A whirlpool associated outbreak of Pontiac fever at a hotel in Northern Sweden

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SUMMARY

In April 1999, an outbreak of Pontiac fever occurred at a hotel in Northern Sweden. A retrospective cohort study to find the source and define the extent of the outbreak was carried out among 530 Swedish and Norwegian guests. Twenty-nine epidemiological cases (8 % of 378 responders) aged 21–57 years were identified. Antibodies against *Legionella micdadei* were detected in 17 of 27 tested cases and 3 other symptomatic persons. Visiting the whirlpool area was identified as the sole risk factor (RR 86; 95 % CI 21–352) and infected cases were confined to visitors to this area over three successive days. The attack rate was 71 % (27/38) and 24 cases (83 %) used the whirlpool. Environmental sampling was negative for *Legionella* sp. But epidemiological investigation strongly suggests that the whirlpool was the source of the outbreak. The possibility of serious legionella infections underlines the importance of strict maintenance practices to maintain hygiene of whirlpools.

INTRODUCTION

Legionellosis is the collective name for clinical syndromes produced by the family *Legionellaceae*, and include Legionnaires' disease, the pneumonic form, and Pontiac fever, an acute febrile, self-limiting illness characterized by headache, high fever and myalgia. It is not known why these two different forms occur [1]. The incubation time for Legionnaires' disease is 2–10 days, but only 1–2 days for Pontiac fever. Outbreaks of Legionnaires' disease usually occur with low attack rates (0·1 %–5 %) in the population at risk, whereas in outbreaks of Pontiac fever attack rates up to 95 % have been reported [2–4]. Outbreaks of legionellosis are frequently linked to

aerosols from evaporative condensers, cooling towers, air conditioners and whirlpools [5, 6]. *Legionella pneumophila* recovered from whirlpool type spas has been associated with outbreaks of Pontiac fever and Legionnaires' disease [6–8] and a large outbreak of Legionnaires' disease in the Netherlands was epidemiologically and microbiologically linked to a whirlpool at an exhibition [9, 10]. The development of both syndromes following exposure to a common source has also been reported [11, 12].

Diagnosis of Pontiac fever is made by recognition of the clinical and epidemiological features, isolation of a *Legionella* species from a source, and demonstration of seroconversion to the suspected agent in affected patients. *Legionella* species are generally not detected in clinical material [4]. Surveillance data in Sweden record 40–80 cases of Legionnaires' disease yearly, half of them infected abroad. Influenza like

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outbreaks linked to whirlpools have occurred in Sweden previously, where *Legionella* species were detected in the water.

We report here an outbreak of Pontiac fever that occurred in a hotel in Northern Sweden and describe the measures taken to control it. The outbreak was investigated to determine the extent and source of the infection, to stop further transmission and to prevent outbreaks in the future.

METHODS

Setting

Lycksele is a town with 14 000 inhabitants, situated 150 km from Umeå, Västerbotten County, Northern Sweden. The 600-bed hotel where the outbreak occurred is used as a conference center during the week. At weekends dancing and concerts attract up to 1000 persons, many of whom stay overnight. A whirlpool area with a sauna, 2 whirlpools and shower facilities is available for overnight guests only (Fig. 1).

On Tuesday 20 April 1999, 2 cases of febrile disorder with headache, myalgia and chest pain consistent with Pontiac fever were reported to the County Medical Officer of Communicable Disease Control in Västerbotten County, Sweden. The two patients were guests at the hotel in Lycksele and they had used the whirlpool of the hotel. In the next few days more guests who had visited the same hotel were reported to have developed similar symptoms. As a preventive measure the whirlpool of the hotel was closed on 21 April. The County Medical Officer informed the Department of Infectious Diseases at the University Hospital in Umeå and general practitioners in Västerbotten County about a possible outbreak of legionellosis and requested reporting of all suspected cases. On Thursday 22 April, the number of reported cases had increased to 20 and the Swedish Institute for Infectious Disease Control (SMI) was informed. As hotel guests came from the whole country, the SMI informed all infectious disease clinics and County Medical Officers nationwide on 22 April.

