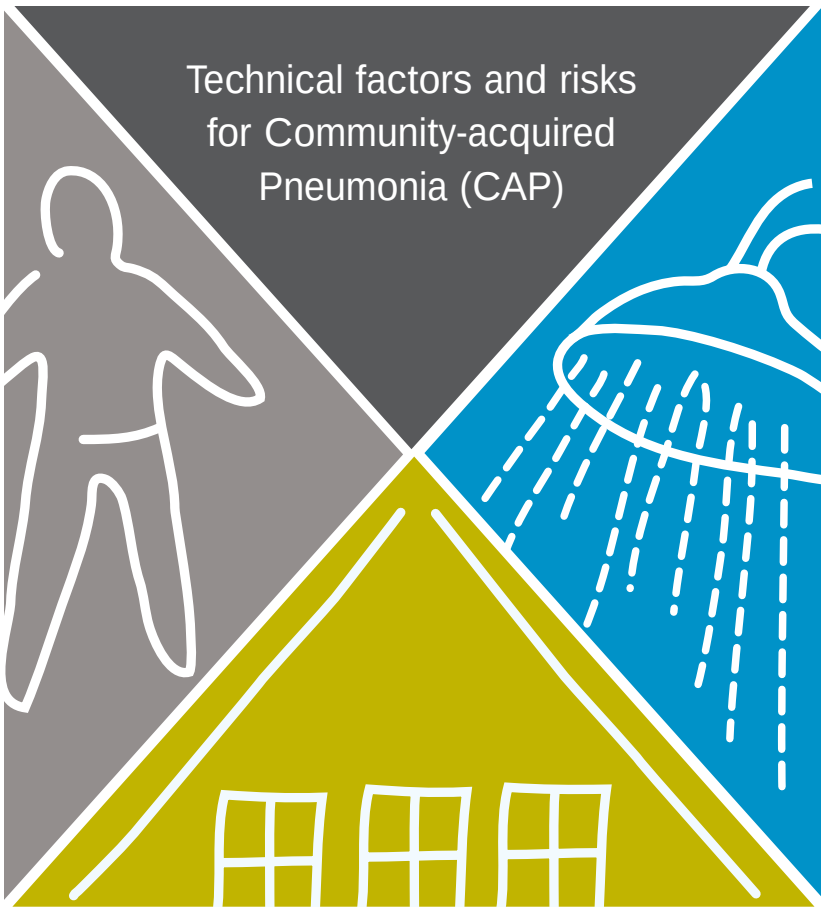


# Legionellae in water installations

(Excerpt in English)

Stockholm 2004-09-27

The National Board of Housing, Building and Planning
Swedish Institute for Infectious Disease Control
The Swedish Association of Contractors, Plumbing and HVAC

Boverket SMITTSKYDDSINSTITUTET VVS Installatörerna

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# 1 FOREWORD

Many public authorities and private organisations are affected by problems with legionella.

The National Board of Housing, Building and Planning, Swedish Institute for Infectious Disease Control (SMI) and The Swedish Association of Contractors, Plumbing and HVAC started a joint project in 2000 in order to shed light on some of the questions regarding legionella issues. The main purpose of this project was to identify those factors within the (physical) environment, which can promote the presence of legionellae in hot water systems and can, therefore, be considered hazardous to health.

## The Project Group

The following group ran project:

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# 2 SUMMARY

About 100 legionellae cases are reported in Sweden annually, which is, according to other studies, only one tenth of the real number. Majority of legionellosis is community-acquired; at work, on public premises or at home (CAP, Community-acquired pneumonia).

The National Board of Health and Welfare, in its ongoing work on recommendations for health care units and officials, has pointed out that there are still big gaps in knowledge about incidence, spreading and control of legionellae. The National Board of Housing, Building and Planning have also pointed out the lack of detailed guidelines for dwelling facilities regarding legionellae.

The main purpose of this project was to identify the factors within the (physical) environment, which can promote the growth of legionellae bacteria in hot water systems and can, consequently, be considered as a health risk.

This Report also includes the general background information on epidemiology and illnesses caused by legionellae bacteria. An earlier study conducted by SMI is also referred to in this Report. Collecting information and data about the occurrence of different types of water installations in Sweden was performed within the framework of this project. This material can be used for risk assessment and further discussions about consequences of measures and emerging demands. This Rapport also includes the overview of different regulations and responsibility areas of different authorities.

## 2.1 The set up of the Project

The project was separated in five sections:

- Retrospective investigation
- Development of routines for data collection and checklists for technical inventory.
- Prospective data collecting
- Work with and analysis of collected data
- Risk- and needs for prevention measures assessment

Under the course of this project 173 cases of legionellae infections were reported to SMI.

