



Death trap? Spa pools have long been associated with life-threatening diseases.

# Could you cause a legionnaires' outbreak?



*Despite years of warnings, spa pools, hot tubs – and swimming pools – still cause life-threatening diseases, says the Health Protection Agency's Dr Susanne Surman*

## Background

Several infections have been associated with the use of hot tubs and spa pools. These include those caused by *pseudomonas aeruginosa*, *legionella pneumophila* and, more recently, *mycobacterium* species particularly *mycobacterium avium*.

*Ps.aeruginosa* (folliculitis) was first associated with low disinfectant levels in spa-pools in the United States in the 1975. I find it amazing that we

have known that these pools can and do cause infections for more than 30 years, and that we know that poor design and management are to blame.

Yet, since then in the UK, we have had outbreaks of folliculitis and cases of legionnaire's disease, including some deaths, associated with hot tubs. They have also been linked with leisure facilities, including a large outbreak linked to a hotel in the West Country in 2003, with 20 cases and two deaths.

## Spa Pools

For the past 10 years, a large percentage of my time has been spent on investigating and advising on problems associated with spa pools, including the hot tub variety found in domestic premises. My interest began while investigating a hot tub which caused an outbreak of pseudomonas folliculitis in one adult and four children who had used their grandparents' new hot tub.

This tub, which had been owned for only 13 days, had been purchased from a garden centre where it had been on display, and was installed by the supplier. The owner, a former microbiology technician, had followed the cleaning and disinfection regime – which included silver ionisation with sodium persulphate, ozone and chlorine – very carefully and as specified by the American manufacturers.

The day after using the hot tub, the children developed a rash which was eventually diagnosed as pseudomonas folliculitis. Samples of water revealed not only high numbers of *pseudomonas aeruginosa* ( $8.0 \times 10^4$ - $5.5 \times 10^5$  CfU/100mls) which matched the patients' strain but also high counts of *legionella* ( $2.9 \times 10^5$  cfu/litre *legionella pneumophila* 2-14). Remedial action included emptying the pool and shock dosing following the manufacturer's instructions and resampling which showed an initial drop in pseudomonas counts to 16-45 cfu / 100mls. Twenty-three hours after treatment, however, the levels had risen to  $6.1 \times 10^4$ cfu/100mls and after two days to  $3 \times 10^6$  cfu / 100mls.

Although *Ps.aeruginosa-folliculitis* is unpleasant, it is not life-threatening in the normal population. But legionnaires' disease caused by *legionella* can, and does, cause deaths.

### Legionnaires' Disease

The largest recognised outbreak to date took place at a spa pool on display in the Netherlands in Westfrieze Flora, Bovenskarpel, 1999. Overall, there were 226 cases, with 28 deaths. The risk of infection was increased with time spent near a spa. Two spa pools on display were positive for patient type.

More recently, much time has been devoted to investigating the causes of poor microbiology results from spa pools, including legionella-positive results. Most spa pools are in local authority-enforced premises and, over the past few years, much proactive work has been carried out by environmental health officers, with support from the Health Protection Agency, to increase awareness and safety of these pools, particularly among hoteliers and leisure/health club operators.

Environmental health practitioners, particularly in London and the south east, the north west and, more recently, Norfolk have inspected spa pools. They have looked at training, particularly with regard to *legionella* awareness, watched poolside tests being performed and looked at management, including cleaning and disinfection, frequency of water replacement and sampling, both for microbiology, and to carry out poolside tests for pH and active biocide.

### Bromine Issues

From the hundreds of samples we have tested, poor results are more likely to be from commercial spa pools. These are spa pools that are open to the general public, whether in a hotel, leisure club or health club. And these poor results are more likely when the pool is treated with bromine.

This is a worrying finding, because bromine has often been the disinfectant of choice for operators because of its ease of application. It is available in tablet form and is less demanding in terms of pH control. In addition, combined bromine, unlike combined chlorine, is still an effective disinfectant.

Further work is needed to establish whether the problem is caused by the manner of application as opposed to the inherent properties of the disinfectant. Another important factor in spa pool management is that in many places, especially in hotels, leisure complex staff often do not stay long in one place and keeping staff competent to monitor and respond to poolside test results is an ongoing problem.

There is a relationship between poor spa pool microbiology results and how well the operators and managers are trained.

