

Cluster of Legionnaires' disease cases caused by *Legionella longbeachae* serogroup 1, Scotland, August to September 2013

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We report six confirmed cases of Legionnaires' disease in Scotland caused by *Legionella longbeachae* serogroup 1, identified over a four-week period in August–September 2013. All cases required admission to hospital intensive care facilities. All cases were amateur gardeners with frequent exposure to horticultural growing media throughout their incubation period. *L. longbeachae* was identified in five samples of growing media linked to five cases. Product tracing did not identify a common product or manufacturer.

We describe a cluster of Legionnaires' disease cases caused by *Legionella longbeachae* identified in Scotland between August and September 2013. This was an unprecedented cluster due to the number of cases identified in such a short time period and the geographical proximity of the cases. A national Incident Management Team (IMT) investigated this cluster, focussing on epidemiological, clinical microbiology and environmental issues.

Scotland, with a population of 5.2 million inhabitants, usually records 20–45 cases of Legionnaires' disease per year, of which around 60% are travel-related [1]. Since 2008, a small but increasing number of cases of Legionnaires' disease caused by *L. longbeachae* have been identified in Scotland. This amounts to 18 cases since 2008, with eight cases in 2013, as of 18 November [2, unpublished data for 2013]. This increase has not been mirrored across the rest of the United Kingdom (UK) and Europe. In 2012, a national IMT investigated the 10 cases detected between 2008 and 2012. The investigation focussed on: case ascertainment; case characteristics; growing media production; and a discussion of whether additional public health action was warranted [2]. It identified that the most likely reason for case ascertainment in Scotland but not the rest of the UK, was the testing protocol in

use, driven by an active Scottish *Legionella* Reference Laboratory (SHLMPRL) that routinely used a *Legionella* species PCR test and *L. longbeachae* specific serology tests. These tests were not routinely used in the rest of the UK. No differences in production of horticultural growing media in Scotland and the rest of the UK were identified [2].

Investigation of the cluster

Incident management

Following identification of two confirmed (culture positive) cases of *L. longbeachae* and an additional suspected third case (*Legionella* species PCR positive), NHS Lothian (one of the health boards in Scotland) called a Problem Assessment Group on 6 September 2013. Upon confirmation of the third case (by culture), identification of a fourth suspected case and another confirmed case in neighbouring NHS Tayside, a national IMT meeting was held on 12 September 2013. Leadership of the investigation was passed to Health Protection Scotland (HPS), the national organisation for health protection in Scotland.

Information about presentation of illness, details of testing and background information on *L. longbeachae* was provided to local medical services in NHS Lothian and Tayside, including general practice, emergency care, respiratory wards and to the national health helpline (NHS24), following the first IMT meeting. All health boards in Scotland received public health alerts highlighting the situation. Other UK countries also received these alerts and the European Centre for Disease Prevention and Control (ECDC) was informed.

There was significant press interest in this cluster of cases. Reactive media statements were prepared after every IMT meeting. Following press reporting of this

TABLE 1Case definitions for Legionnaires' disease cases caused by *Legionella longbeachae* serogroup 1, Scotland, August–September 2013

Confirmed case	<ul style="list-style-type: none"> • clinical or radiological evidence of community-acquired pneumonia with disease onset on or after 1 August 2013 AND • evidence of having been exposed in Scotland to horticultural growing media (including composted material produced locally or domestically) in the 14 days prior to the onset of symptoms AND • isolation of <i>Legionella longbeachae</i> from respiratory secretions
Probable case	<ul style="list-style-type: none"> • clinical or radiological evidence of community-acquired pneumonia with disease onset on or after 1 August 2013 AND • evidence of having been exposed in Scotland to horticultural growing media (including composted material produced locally or domestically) in the 14 days prior to the onset of symptoms AND • detection of <i>Legionella</i> species specific nucleic acid in respiratory secretions (accompanied by a negative urinary antigen test), or a detected rise in <i>L. longbeachae</i> serum antibody levels of at least fourfold, or a single high titre of <i>L. longbeachae</i> serum antibody
Possible case	<ul style="list-style-type: none"> • clinical or radiological evidence of community-acquired pneumonia with disease onset on or after 1 August 2013 AND • evidence of having been exposed in Scotland to horticultural growing media (including composted material produced locally or domestically) in the 14 days prior to the onset of symptoms AND • no current microbiological evidence as to the causal agent

cluster, representatives from growing media retailers approached HPS for advice they could provide to customers to reduce risk of illness. Growing media retailers have had increased awareness of Legionnaires' disease from press reporting of cases in Scotland since 2008. A statement was developed for the retail industry describing the low risk of infection and highlighting general gardening hygiene.