Retrospective cohort study

The SMI carried out a retrospective cohort study in co-operation with the Norwegian National Institute of Public Health, the County Medical Officer and the Local Environmental Health Officer to identify activities potentially responsible for transmission of the illness. The attack rates of Pontiac fever were
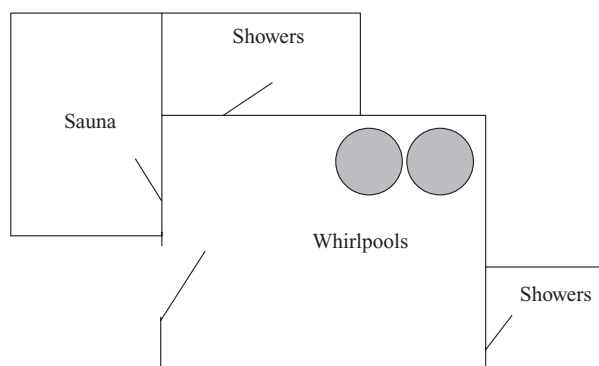

Fig. 1. Plan of the whirlpool area of hotel in Lycksele, April 1999.

calculated according to exposure to potential risk factors for legionellosis in the period 15–20 April.

Case definition and case finding

A case was defined as a guest staying at the hotel in the period from 15–20 April, and developing headache and fever and myalgia during his/her stay or within 2 days after departure from the hotel. Case finding was done by informing all infectious disease clinics in the country and requesting them to report suspect cases. Locally, information via the media was used to increase awareness of the outbreak. Following preliminary telephone interviews with 28 symptomatic guests, a definitive questionnaire was designed containing demographic data including area of residence, chronic diseases, medication, smoking habits, date of onset of symptoms (after 15 April), date of visit to the hotel and exposure to activities in and outside the whirlpool area of the hotel. The hotel management provided a list of 13 companies with telephone numbers, who had conferences between 15–20 April, as well as a list of persons who had booked rooms. Through telephone enquiries and searching through the register of the national telephone company, addresses for 530 of 660 guests were obtained. The SMI mailed the questionnaire to 400 Swedish guests and a translated questionnaire was forwarded by the Norwegian National Institute of Public Health to the 130 Norwegian guests.

Statistical analysis

Calculations were performed using Epi-Info 6.04c (Centers for Disease Control and Prevention, Atlanta, USA). Crude and specific attack rates according to various activities were calculated. Activity specific attack rates of cases of Pontiac fever were calculated

by day of presence at the hotel, for which the total number of guests present on each specific day was used as the denominator. Relative risk (RR) and 95% confidence intervals (95% CI) were computed for each potential risk factor. Where appropriate, p-values were calculated with Fisher's exact test (2-sided). The aetiologic fraction (the proportion of exposed cases for whom the disease is attributable to exposure [13]) among exposed subjects was computed with the formula (RR-1)/RR for each potential risk factor. Multivariate logistic regression using SPSS (version 8.0.0, SPSS Inc., Chicago) was done including all variables statistically associated with the dependant variable in univariate analysis.

Laboratory analysis

Laboratory investigations were carried out to confirm the cause of the disease. In addition to patients seen at the Department of Infectious Diseases at Umeå University Hospital, an attempt was made to obtain serum from all persons in the study population who fulfilled the case-definition. An immunofluorescent antibody test (IFA) was performed at the SMI by the same person to detect serum antibodies to heat-killed *L. pneumophila* serogroup 1 and 2–8, *L. micdadei*, *L. bozemanii*, and *L. longbeacheae* serogroup 1 and 2 antigens as previously described [14, 15]. A fourfold rise in titre to at least 64 after 1 month was considered as indicative of recent infection. Bacteriological cultures (blood, nasopharynx) and serology for common respiratory pathogens including legionella were performed on patients seen at the Department of Infectious Diseases at Umeå University Hospital. *L. pneumophila* antigen in urine was assayed using a commercial test (Biotest AG, Dreieich, Germany).

