CASE STUDIES

EFFECTIVE LEGIONELLAE CONTROL AT THE ACADEMIC HOSPITAL SAINT-LUC, BRUSSELS

Organisations involved

Cliniques universitaires Saint-Luc, Brussels, Belgium

Description of the case

3.1. Introduction

The Cliniques Universitaires Saint-Luc is a non-profit (ASBL; *association sans but lucratif*) hospital (housed in a nine-storey building in east Brussels. In 2009 there were about 5,200 employees working there (Picture 1). Normally, hospitals have large and complex water supply systems. They also include large storage tanks for hot water, which can be a potential source of legionellaa. In the lower part of hot water tanks, sediments and sludge with a high microbiological load can accumulate. This may also contain legionella.

Legionella poses a higher risk in hospitals and healthcare facilities than in other large buildings. This is because they have higher numbers of immunocompromised people. Legionella bacteria can also affect healthy people, however, and staff involved in maintaining and cleaning the water supply system, showers, taps, whirlpools and spa baths, have an increased risk of infection.

The domestic hot water system in hospitals is the greatest risk source of infection with legionella for patients, staff, and maintenance personnel. According to a survey, hospital-acquired *Legionella* pneumonia has a fatality rate of 28% [1]. The principal route of transmission is by inhalation of contaminated aerosols from e.g. taps, showers, cooling towers, respirators, and fountains.

Picture 1: Saint-Luc Academic Hospital (Cliniques universitaires Saint-Luc), Brussels

Source: Cliniques universitaires Saint-Luc

In Belgium about 40% of all large hot water supply systems (e.g. in blocks of flats, swimming pools, retirement and nursing homes, and hospitals) are contaminated with legionella [2]. According to a 2002 report by the Belgian Public Health Board (Conseil Supérieur d'Hygiène), five of out of eight hospitals in Belgium were contaminated with legionella [3].

The Saint-Luc hospital implemented effective control measures to prevent legionella contamination of its water supply system. The hospital now uses a chemical method to disinfect its hot water.

Water disinfection can be carried out with various chemical substances, which are used to kill or deactivate pathogenic microorganisms. Chlorine is present in disinfected drinking water at concentrations between 0.2 and 1 mg/litre [4]. It is added to water as chlorine gas, calcium hypochlorite or sodium hypochlorite. Some EU countries use alternatives such as ozone or chlorine dioxide.

3.2. Aims

Preventing Legionellae contamination of the warm water system in the Belgian Academic Hospital Saint- Luc in Brussels.

3.3. What was done, and how?

The Saint-Luc hospital was founded in 1976. In the 1980s the hospital had some outbreaks of legionellosis due to its water system. Legionella pneumophila serogroup 6 was the predominant cause of nosocomial legionellosis in 15 sporadic cases in immunocompromised patients from 1981 to 1987. Researchers at the hospital started to investigate the potential source of Legionella spp. in order to better understand the transmission routes of legionellae to hospitalised patients and to develop control measures [5]. Since then, several control measures have been put into force and tested.

In 2004 the hospital used a thermal disinfection method of the hot water supply system. The water was heated up to 70 °C throughout the whole supply system, including the tapping points. This was organised and controlled by the internal technical service and carried out only at night to prevent burns and scalding caused by the hot water. Four plumbers went to the tenth floor and opened all the taps for five to 30 minutes. Then they went downstairs and repeated the procedure on each floor [6]. This helped reduce the numbers of legionella in the hot water supply system. Nevertheless, the effect was not long-lasting, because most of the pipes in the supply system were about 27 years old and this method was unable to remove biofilm that had formed in them. The legionella began to proliferate again. Another problem was that the very hot water flushed through the pipes affected the piping material.

The analyses of the water quality showed a legionella level higher than 4,000 CFU (colony forming units) per litre of water. Flemish legislation stipulates that levels higher than 1,000 CFU/l legionella in the water supply system in high-risk sectors (e.g. hospitals) require prevention measures [7] (it is assumed that the legislation will be harmonised in Flanders and Wallonia [7]). Flemish legislation stipulates prevention measures based on thermal disinfection. Thermal disinfection by shock is based on heating the hot-water pipeline system up to ≥ 80 ° C and running all taps for at least 30 minutes. This procedure is not recommended for facilities where water is needed 24 hours a day (e.g. hospitals). The chance of burn injuries is too high in such facilities [9].