Epidemiological investigation

Case definitions are detailed in Table 1. These were adapted from the ECDC case definitions [3] with additional details of time, place and exposure. A 'possible' category was introduced to include those who met clinical and epidemiological criteria whilst test results were awaited. In reality, this 'possible' category was not used as cases were only notified to public health teams following microbiological analysis establishing them as 'confirmed' or 'probable' cases. Cases had a date of onset between 11 August and 10 September (Table 2). Cases were confirmed as *L. longbeachae* infections on average 12 days (range 7–16 days) after the initial diagnosis of community-acquired pneumonia. Due to the relative rarity of this infection, clinicians may not consider Legionnaires' disease until some time into the diagnostic process. This is particularly likely where there is a negative *Legionella* urinary antigen test result, which is often used by clinicians to exclude Legionnaires' disease. Cases were within 130 km of each other, in two neighbouring health board regions.

All confirmed cases were interviewed by nurses in the health board's health protection team, using a standard questionnaire. This sought details on clinical presentation and testing, travel history, recent hospitalisation, possible water aerosol exposures, possible horticultural growing media exposure, gardening

activities. In the first instance, partners and relatives were interviewed, as the cases themselves were too unwell to be interviewed.

All cases had severe community-acquired pneumonia and were all admitted to intensive care facilities. They remained in hospital for an average of 22 days (variation 11–43 days). The cases comprised of three females and three males with a mean age of 70 years (range 55–84 years). Five out of six cases had health problems contributing to underlying immunosuppression. Five out of six cases were active or ex-tobacco smokers. All cases had lived at home throughout their exposure period of 14 days and had not undertaken any activities outside their usual activity pattern. Five out of six cases were keen amateur gardeners who had regular exposure to horticultural growing media during the incubation period of their illness. One case did not describe any clear exposure to growing media. No other relevant exposures were identified for these cases.

In addition to the six confirmed cases of Legionnaires' disease there was one case of probable Legionnaires' disease in a keen gardener with frequent exposure to growing media during the incubation period of their illness. This patient had a moderately high titre of 1:128 to *L. longbeachae* which reverted to negative on follow up testing; no acute serum sample or sputum was available for testing. This case was clinically less severe than the other cases and was managed in the community. The patient was younger than the other cases and did not have any underlying morbidity. This case was detected some time after the six confirmed cases, but had an estimated date of onset within the four-week period between August and September. This case was diagnosed retrospectively, following treatment for pneumonia and it is likely that detection was

TABLE 2

Summary of clinical microbiological testing for the six cases of Legionnaires' disease caused by *Legionella longbeachae* serogroup 1, Scotland, August–September 2013

Case	Date of onset of illness (2013)	Urinary antigen test	PCR		Culture	Serology (<i>Legionella longbeachae</i> specific antibody response)	Organism
			<i>Legionella pneumophila</i>	<i>Legionella</i> species			
1	11 August	negative	negative	positive	positive	four-fold rise	<i>Legionella longbeachae</i> serogroup 1
2	15 August	negative	negative	positive	positive	four-fold rise	<i>Legionella longbeachae</i> serogroup 1
3	24 August	negative	negative	positive	positive	four-fold rise	<i>Legionella longbeachae</i> serogroup 1
4	27 August	negative	negative	positive	positive	single high titre	<i>Legionella longbeachae</i> serogroup 1
5	28 August	negative	negative	–	positive	–	<i>Legionella longbeachae</i> serogroup 1
6	10 September	negative	negative	positive	positive	single moderate titre	<i>Legionella longbeachae</i> serogroup 1

–: test not performed

due to information about this cluster being circulated to general practice physicians.

Clinical microbiological findings

Cases 1–4 were identified by the local clinical diagnostic laboratory in NHS Lothian, which had implemented testing of severe community-acquired pneumonia lower respiratory tract samples by both *L. pneumophila* and *Legionella* species PCR in 2010. *Legionella* species PCR positive samples were referred to SHLMPRL for confirmation and culture. All isolates were *L. longbeachae* serogroup 1. Cases 5 and 6 were identified in NHS Tayside shortly after the first Lothian cases. Sputum/bronchial alveolar lavage samples were cultured in the local diagnostic laboratory and *Legionella* colonies were isolated. These isolates were identified as *L. longbeachae* serogroup 1. This local diagnostic laboratory did not routinely use a *Legionella* species PCR test. All patient isolates were genotyped by amplified fragment length polymorphism (AFLP) at SHLMPRL. Testing results are summarised in Table 2.

Environmental investigation

The environmental investigation focussed on three main areas:

1. identifying specific gardening activities and exposures which may be considered as a high risk;
2. establishing sources through microbiological testing;
3. tracing supply chain and manufacture of potential sources.

There was no common theme in gardening activities and no particular single gardening activity or garden exposure was common amongst the cases, other than use of recently purchased shop-bought growing media. Samples of any remaining growing media were taken for microbiological testing.