Environmental investigation

Water samples from the whirlpools were collected on Tuesday 20 April. In addition, on 23 April the water temperature was measured and water samples and environmental swabs of biofilm from showers were collected in guest rooms and relaxation area. As the pools had been emptied and closed on 21 April swabs were taken from the pipes, inlet and outlet nozzles. The pipes were then flushed and the flushings collected for culture. The cartridge filter and water from the filter container were also sampled for culture.

Water samples were concentrated both by centrifugation and membrane filtration and treated with
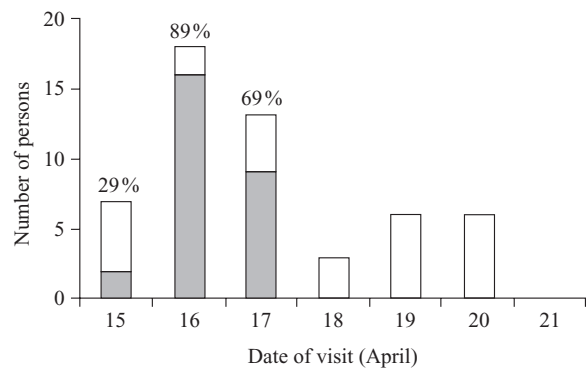

Fig. 2. Number of cases and attack rates (%) for Pontiac fever among visitors to the whirlpool area of hotel in Lycksele, by day of visit, April 1999. Two visitors who were in the whirlpool area on 18 and 19 April appear twice in the figure. Grey bars, cases; white bars, non-cases.

acid directly into the funnel [15]. The environmental swabs were cultured on selective legionella agar (BCYEα) and a parallel culture with antibiotics supplement (MWY agar) was also performed. Plates were examined after 3–5 days with a final check after 10 days. Pieces of the cartridge filter material were treated with TWEEN-buffer and organisms concentrated by centrifugation followed by culture.

RESULTS

Descriptive findings

Overall, 407 hotel guests (77%) responded to the mailed questionnaire. Twenty-nine interviewees were excluded as they had not stayed overnight in the hotel. The Swedish visitors came from all over the country, the majority (80%) from Västerbotten County. Seventy-two persons (19% of 378) had symptoms of illness during or within 2 days after staying at the hotel. Twenty-nine responders met the case definition (7·7% of 378); one of them was Norwegian. The median age of the cases was 41 years (21–57) and of non-cases 42 years (18–76). The attack rate was 9·5% (18/190) among women and 5·9% (11/187) among men (RR = 1·6; 95% CI [0·8–3·3]). The attack rate among smokers was 11·2% (10/89), compared with 7·1% (19/267) in non-smokers (RR = 1·6; 95% CI [0·8–3·2]). One of two persons with immune-suppressive treatment for rheumatic disease was defined as a case. In addition to signs and symptoms included in the case definition, cough (50%), chest pain (47%) and dyspnoea (23%) were common. There were no fatalities. Cases were restricted to persons who visited the whirlpool area on 15, 16 and 17 April (Fig. 2) and

Table 1. *Activity specific attack rates of cases of Pontiac fever by date among visitors to hotel, April 1999*

	Exposed			Non exposed				
	Nr	Case	AR*	Nr	Case	AR	RR†	95% CI‡
Thursday 15 April	7	2	29%	93	1§	1%	26·6	2·7–258·3
Friday 16 April	18	16	89%	74	1	1%	65·8	9·3–464·0
Saturday 17 April	13	9	69%	186	1	1%	128·8	17·6–940·2

* Attack rate.
† Relative Risk.
‡ Confidence interval.
§ Non-exposed case on 15 and 16 April is the same person.

