

▶ Controlling Legionella

The issues and compliance advice for
air conditioning and water systems maintenance

ECGFS
FACILITIES SERVICES

Executive Summary

Potentially fatal Legionella bacteria and similar hazards in air conditioning and water systems present a health risk to employees and visitors of affected premises.

Employers, managers and responsible persons face prosecution if they fail to comply with UK legislation on the subject. Maintenance training is essential to control Legionella and other water-borne hazards in air conditioning and water systems. Many workplaces and public spaces are potentially at risk, and the health consequences, including the likelihood of fatalities, increase in facilities where people may have impaired immunity, such as hospitals and care homes.

It is crucial that facilities managers are aware of the dangers and have effective processes in place to mitigate them to ensure the health and wellbeing of building users as well as compliance with legislation.

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Introduction:

How artificial water systems allow bacteria to thrive

At the time of writing, 12 people had died and more than 120 were sick from a 2015 outbreak of Legionnaires' disease in New York's South Bronx.

While investigations focussed on the Opera House Hotel, health officials have tested more than 135 other buildings, discovering the Legionella bacteria in the cooling towers of 20 of them (around one in seven).

Legionnaires' disease has an exotic reputation, but it is not uncommon. In England and Wales, cases number around 300 annually, including infections contracted abroad. The disease is not, as might be supposed, related to the French Foreign Legion but instead acquired its name from the first recorded outbreak in Philadelphia in 1976 at a convention of the American Legion, the US equivalent of the Royal British Legion. More than one in ten of the 2,000 delegates at that convention contracted the disease, and 34 died. Nor is Legionnaires' disease a mysterious or rare plague. It is, in fact, a common form of severe pneumonia, but may not be diagnosed in many cases due to a lack of clinical awareness, so there are likely to be substantially more cases than are reported.

Legionnaires' disease is one of a number of infections, collectively named legionellosis, caused by Legionella pneumophila and related bacteria, legionellae.

The severity of illnesses caused by these bacteria varies from mild fever to the potentially fatal Legionnaires' disease. Anyone may be affected, but age, illness, impaired immune system and risk factors, such as smoking, put certain people at particular risk.

The bacteria breeds in water and causes respiratory disease in humans when a susceptible host either inhales aerosolised water or, in rare cases, aspirates water containing the bacteria. Symptoms include fever, non-productive cough, headache, myalgia, rigors, dyspnoea, diarrhoea and delirium. As the 2015 Bronx case suggests, the causal bacteria are widespread in water systems. However, detection is not easy.

Any building with a water system can provide the conditions the bacteria need to multiply, with numerous cases attributed to cooling towers and evaporative condensers, which allow the bacteria to take to the air in water droplets. Distributed water (including 13 to 17 per cent of mains water) is likely to contain some microorganisms, including legionellae, which find their way into buildings' water systems. Once they have penetrated the artificial environments of water systems in buildings and cooling towers, they may find the particular conditions they require for growth.

Fact

Risk factors identified by the WHO that can promote the proliferation of legionellae

- TEMPERATURE
- WATER QUALITY
- DESIGN
- MATERIAL USED IN CONSTRUCTION
- PRESENCE OF BIOFILMS

Fact

High risk facilities

- **Healthcare facilities:** Pre-existing medical conditions increase the chances of contracting, and dying from, Legionnaires' disease with up to 40 per cent mortality. Piped hot and cold water systems have been responsible for many incidents, as well as cooling towers.
- **Hotels:** Large, complex and subject to seasonal use, the piped water systems of hotels are prone to legionellae.
- **Ships:** With the same problems as hotels, ships are also self-contained systems where airborne infections may spread. Cruise ships also often include spas and pools (see below).
- **Natural spas, hot tubs and swimming pools:** With their warm water and concentrated numbers of human users, hot tubs are fertile breeding grounds for legionellae and, along with natural spas, have been responsible for numerous outbreaks. Showers near pools also present a risk.

The bacterium *Legionella pneumophila* can withstand temperatures of 50°C for several hours, but does not multiply below 20°C. So the presence of *Legionella* in certain artificial aquatic environments, which can be assumed to be likely, combined with warm temperatures increases the risk of Legionnaires' disease. Biofilms, thin layers of microorganisms that cling to surfaces in water systems, also help the bacteria to thrive.



