoeist following a white-water event on the River Liffey. It emerged that a second race participant was also a possible case. An outbreak control team coordinated the epidemiological investigation, laboratory investigation, environmental assessment, communication and control measures. A cluster of six laboratory-confirmed cases of leptospirosis, serologically *Leptospira interrogans* serogroup Icterohaemorrhagiae was found. The attack rate was 9·2% (6/65). Fever, chills, red eyes and shortness of breath were significantly associated with being a confirmed case. Five cases were hospitalized. Swallowing more than one mouthful of water was associated with an increased risk of developing leptospirosis. Increased rainfall and release of hydroelectric water may have contributed to this outbreak. A multidisciplinary approach and use of the Internet and e-mail facilitated rapid and effective communication.

INTRODUCTION

Leptospirosis is a worldwide bacterial zoonotic infection caused by motile spirochaetes of the genus *Leptospira* [1]. Human infection occurs through direct or indirect exposure to an infected animal's urine. Common animal reservoirs (maintenance hosts) include rodents, cattle and pigs [2]. Risk factors include occupational exposure, such as in farm workers, abattoir workers and sewer workers, recreational activities such as freshwater swimming, canoeing,

kayaking and household exposure from pets or domesticated livestock [3].

Leptospirosis is primarily a disease of tropical and subtropical regions. In temperate climates leptospirosis is uncommon and clusters of cases are unusual [4]. Reported cases in Ireland have occurred mainly in farmers, especially dairy farmers and individuals participating in water-related activities [5]. In many areas the epidemiology of leptospirosis has been modified by changes in animal husbandry, climate and human behaviour [6].

Leptospirosis is an acute biphasic illness with a typical incubation period ranging from 7 to 14 days with an average of 10 days [1]. Some cases may be asymptomatic or may present in the first phase

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(bacteraemic phase) with the abrupt onset of a 'flu-like' illness with fever, rigors, myalgia, headache or conjunctivitis. This phase may resolve without treatment. In other cases an immune phase may follow with the return of fever associated with more serious manifestations of jaundice, renal failure or meningitis [7]. In developed countries the case fatality rate is 1–5% [1]. Leptospirosis is a notifiable infectious disease in Ireland [8], requiring reporting to the regional Medical Officer of Health.

A white-water canoeing event took place on 13 and 14 October 2001 on the River Liffey in Dublin. Preceding the competition, there was increased rainfall in the area and, at the request of the canoeists, further water had been released into the river that morning from a hydroelectric power station.

The management of an outbreak of leptospirosis following the competition is described in this paper.

MATERIALS AND METHODS

Initial investigation

This commenced on 6 November 2001 when the National Disease Surveillance Centre was notified by a hospital clinician of a possible case of leptospirosis in a 23-year-old man. He had recently competed in the canoeing event on the River Liffey. It subsequently emerged that a second race participant had presented to a different hospital on 30 October with possible leptospirosis.

The Department of Public Health in the Eastern Regional Health Authority was notified of a possible outbreak. An outbreak control team was convened in order to further investigate this clinical suspicion of an outbreak, to coordinate control measures and to communicate with the public, canoeists and relevant medical practitioners. The membership comprised a Specialist and a Specialist Registrar in Public Health Medicine, an Environmental Health Officer (EHO), an Infectious Disease Consultant, an Infection Control Nurse in the Department of Public Health and an Area Medical Officer.

Analytical epidemiology

A list was compiled of all 65 canoeists participating in the competition with the assistance of the event organizers and the Irish Canoe Union. Canoeists either came from one of 15 clubs based in different parts of the country or participated independently.

A telephone questionnaire developed from a previous model [9] was piloted and then administered by telephone to the 62 contactable participants to assess symptoms and identify any potential environmental and/or behavioural risk factors.

The questionnaire data was analysed using the Epi-Info version 6 statistical software package [10].

Case definition

A *suspected case* of leptospirosis was defined as 'a person with an onset of fever occurring within the incubation period of leptospirosis associated with at least two of the following symptoms or signs: chills, headache, myalgia, diarrhoea, eye pain or red eyes' [9]. Laboratory evidence for a *confirmed case* of leptospirosis was defined as a positive screening test for leptospiral IgM by Panbio enzyme-linked immunosorbent assay (ELISA), confirmed at the PHLS *Leptospira* Reference Unit (LRU) in Hereford, England by an 'in-house' IgM ELISA [11] and a positive microscopic agglutination test (MAT).

Microbiological investigations

For the MAT, titres greater than or equal to 1:320 or a fourfold rise in titre between acute and convalescent serum samples were considered positive. The presumptive infecting serogroup was taken as that which gave the highest MAT titre with a convalescent serum. The MAT [12, 13] was performed using a battery of leptospiral antigens. The antigens used were reference strains of *Leptospira interrogans* from the following serogroups, with selected serovars combined into pools based on serogroups.