There are now online courses available through ISRM which, if used, would make basic training more consistent. These could be followed up with more intensive training through various sources.

### DID YOU KNOW?

- Legionella is named after the first recognised outbreak among the members of the 58th state convention of the American Pennsylvania Legion in July 1976.
- Legionella pneumophila is the organism most often associated with causing outbreaks of a legionnaires' disease. Pneumophila means 'lung-loving'.
- Legionnaires' disease may result in the death of approximately 12 per cent of those affected.

### How Does Legionnaires' Disease Develop?

*Legionella* is a micro-organism that can grow, if the conditions are favourable, in artificial water systems, including water-cooled air conditioning systems and hot and cold water distribution systems in buildings and spa pools.

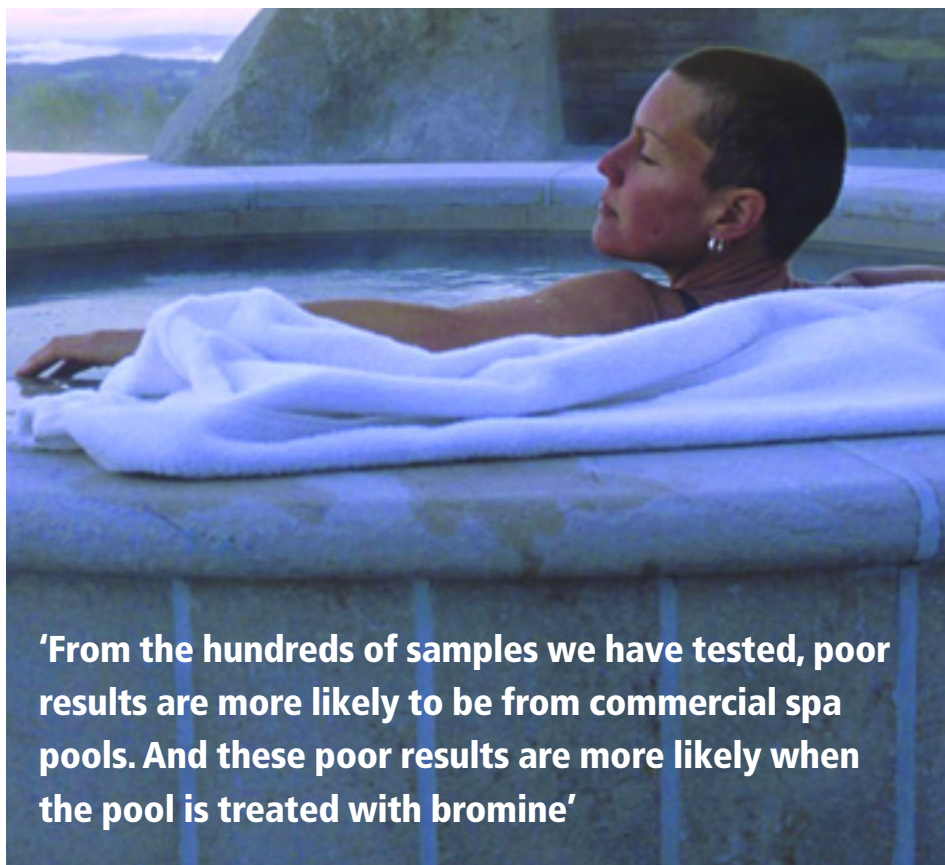
*Legionella pneumophila* is the organism most often associated with causing outbreaks of a severe form of pneumonia called Legionnaires' disease (LD), which may result in the death of approximately 12 per cent of those affected.

The rate of infection is low; generally, fewer than one in 100 of people who are exposed will become ill with LD, although some people may become ill with a milder form of the disease called Pontiac fever. This is similar to flu, does not require treatment and lasts only a few days.

Some people are more susceptible than others and approximately three times more men than women are likely to be infected. Those with suppressed immune systems, such as those on post-transplant therapy, high-dose steroids or who have chronic underlying disease, are considered to be a high risk for acquiring legionnaires' disease.

*Legionella* grows in warm water between 25 °C and 42 °C, especially if there are areas of stagnation, available nutrients, scale and sediment present. Other micro-organisms present in the system support the growth of legionellae by providing a food source.