For business owners and managers as well as responsible individuals, failing to comply with health and safety legislation related to the control of legionella could result in substantial penalties, including unlimited fines, court costs, compensation claims, disqualification and up to two years' in prison. Basildon and Thurrock University Hospitals NHS Foundation Trust was ordered to pay £350,000 in fines and costs for safety failings, including an incident in which seven patients were infected with legionella from the hospital's water system. One man died as a direct result of Legionnaires' disease, and it contributed to the death of another man. Another five patients and a hospital visitor were infected between 2006 and 2010.

Even if poor housekeeping has not resulted in an infection, organisations face prosecution if they fail to adequately maintain systems to prevent the risk. Fines and costs totalling nearly £250,000 were imposed on two firms in the West Midlands after workers and members of the public were put at risk of exposure to the bacteria.

So it is clear legionellae and other bacteria in the water systems of buildings present a potentially serious risk to health, lives, businesses and reputations. Since proper maintenance has been identified as the single most effective action to negate the risk, why do cases continue to occur?

Confirmed Cases of
Legionnaires' disease
in England and Wales

2010 : 357

2011 : 235

2012 : 306

2013 : 285

2014 : 331



Legionella:

The problem with air conditioning and water systems maintenance

Left alone in their natural freshwater environments, the legionellae group of bacteria would present little risk to humans. However, in artificial aquatic environments where the water temperature rises above ambient, it is a different story.

Legionnaires' disease is considered preventable by controlling the causal bacteria in the locations where they could otherwise thrive.

The opportunity to impact on health and the risk of culpability for an outbreak heightens its significance for public health professionals and anyone involved in, or responsible for, maintaining water systems in buildings. Internationally, the World Health Organisation (WHO) has published guidelines, as have the Health and Safety Executive in the UK.

Nevertheless, it is still uncertain exactly how outbreaks occur.

The known factors are:

- **The bacteria are present in an aquatic environment**
- **They grow to a level that is infectious (though it is not known what that level is)**
- **They are carried via aerosol to a human host that is susceptible to infection.**

The World Health Organisation recommends focusing on preventing both proliferation and exposure with control measures.

- **Source water quality**
- **Treatment of source water**
- **Design of systems to prevent stagnation**
- **Control of temperature to minimise proliferation.**

Fact

Major outbreaks of legionellosis

- **April 1985, Stafford, England:** 175 people admitted to hospital with chest infection or pneumonia. 28 die. Source traced to air-conditioning cooling tower on roof of Stafford District Hospital.
- **March 1999, Bovenkarspel, Netherlands:** 318 people become ill at Westfriese Flora flower exhibition. At least 32 confirmed dead.
- **July 2001, Murcia, Spain:** The world's largest outbreak. More than 800 suspected cases. At least 16,000 people exposed to the bacterium. Six die.
- **September 2005, Canada:** 127 nursing home residents become ill. 21 die in first week. Source traced to air-conditioning cooling towers on the nursing home's roof.
- **November 2014, Vila France, Portugal:** 302 people hospitalised. Seven related deaths. Cooling towers of fertiliser plant are suspected source.

HUMAN ERROR

Imperfect procedures, carelessness and a lack of appreciation of the real risk presented may all contribute to a failed maintenance programme. Where systems are complex or where they are a peripheral responsibility for individuals, a lack of knowledge of the risks and the causal processes involved would also appear to be a likely cause of problems.