Leptospiral serogroups used were Australis, Autumnalis, Ballum, Bataviae, Canicola, Celledoni, Cynopteri, Grippotyphosa, Hebdomadis, Ictero-haemorrhagiae, Javanica, Mini, Pomona, Pyrogenes, Sejroe hardjo, Sejroe saxkoebing, Sejroe sejroe, Tarassovi. All competitors' samples negative by leptospiral IgM ELISA were also tested by the LRU.

Communication methods

The Department of Public Health contacted all other Directors of Public Health in the country and local Senior Area Medical Officers by personal communication and by letter. Relevant practitioners including accident and emergency consultants, general practitioners, clinical microbiologists, infectious disease

Table 1. *Potential exposure risks in non-cases and confirmed cases*

Potential exposure during event	No. of non-cases (<i>n</i> = 56)		No. of confirmed cases (<i>n</i> = 6)	
	<i>n</i>	%	<i>n</i>	%
Submerged	52	92.8	6	100.0
Swallowed small amount of water	28	50.0	1	16.6
Swallowed >1 swallow of water*	3	5.3	3	50.0
Presence of significant open wound	5	8.9	2	33.3
Presence of minor cuts and abrasions	17	30.4	2	33.3

* $P < 0.001$.

consultants and student health physicians were alerted. The outbreak control team, in conjunction with the Director of Public Health, participated in the media management of the outbreak with media alerts to the general public, and to canoeists in particular, giving information on the signs and symptoms of leptospirosis, and on the need to seek medical attention if particular symptoms occurred. Leaflets with advice on disease prevention were provided to canoeists. A website developed by one of the event organizers was invaluable in disseminating information from the Department of Public Health to canoeists. Over 50 e-mails to a Department of Public Health contact address listed on the website were responded to.

Environmental investigation and control

An EHO gave advice to all local canoe clubs on pest control and canoe storage, and arranged for further public warning notices to be erected alongside the weir area.

RESULTS

Epidemiological results

Of 62 participants investigated, 55 were male and 7 female. Forty-six (74.2%) resided within the local health authority area (Eastern Regional Health Authority). The median age of respondents was 22 years old (range 11–43 years). Potential exposure risks among participants are shown in Table 1.

Regarding potential preventive measures, 54 (87.1%) reported showering after the event: 8 within 2 h, 19 within 4 h and 3 over 12 h after the event.

Illness in participants

Eighteen respondents (29%) had symptoms or signs of constitutional upset in the week immediately

Table 2. *Symptoms and signs reported in the week following the race in 12 non-cases and in 6 confirmed cases*

Symptom/sign	Competitors reporting illness (<i>n</i> = 12)		Confirmed cases reporting illness (<i>n</i> = 6)	
	<i>n</i>	%	<i>n</i>	%
Headache	7	58.3	6	100.0
Muscle pain	8	66.6	5	83.3
Fever*	6	50.0	6	100.0
Abdominal pain	9	75.0	3	50.0
Diarrhoea	8	66.6	3	50.0
Cough	8	66.6	3	50.0
Vomiting	5	41.6	4	66.6
Chills*	2	16.6	6	100.0
Leg pain	2	16.6	5	83.3
Painful and stiff neck	2	16.6	5	83.3
Dark urine	4	33.3	3	50.0
Swollen glands	4	33.3	3	50.0
Red eyes*	2	16.6	4	66.6
Shortness of breath*	2	16.6	4	66.6
Rash	2	16.6	1	16.6
Jaundice	0	0.0	3	50.0
Joint ache	0	0.0	1	16.6

* $P < 0.01$.

following the event (Table 2). Ten (16.1%) described an illness meeting the suspected case definition. Fever, chills, red eyes and shortness of breath were significantly associated with being a confirmed case (Table 2).

Twelve people (19.4%), including 6 subsequently confirmed cases, 1 non-confirmed suspected case and 5 others, sought medical care. Of the 6 who were hospitalized, 5 were confirmed as cases. One further person hospitalized for 5 days with a clinical picture suggestive of leptospirosis was not confirmed as a positive case by IgM ELISA or by MAT. One confirmed case was not hospitalized. All 6 confirmed cases and 5 others were prescribed antibiotics.

Table 3. Presentation and management of confirmed cases in October/November 2001

Case no.	Age	Sex	Date of illness onset	Date first sought medical attention	Date admitted to hospital	Time spent in hospital	Treatment
1	35	M	22 Oct.	23 Oct.	24 Oct.	4 days	Erythromycin
2	18	M	25 Oct.	26 Oct.	27 Oct.	6 hours	Augmentin
3	23	F	27 Oct.	1 Nov.	16 Nov.	7 days	Penicillin G
4	21	M	29 Oct.	30 Oct.	30 Oct.	7 days	Doxycycline
5	23	M	31 Oct.	31 Oct.	2 Nov.	12 days	Benzyl penicillin, cefuroxime, flucloxacillin
6	20	F	6 Nov.	Not known	Not admitted	Not applicable	Amoxicillin

The median incubation period for confirmed cases was 14 days (range 10–18 days). The time from exposure to presentation, clinical symptoms and signs of presentation and the management of confirmed cases are shown in Table 3. All confirmed cases showered within 3 h of the event. Becoming a confirmed case was significantly associated with swallowing more than one mouthful of river water. There was no statistically significant association with age, gender, submersion, the presence of cuts or abrasions, or time taken to showering post-exposure. No competitor was taking anti-*Leptospira* prophylaxis prior to the event.