Table 2. *Activity specific attack rates of cases of Pontiac fever among visitors of the whirlpool area from 15 to 17 April (N = 38)*

Potential risk factors in whirlpool area	Exposed			Non exposed				
	Nr	Case	Ar*	Nr	Case	AR	RR†	95% CI‡
Using whirlpool	27	24	89%	10	3	30%	2·9	1·1–7·7
Using shower	30	24	80%	8	3	38%	2·1	0·9–5·3
Using sauna	16	12	75%	20	14	70%	1·1	0·7–1·6

* Attack rate.
† Relative Risk.
‡ Confidence interval.

the attack rate among visitors during these 3 days was 71% (27/38). The attack rates according to date of visiting the whirlpool area are shown in Table 1 and Figure 2. Twenty-three of 27 cases fell ill 2 days after a visit to the whirlpool area, 2 after 1 day and 2 after 3 days. The median incubation period was 40 h (26–47 h) in 12 cases with known time of onset of symptoms.

Analytical study

The attack rate among the 50 visitors (13·5% of 378 guests) to the whirlpool area was 54% compared with 1% among those who did not visit this area (RR 86; 95% CI [21–352]). For those using the whirlpool the attack rate was 71% and 2% among those not using it (RR 47; 95% CI [19–114]). For persons taking a shower or a sauna in the whirlpool area the rates were 63% and 50% respectively, compared with 2% and 5% among guests not exposed to these activities. Of the 29 cases, 27 (93%) had visited the whirlpool area, 24 (83%) had used the whirlpool, 24 (83%) had used the showers and 12 (42%) had taken a sauna in the relaxation area. The aetiological fraction for visiting the whirlpool area was 99%. Attack rates for activities

outside the whirlpool area such as using the room en suite shower, shower in the massage room and sauna) ranged from 0–8% in exposed persons compared with 8–14% in non-exposed persons.

As the water in the whirlpools was said to be changed daily, analysis was performed according to the day of presence of cases in the hotel (Table 1). The relative risk of falling ill after visiting the whirlpool area compared with not-visiting this area increased from 15 to 17 April. A clear dose-response relationship could not be established for the duration of exposure to suspected activities for the 3 successive risk-days. Among the 38 persons who visited the whirlpool area from 15 to 17 April, the attack rates were 71% (17/24) for women and 71% (10/14) for men (RR 0·9; 95% CI [0·6–1·5]). Attack rates by 10 years age group ranged from 64–86%. No person above 60 years visited the whirlpool area. Among the visitors to the whirlpool area, those who used the whirlpool or the shower complex were more likely to become a case than those who did not (Table 2). Controlling for confounding factors, in a model including use of whirlpool or shower or sauna among the 38 persons visiting the whirlpool area on the 3 risk days, showed that only use of the whirlpool was a significant risk factor (OR 41·0, P 0·02).

Laboratory analysis

No *Legionella* species was isolated from respiratory secretions of patients. Urine antigen analysis was also negative for all patients. Antibody titres against *L. micdadei* at a level implying recent infection ($\geqslant 64$) were found in 17 of 27 tested cases and in 3 patients at the Department of Infectious Diseases at Umeå University Hospital who did not fulfil the case criteria (total 30 tested persons).

Environmental investigation

The separate pipe systems of the whirlpools were filled with non-chlorinated groundwater from the public water supply. Chlorinating was then performed daily using tablets and all water was changed daily. Water temperature at the hot taps was 45–60 °C and the water in the filter container smelled strongly of chlorine. There was no air-conditioning in the hotel. None of the samples of water and filter nor the environmental swabs yielded *Legionella* species.

DISCUSSION

This report describes an outbreak of Pontiac fever among guests of a hotel in Northern Sweden. The clinical signs and symptoms, incubation time (40 h), high attack rate (71 %) and the wide age-range of the cases in the outbreak are consistent with a diagnosis of Pontiac fever, the source of which was the whirlpool area of the hotel. Visiting the whirlpool area, taking a shower or using the whirlpool or the sauna were the activities most associated with a high risk for infection. Disentangling the activities among the epidemiological cases who visited the whirlpool area showed that 23 of 24 cases had used both whirlpool and shower. Of the remaining cases who had not used the whirlpool, one had taken a sauna on 15 April, another a sauna and a shower but had sat on the steps of the whirlpool on 16 April, while the third person sat in the whirlpool area on 16 April. After adjusting for confounding factors, only the use of the whirlpool proved to be a risk factor.