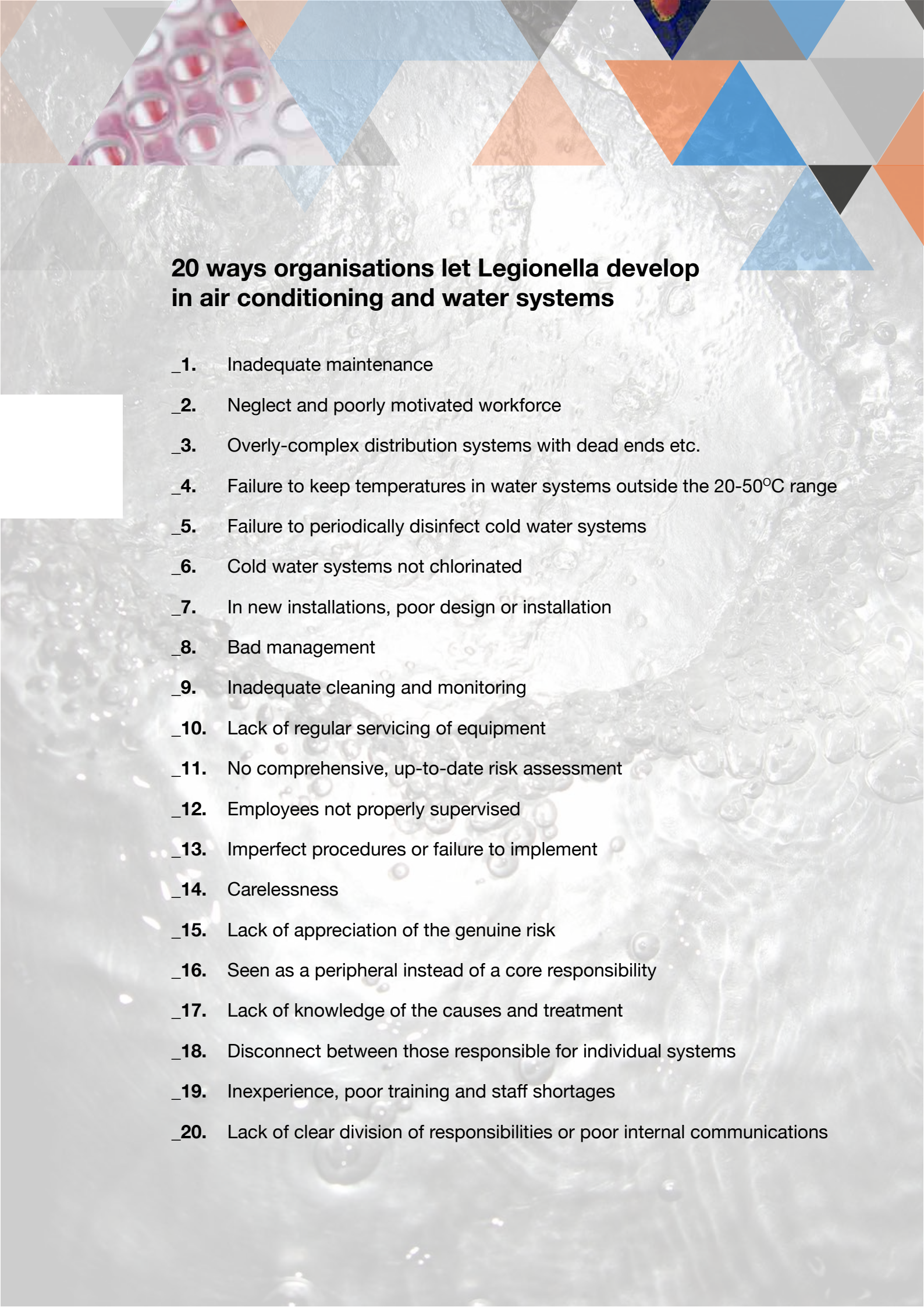
For example, individuals may form the opinion that cleaning a system once a year may be sufficient to eliminate risk, without realising that other factors such as water temperature and system design can also be very significant contributors to the proliferation of the bacteria.

Because outbreaks are commonly associated with systems for heat control, there is a risk from a disconnect between those responsible for the maintenance of thermal systems and their counterparts responsible for maintaining water systems. A lack of appreciation of the problem, or experience in control measures, on either side could lead to an issue developing, as could a breakdown in communication or lack of clear division of responsibilities.

It is worth noting that the bacteria and the disease present difficulties to scientists and medical professionals as well as those involved in, or responsible for, buildings and water systems maintenance. In the Canadian nursing home incident, first culture results were negative, which is not unusual, as *Legionella pneumophila* is a fastidious bacterium and cannot grow without specific nutrients and living conditions.

As noted earlier, it is believed there are many more cases of Legionnaire's disease because of its similarities to common pneumonia while other forms of legionellosis may not be diagnosed without appropriate tests for the bacterium responsible.