*Legionella* capable of causing infections in humans may also infect and grow within protozoa



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such as amoebae, or within a slime layer of other microorganisms, known as a biofilm, which stick and grow on the surfaces within water systems. These surfaces include, for example, pipework carrying water, balance tank surfaces and, in spa pools, the humid surfaces of the air channels and/or pipework.

Legionnaires' disease is usually acquired by inhalation of aerosols containing *legionella* bacteria. Aerosols can be formed, for example, by water hitting a hard surface, such as a tap running on a wash-hand basin, by running a shower or by bubbles rising to the surface and bursting, flushing a toilet, wave formation and water running over a pack in a cooling tower.

*Legionella* contained in such aerosols can survive for prolonged periods of time and, if outdoors, may travel several kilometres, particularly if the conditions are favourable, such as in areas of high humidity.

Either negligence or ignorance – or both – are the main reasons why outbreaks occur. Water systems that are not appropriately designed, installed and maintained or adequately controlled, allow bacteria such as *legionella* and *pseudomonas*

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SOURCE	NO.	CASES LD	CASES PF	DEATHS
Cooling tower / evaporative condenser	31	493	49	56
Hot water system	25	72	0	20
Spa pool	6	55	7	3
Cold & hot water systems	3	11	0	4
Cold water system	4	8	1	2
Hot water system & cooling tower	1	8	0	3
Humidifier (food display)	1	7	0	2
Cooling tower & cold water system	1	3	0	0
Hot water system & spa pool	1	2	0	1
Not known	71	211	16	29
<b>TOTAL</b>	<b>144</b>	<b>870</b>	<b>73</b>	<b>120</b>

Table 1 Outbreaks by Source (Data from the Health Protection Agency Centre for Infections)

to grow to sufficient numbers to cause a range of infections in humans which can be life threatening.

There is no way of determining when you enter a building such as a hotel, health club or leisure centre whether there are legionellae in the atmosphere. You do not have to use a water system contaminated with legionellae to become infected; just passing by a system that is producing aerosols containing *legionella* is sufficient. Large outbreaks occur and people do die from legionnaires' disease.

#### Legionella in swimming pools

There are no recorded outbreaks of LD directly associated with bathing in a swimming pool, although *legionella* has been isolated from swimming pool water and filters. In Germany, the presence of *legionella* is used as an indicator of inadequate treatment.

If swimming pools are properly maintained, the risk of infection is low. However, there have been cases of legionnaires' disease associated with water distribution systems in leisure facilities as some local authorities know to their cost. Every facility open to the public or where there are five or more employees must have a competent person who takes responsibility for ensuring *legionella* is controlled within their premises. Every use of water within the facility must be assessed to determine whether it poses a risk for *legionella* infection and appropriate measures must be implemented and maintained to control this risk.

In leisure facilities, the spa pool usually poses the highest risk of users and visitors catching LD. In England, spa pools (including hot tubs) are the third most common cause of outbreaks after cooling towers and hot water systems (Table 1).

Sitting in a spa pool should be a relaxing experience. It can have some beneficial effects, such as relieving painful joints and muscles. But in order to avoid unpleasant effects following use of a poorly-maintained spa pool, these pools must be continuously treated, be monitored at

a minimum of every two hours during use and be regularly maintained and cleaned.

Spa pools have a small volume of water relative to the number of users and, because users rarely follow the guidance on the poolside to shower before use, maintaining an effective disinfectant residual offers a real challenge to operators. The risk of poor water quality is increased because spa pools operate at a temperature range which is also ideal for legionellae growth – generally between 35 °C and 42 °C.

*Management of Spa Pools* is a new guidance document put together jointly by the Health and Safety Executive and the Health Protection Agency. This gives detailed information on design, installation and safe ongoing management. It is primarily aimed at commercial overflow type pools, describing what is deemed to be 'best practice' by the team which included representatives not only from the HSE and Health Protection Agency but also from the spa industry trade associations, the Pool Water Treatment Advisory Group (PWTAG), local and central government, representatives from ISRM and CIEH and specialist consultants.

As domestic ownership of hot tubs has increased dramatically in the past few years, with around 15,000 installed in private homes last year, the guidance also contains some useful information for private owners.

#### FURTHER INFORMATION



The joint guidance from the Health and Safety Executive and Health Protection Agency is called 'Management of Spa Pools: Controlling the Risk of Infection'. It can be purchased from the Health Protection Agency or downloaded from [www.hpa.org.uk](http://www.hpa.org.uk)