Microbiological results

Seventeen competitors submitted at least one serum specimen. Five of the participants had a positive assay for IgM ELISA at the National Virus Reference Laboratory and one was positive by MAT in a Belfast city hospital. All were confirmed positive by MAT at the LRU where serogrouping confirmed that all six cases were caused by *Leptospira interrogans* serogroup Icterohaemorrhagiae (Table 4).

One unconfirmed low positive IgM ELISA report was subsequently reported as negative by MAT and IgM ELISA by the LRU. Laboratory results for the remaining 10 samples were negative.

Environmental results

An environmental risk assessment was carried out. There had been no recent demolition of buildings or harvesting of fields in the surrounding area, which could have contributed to an increased rodent population.

Table 4. Serological results in 6 confirmed cases

Case no.	Sample collected	ELISA IgM titre (in-house)	MAT	Presumptive infecting serogroup
1	26 Oct. 2001	Neg.	Neg.	
	8 Nov. 2001	640	Neg.	
	6 Feb. 2002	160	2560	Ictero
2	12 Nov. 2001	640	320	
	3 Dec. 2001	320	2560	Ictero
3	11 Nov. 2001	1280	1280	
	2 May 2002	160	320	Ictero
4	30 Oct. 2001	Neg.	Neg.	
	15 Nov. 2001	160	640	
	24 Jan. 2002	40	320	Ictero
5	4 Nov. 2001	320	Neg.	
	26 Nov. 2001	1280	1280	
	13 Feb. 2002	160	160	Ictero
6	18 Dec. 2001	320	5120	Ictero

Ictero, *Leptospira interrogans* serogroup Icterohaemorrhagiae.

DISCUSSION

Leptospirosis is a globally important zoonotic disease that affects people on all continents and in temperate and tropical climates [1]. While underestimation is likely [5, 14] there was an incidence rate of 4.96/1 000 000 in 2000 [15]. The high rate of *L. interrogans* serogroup Icterohaemorrhagiae infection in Ireland has been attributed to indirect exposure to rat urine during leisure activities [16]. The River Liffey has been previously reported as a possible reservoir of leptospires [17]. This cluster occurred in late autumn which is similar to UK reports [18]. The increased rainfall prior to the event may have flushed both rodents and

their urine and hence leptospires, out of the environment. The additional release of hydroelectric water would have raised the river level, possibly drawing in stagnant water from the river edge. Outbreaks have been previously related to flooding [19] and rainfall [20, 21].

Leptospirosis is associated with serious morbidity; this outbreak resulted in six hospitalizations with one admission to an Intensive Care Unit. While canoeists reported varied and non-specific symptoms, most are consistent with described case series [22], although other unconfirmed co-existing river water-related conditions may have been implicated.

Swallowing of more than one mouthful of water by canoeists was identified as a significant risk factor; this relationship has previously been identified in swimmers [23]. No other specific exposure was associated with increased risk of developing leptospirosis among these cases, compared to non-cases, and early showering did not confer a protective effect.

Chemoprophylaxis (doxycycline, 200 mg weekly) may reduce the attack rate of clinical leptospirosis [24, 25]. No participant received anti-microbial prophylaxis prior to this event. Human vaccines are available in a number of countries using locally isolated serovars, but no vaccine is currently available in the United Kingdom or Ireland. Early recognition by physicians is important; initiation of appropriate antibiotic therapy within 2 days of onset of illness can significantly shorten illness duration [22].

The diagnosis of leptospiral infection is based upon clinical suspicion confirmed by laboratory tests. Leptospiral IgM antibody can usually be detected after days 5–6 following the onset of symptoms; therefore the ELISA test has limited utility for diagnosis and management during the initial evaluation of patients. Positive IgM results must be confirmed by MAT, with follow-up samples, to determine the infecting serogroup, and possible source.

Communication with participants and health-care workers was seen as vital during this outbreak. The use of e-mail and the Internet was found to be a quick and effective method of disseminating information to canoeists.

Total eradication of leptospires from natural reservoirs of water is impossible and the optimal preventive measure is avoidance of hazardous recreational pursuits. Advice on practical measures such as the covering of abrasions, minimizing submersion, hand washing and early showering may reduce risk [16].

The described cluster of six cases is unusual in a temperate climate and the size of this outbreak reflects the shift from occupational to recreational exposure [26], with leptospirosis now a well-recognized recreational hazard for canoeists. The challenge for those in public health is to raise awareness of leptospirosis among clinicians and the public, with emphasis on education, prevention, risk reduction, early diagnosis and treatment complemented by effective surveillance and control.

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