Scientists raise alarm over today's measures against Legionellosis

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Catrine Ahlén has been doing research on the problem of legionella bacteria at sea since 2004. Credit: Thor Nielsen

According to the textbooks, both high doses of chlorine and hot water are lethal to legionella bacteria. But now Norwegian scientists are sounding the alarm that the bacteria can survive these treatments, by hiding in amoebae.

Legionella bacteria can cause deadly pneumonia via our shower water. On the basis of her own recent findings, SINTEF scientist Catrine Ahlén warns that we should not blindly assume that the measures recommended to deal with legionella infections in water systems always work.

Mystery solved

The number of cases of legionellosis, or Legionnaires' disease, has increased in Europe during the past few years, at the same time as a mystery has been building up; on board ships and in buildings all over the world, the feared bacteria have repeatedly turned up in tap-water, in spite of the recommended high doses of chlorine and hot-water treatments that have been implemented – measures that these bacteria don't normally survive.

But now the mystery appears to have been solved.

Time to extend emergency preparedness

For the past three years, Catrine Ahlén has been collaborating with the Royal Norwegian Navy and her own colleagues at SINTEF and NTNU in systematic studies of how legionella problems arise and remain in ships' water systems.

In the samples from the navy ships, the SINTEF senior scientist found evidence that the bacteria had survived the recommended treatment by using the amoebae as a shield, something that had not previously been demonstrated in a water supply system.

Chlorine and hot water kill legionella, but not amoebae, so Ahlén now strongly recommends that our contingency planning for legionella outbreaks should be extended to include the demonstration and

elimination of amoebae, both at sea and ashore.

Old water pipes

On land, legionella bacteria are tend to be found in the water supply of hotels, sports halls and swimming baths, and of institutions like hospitals and nursing homes.

"The Norwegian water supply system is old. The pipes contain huge amounts of internal fouling in the shape of biofilm, a slimy coating that offers amoebae first-class living conditions. The network can therefore spread amoebae, even though many purification systems at sources of drinking water are hypermodern," says Ahlén.

In view of her findings on behalf of the Navy, she therefore recommends that everyone whose tap-water has been shown to contain legionella should order a set of analyses that would show whether the water also contains amoebae.

Find themselves hosts

Amoebae are relatively large single-celled organisms. They normally eat bacteria, including legionella; in other words, they kill them. However, laboratory tests in the USA showed as long ago as 2000 that a few legionella bacteria do manage to survive and reproduce inside amoebae.

The research project with the Royal Norwegian Navy sampled water from 41 naval vessels. Half of them turned out to be infected by the species Legionella pneumophila (see fact-box). Ahlén and her colleagues also found amoebae in all the legionella-infected ships. What is more, legionella were found inside many of the amoebae.

"Our findings made it easy to realise that the bacteria would be able to survive and spread as soon as the chlorination process had finished. And not only that: the bacteria emerge from the amoebae in a new and even more dangerous form than they had when they sheltered there," says Ahlén.

Nasty "training camp"

For according to Ahlén, American studies have shown that the amoebae function as a training camp, where the legionella bacteria also learn to fight our bodies' immune defence system.

"The Americans saw that the bacteria that survive inside the amoebae manage to defend themselves against the cells that our immune defence system activates against infections. The increased threat to health makes it particularly important to extend our preparedness to deal with legionellosis by focussing on amoebae," says the SINTEF scientist.

Amoebae starve to death

On board the infected naval vessels, Ahlén and her colleagues have no launched a special water treatment process that starves the amoebae to death.

"This is a time-consuming treatment, and it will continue until all the Navy's ships are free of amoebae, and thus also free of legionella," says Ahlén.

Pioneering findings on bunkering

Catrine Ahlén has been doing research on the problem of legionella bacteria at sea since 2004. She says that vessels have been

overrepresented in reports of repeated outbreaks of legionellosis. Ahlén believes that she has identified the reason for this through the project for the Royal Norwegian Navy.

She explains that:

- When vessels bunker water, they do so via pipes that lead from a certified water-works, which may well lie several kilometres distant.
- These pipes may be lined with biofilm, a slimy coating in which bacteria grow.
- Amoebae are commonly found in biofilms.

"By developing new bunkering routines, such as introducing a hygienic barrier between pipe and vessel, we can reduce the risk of transferring amoebae to vessels, but no-one thought of that until we made these findings," says Ahlén.

She also believes that more establishments on land could upgrade their protection against outbreaks of Legionnaires' disease by thinking along similar lines.

Scientific publications

Together with her SINTEF colleague Marianne Aas, Professor Ole Jan Iversen and senior engineer Anne Nor of NTNU, and the Royal Norwegian Navy project group, Ahlén has published her findings in the Journal of the Norwegian Medical Association.

"Do you believe that amoebae are the problem in all water systems in which outbreaks of legionellosis keep recurring?"

"We have every reason to believe that amoebae play a key role. These

bacteria must have a host organism in which they can hide, enabling them to survive high doses of chlorine and/or heat treatment."

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