The Flemish legislation on *Legionella* (*Arrêté du Gouvernement flamand relatif à la prévention de la maladie du légionnaire dans des espaces accessibles au public*) prescribes additional alternative control measures that may include:

- Disinfection with chlorine dioxide

- Disinfection with UV rays

- Disinfection with electrolysis.

Dr Anne Simon, hygienist at Saint-Luc hospital, decided, in cooperation with the technical and finance departments, to install a new system based on chemical disinfection with chlorine dioxide, bought from Danish water treatment specialists Guldager. Before the chemical disinfection system was installed, the water in the piping system was analysed to determine its compatibility with the chemicals concerned. It was confirmed that the existing piping system is resistant to an average chlorine dioxide concentration of 0.5 ppm, a water temperature of 70 °C, and a pressure of 9 bars during a 24-hour operation [10].

Because of the close cooperation and the active involvement of all those involved, no problems arose during the implementation of the new system.

Picture 2: The pumps of the water supply system, with entry point for chlorine dioxide (see arrow).

Source: Cliniques universitaires Saint-Luc

Chlorine dioxide is an oxidising biocide that kills microorganisms effectively. It has a double effect in the prevention and control of legionella:

1. Chlorine dioxide is able to destroy and prevent the development of biofilms inside the pipes even when the piping system is old.
2. It rids the water of legionella and controls legionella growth very effectively.

Additional advantages of the disinfection method with chlorine dioxide (in comparison to that with chlorine) are as follows:

1. The bactericidal effect is relatively independent from pH values,
2. Chlorine dioxide has better solubility,
3. No corrosive effect,
4. No formation of chloramines
5. No negative effect on odour and flavour of drinking water

The chemical disinfection at Saint-Luc is done with an automatic chlorine dioxide dosing unit that was easily fitted to the existing piping system [11]. It is based on two chemicals: a saturated solution of oxy chlorine and a solution of blended inorganic acids. By mixing these chemicals, chlorine dioxide is produced according to the requirements (Picture 3). The concentration of chlorine dioxide needed for effective disinfection (0.5 ml/l on average) is much lower than that needed for disinfection with chlorine. Although chlorine dioxide is a potentially dangerous chemical, the concentrations used at the hospital are below current thresholds and the benefits clearly outweigh the risks. After the new control measure was implemented, no legionella could be detected. The risk for maintenance personnel, patients and residents of being infected by *Legionella* bacteria fell to almost zero.

The technical department, in collaboration with the hygienist responsible for the hospital, conducted a risk assessment for legionella, based on HACCP (hazard analysis critical control point).

Picture 3: Tanks with the two chemicals needed for the disinfection,

Source: Cliniques universitaires Saint-Luc

3.4. What was achieved?

Before the new system was installed, analyses of the hot water in the hospital showed about 4,000 CFU/l. After the new control measure was implemented, no legionellaa could be detected. It had achieved:

- Reliable elimination of legionella and other germs
- Elimination of microbiological sludge in the piping system
- Control of *Legionella* and other bacteria without interruption of the daily water supply

3.5. Success factors

After installing the new method based on the chemical disinfection chlorine dioxide, no Legionella was detected.
The prompt and convincing result of this method was may be the main success factor.
The chlorine dioxide system was relatively easy to dose and to install.

3.6. Further information

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3.7. Transferability

The control measure through an automatic chlorine dioxide dosing unit can be easily installed in the hot water supply system.

3.8. Abstract

The Saint-Luc hospital in Belgium has a long history regarding the prevention of legionella growth in the warm water supply system. Since 1980 the hospital has installed and tested different control measures with varying degrees of success. The new method of chemical disinfection with chlorine dioxide is so successful; however, that legionella is no longer detectable at all in the hot water. The automatic dosing unit for chlorine dioxide is easily to install and to maintain. The concentration of chlorine dioxide complies with the legal requirements of Flemish law.

4. References, resources

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See also clinic website: http://www.saintluc.be/institution/index.php

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