In five out of six cases, the use of growing media was investigated. Shop-bought growing media was of a range of brands bought in different premises. All had been stored at home inside, either in the cases' house or greenhouse/polytunnel/garden shed/garage. Using the barcodes on the bags of growing media, batch number and manufacturer details were obtained. There was no common manufacturing site; manufacturing sites were located in England, Scotland and Northern Ireland. Of those growing media produced at the same manufacturing site, there was no common batch number. In addition, there was no common supplier of composted material to these manufacturing sites. All of these growing media contained composted green material and four out of five contained peat.

Microbiological testing of bagged growing media and other garden samples obtained from the cases' homes, detected *L. longbeachae* serogroup 1 in five out of 11 samples tested, resulting in positive growing media samples linked to five cases. In all cases, the same AFLP DNA profile was found in the patient isolate and the implicated growing media isolate. Each patient and growing media isolate was identified as one of three circulating AFLP types regularly identified in Scotland.

The genetic similarity or diversity of all the strains is currently being analysed by whole genome sequencing. Given the match in organism and exposure during the incubation period, it is highly likely that these growing media were the source of infection for these cases. Further work is ongoing looking at further genetic analysis and comparison of the *L. longbeachae* clinical and environmental isolates, using whole genome sequencing.

Discussion

Detection of *L. longbeachae* infection is unusual in Europe with 43 cases reported to the European Surveillance System (Tessy) between 2005 and 2012 (personal communication, Encarna Gimenez, September 2013). Diagnosis of Legionnaires' disease in the European Union relies heavily on urinary antigen testing that does not detect *L. longbeachae*. Culture has always been the gold standard for the definitive diagnosis of Legionnaires' disease [3]. However, *Legionella* culture requires specific laboratory media and expertise; it may miss cases that would be detected by PCR [4] and results may not be available in a timely manner to allow effective clinical and public health action. Detection of the four Lothian cases relied on the local diagnostic service using a *Legionella* species PCR test, a test which, to our knowledge, no other diagnostic laboratory in the UK uses. In addition to culture and PCR, a four-fold change in titre to a *L. longbeachae* specific antibody was seen in the three cases from whom sufficient samples were taken. Serological diagnosis of Legionnaires' disease for serogroups and species other than *L. pneumophila* serogroup 1 has never been fully validated because of the rarity of these infections. However, in cases of severe Legionnaires' disease, a *Legionella* species-specific positive PCR and a greater than four-fold rise in titre to a particular *Legionella* species, have helped to verify the causative organism. These data support the growing suspicion that *L. longbeachae* infection is under-ascertained in Scotland and probably across Europe. Following detection of this cluster, Public Health England has implemented a *Legionella* species PCR test in the National Reference Laboratory for a trial period. Assessment of this should take into account the possible seasonal nature of *L. longbeachae* infections, coinciding with seasonal use of growing media. It is also recommended that national surveillance units consider ways of raising awareness amongst frontline clinical staff, to consider the diagnosis of Legionnaires' disease (including non-pneumophila species infections) in those with community-acquired pneumonia.

L. longbeachae infection accounts for approximately half of all cases of Legionnaires' disease in Australia [5] and New Zealand [6], where growing media is peat-free and a major component is composted green material such as pine woodchip and bark. Predominantly peat-based growing media is used in Europe and this is likely to be a low risk for *L. longbeachae* contamination. In the UK, there is political pressure and legislation in

place to reduce the volume of peat used in growing media to preserve peat stocks [7]. As peat is phased out, the volume of composted green material in growing media will increase. It is therefore likely that we will see increasing numbers of cases of Legionnaires' disease caused by *L. longbeachae* infection, providing that we can detect them.

No single source of contaminated growing media could be identified in this cluster, which supports research findings that *L. longbeachae* is ubiquitous in soils and growing media [8,9]. Growing media manufactured in the UK for retail is required to meet manufacturing standards (PAS 100 [10]) which includes some microbiological testing, but not testing for *Legionella* bacteria. As in many other infections, a combination of infectious dose, mode of infection and host susceptibility is likely to influence outcome. It is not clear whether clinical infection follows inhalation of a particular infectious dose of bacteria, or at which stage in the manufacturing and/or retail process a bacterial load might be reached which poses a risk to susceptible individuals. It is possible that higher concentrations of *Legionella* bacteria develop during storage of growing media prior to use. All of the cases in this cluster with exposure to growing media had stored bags of growing media in their home or in sheds or other enclosed spaces. It is possible that the unusually warm summer in Scotland in 2013 caused a rise in temperature of the growing media during the day whilst being protected from cool nights indoors, providing opportunity for the *Legionella* to grow and resulting in a higher than usual concentration of these organisms in the product.

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Conflict of interest

None declared.

Authors' contributions

All authors contributed to the writing of this manuscript and approved the final version.

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