20 ways organisations let Legionella develop in air conditioning and water systems

- _1. Inadequate maintenance
- _2. Neglect and poorly motivated workforce
- _3. Overly-complex distribution systems with dead ends etc.
- _4. Failure to keep temperatures in water systems outside the 20-50°C range
- _5. Failure to periodically disinfect cold water systems
- _6. Cold water systems not chlorinated
- _7. In new installations, poor design or installation
- _8. Bad management
- _9. Inadequate cleaning and monitoring
- _10. Lack of regular servicing of equipment
- _11. No comprehensive, up-to-date risk assessment
- _12. Employees not properly supervised
- _13. Imperfect procedures or failure to implement
- _14. Carelessness
- _15. Lack of appreciation of the genuine risk
- _16. Seen as a peripheral instead of a core responsibility
- _17. Lack of knowledge of the causes and treatment
- _18. Disconnect between those responsible for individual systems
- _19. Inexperience, poor training and staff shortages
- _20. Lack of clear division of responsibilities or poor internal communications

Strategies to prevent legionella in air conditioning and water systems

It has been established that there are complex reasons for outbreaks of legionellosis, including the potentially deadly Legionnaire's Disease.

However, it is also clearly understood that the single most effective strategy to prevent bacteria developing is a programme of proper maintenance of water systems. To quote the World Health Organisation: *"The major risk factor for legionellae proliferation appears to be neglect or insufficient maintenance."*



Periodic major eruptions of the disease, such as the NYC 2015 outbreak, gain worldwide publicity, so it might be expected that building managers would be fully aware of the threat and have programmes in place to deal with them. This is especially true in the health sector where there is heightened awareness of hygiene risks following high profile incidences of MRSA and other bacterial infections.

Nevertheless, perhaps because it is some years since a major incident in the UK, it seems reasonable to suggest that management in many organisations are less aware of the risk and the steps required to mitigate it than they should be. In smaller organisations where there is no dedicated health and safety officer, that possibility is increased since premises management and health and safety as a whole will both be peripheral to the main management function of running the business. Under financial pressure, there is an increased likelihood for corner cutting.

Education is important, and to this end the UK government Health & Safety Executive publishes guidance for businesses and landlords on the subject and also publicises cases where it has brought prosecutions in both the private and public sector.



In organisations where management are ignorant or wilfully neglectful, there will be little appetite for solutions to the problem. In organisations that are concerned about the issue and wish to be sure that they take adequate steps to prevent an occurrence in their premises, maintenance is vital. **Studies of the causes of accidents have highlighted inappropriate systems of work, poor maintenance, use of defective materials, and poor supervision and training as key contributors. Inadequately trained operators have also been identified as a major reason for the prevalence of water quality incidents and disease outbreaks. Error management techniques put forward as solutions to the problem include selection, training, licensing and certification.**

It is clear that addressing these issues with appropriate management and technician training is imperative for building managers and anyone with a duty of care for at-risk premises.

To ensure adequate systems for maintenance and monitoring are in place, and to ensure compliance with legal responsibilities, it is necessary to implement procedures and documentation, which may include compliance with international standards. Again, it is self-evident that these procedures will not produce the desired outcome unless individuals with appropriate skills are available, tasked and motivated to implement them.

In order for management to be confident that the issue is fully addressed, they will need to ensure that they have effectively communicated with, motivated and delegated to their contractors, and that the contractors personnel is reliable and capable. In the latter instance, qualifications, ideally endorsed by HCOP8, can be used to evidence that the responsible person is adequately qualified, increasing management confidence levels.

The major risk factor for legionellae proliferation appears to be neglect or insufficient maintenance

[World Health Organisation](#)

Business benefits of Water Hygiene preventative maintenance with ECGFS

Legionellosis is a real risk to health in any premises with water systems and air conditioning. Additionally, organisations in the UK that fail to have appropriate risk management and maintenance procedures in place are at risk of prosecution. So it is imperative that a fully trained and properly supervised maintenance team is in place to ensure safe operation of air conditioning and water systems.

Effective maintenance is proven to substantially reduce the risk of legionellosis in premises and equipment. Effective maintenance also delivers real and measurable business benefits with more efficient operation and longer system life of systems and equipment. It also protects organisations and individuals with a duty of care from prosecution or civil claims.

- **Health and safety of staff and visitors**
- **More efficient operation of systems and equipment**
- **Modern maintenance techniques for more cost effective hygiene**
- **Compliance with health and safety legislation**
- **Longer system life**
- **Quality assurance**
- **Avoidance of prosecution and/or civil claims**
- **Flexibility of delivery and location for cost effectiveness**
- **Online tracking for effective, ongoing delivery**





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