The most plausible source of this outbreak was the whirlpool, as from there, spread of bacteria by aerosols could have taken place to the whole area. Another supporting fact in incriminating the whole room was that one of the hotel staff-members who had served guests in the whirlpool area and who had fallen ill fulfilled the case definition. Based on the calculations of aetiological fractions, 99 % of the cases having visited the whirlpool area could be attributed to that exposure. The epidemiologic evidence (relative risk) that visiting the whirlpool room was a high risk for becoming a case became stronger over 3 consecutive days and this was determined by the number of visitors to the hotel each day. The risk for falling ill when visiting the whirlpool room increased from 15 to 16 April, which suggests an increasing infective dose of legionella bacteria. A possible explanation for this could be an interruption of the disinfecting process. As there was no log-sheet kept for pool maintenance, it remained unclear if the whirlpool was emptied and the water disinfected daily. Interviews with the manager revealed that several persons were tasked to maintain the pool but no single person was responsible. The amount of chlorine used for chlorination of the pool was not known.

In the retrospective study we contacted 530 out of 660 guests, and half of the missing 130 guests were not overnight visitors. It is not likely that there were missed clinical cases among the guests whom we could not reach and the non-responders, as media and public attention was quite high. As media attention was focused on the whirlpool, it is possible that some of the non-responders did not visit the whirlpool area. In that case the relative risk would be higher than that found. As the questionnaires were sent out within 2 weeks after the outbreak, a recall bias is not likely to have lead to misclassification of exposure. However, since Pontiac fever is often sub-clinical, some persons who were infected with *L. micdadei*, may have been missed but this will not have influenced the relative risk estimate.

Among the persons who fell ill but did not fulfil the case-definition there may have been individuals with Pontiac fever. With our clinically based case definition we found only two cases who had not visited the whirlpool area. They might have been false positive epidemiologic cases with flu-like illness due to another cause. None of these was available for serology testing. As analysis of antibodies to species other than *L. pneumophila* has not been validated we chose to use only clinical signs and symptoms for the case definition. Three serologically confirmed patients were not included as cases because, at the time of completing the questionnaire, they were incompatible with the clinical case definition. Later it came to our attention that two of them were inconsistent in their answers and that their symptoms were compatible with our definition of cases of Pontiac fever. The only

serologically confirmed patient (titre 64) who was not defined as an infected case, reported fever, cough and chest pain. In a previous whirlpool associated outbreak of Pontiac fever in children both *L. pneumophila* and *L. micdadei* were reported and one case was culture positive for *L. pneumophila* [16]. We could only confirm *L. micdadei* serologically in 20 of 30 tested patients, with the cut-off value of 64, which was chosen for the purpose of this investigation taking into account the low baseline prevalence of *L. micdadei* antibodies in the Swedish population [17] (Kallings I, personal communication). However we consider the finding of seroconversion of 63% of 27 tested cases strongly indicative of *L. micdadei* as the causative agent of this outbreak.

Recovery of *Legionella* species other than *L. pneumophila* is technically more demanding than for the latter and thus they are less frequently detected [4]. Whirlpool associated outbreaks with a range of clinical symptoms from Pontiac fever to legionella pneumonia caused by *L. pneumophila* and *L. micdadei* in patients have been described where no legionella was found in the suspected source [12, 18]. Isolation of *L. micdadei* from environmental sources has been achieved, using culture in amoeba [19, 20], but this method was not available to us here. We were not able to detect *Legionella* species in the water system of the hotel, but sampling after the 17 April when the water had been heavily chlorinated, may have played a role in this.

In the whirlpool associated outbreak of Legionnaires' disease in the Netherlands there were 106 cases of pneumonia and 23 deaths [9, 10], whereas this outbreak was characterized by the mild form of disease with around 30 cases and no fatalities. Nonetheless, our investigation shows that the conditions for an outbreak of serious legionellosis were present which underlines the importance of strict maintenance routines and regular controls of whirlpools.

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