Out of those, 90 were considered as community-acquired and 43% of those (37/90) were included in this study.

The work on data collecting was performed by gathering the facts about water sources and chemical parameters as well as by water sampling and analysis.

Conducting a technical inventory of water installations at the affected buildings followed investigation of the source of the disease. The technical inventory was performed by using a specified checklist. This checklist was build upon the results from the retrospective investigation (review), upon the experience of persons skilled in legionellae-sanitation measures and upon the information gathered by literature review. The checklist adopts four different aspects of water installation in specific building:

- The data on the estate in question
- Administrative factors
- Factors related to the type of installation
- Factors related to temperature

Collecting of data has followed the routine as described below:

- Suspected legionellae case was reported by involved physician or municipal healthcare officials.
- Water was sampled and analysed in order to determine the source(s) of disease
- Technical inspection was conducted and collecting of data was performed
- When possible typing of environmental and patient isolates were performed for the purpose of comparison.

## 2.2 Results

In connection to 78 reported cases of legionellae infections in Sweden an investigation of contractive disease source(s) was followed by collecting the technical data and physical parameters.

Data collecting was conducted between 2002-07-01 and 2004-06-30 and resulted in technical investigations of 46 buildings where legionellae was confirmed. Data from 41 of those buildings have been analysed.

*Table 1. Out of 78 cases of investigations to localize a source of disease legionellae has been isolated from water samples in 46 buildings.*

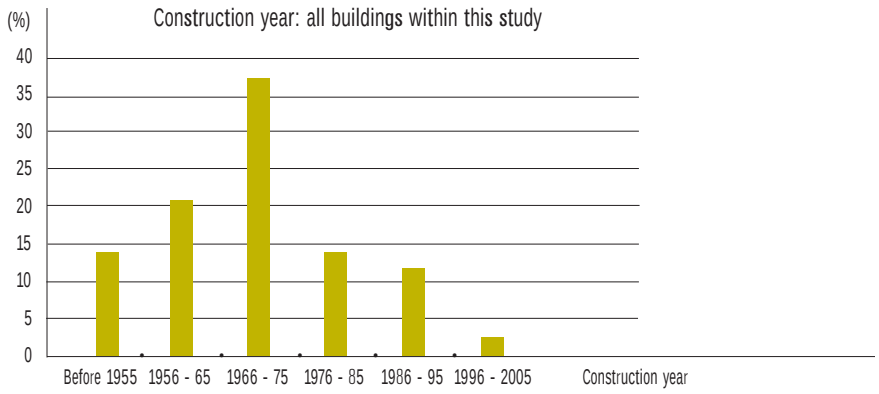
| | Homes | GYM | At work | Hotels | Physiotherapy Health care inst. | Legionellae found in |
|---|---|---|---|---|---|---|
| Number | 30 | 6 | 4 | 3 | 3 | 46 |
| (%) | (65) | (13) | (8) | (7) | (7) | |

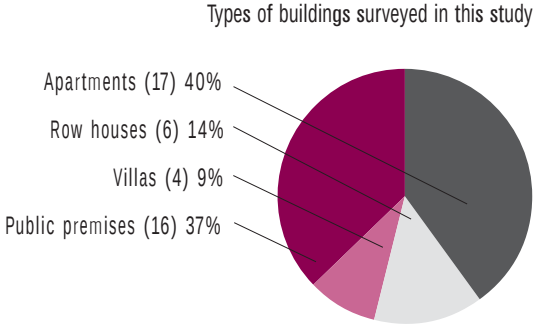
### Detection of legionellae

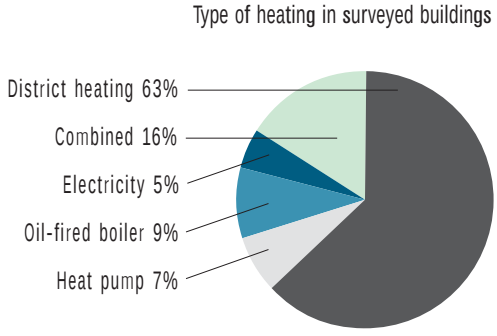
In 43/46 objects that underwent the investigation legionellae was found in hot water taps. Out of those – 39 legionella findings were related to showers. Usually, the numbers of legionellae were higher in immediate water samples. In 12 immediate samples that were positive for legionellae, legionellae was not found in post-flush water samples. Four bubble pools had very high numbers of legionellae (105 CFU/100 mL). In two cases legionellae was detected only in bubble pools.

## 2.2.1 Technical data

### Types of buildings



## Administrative factors

It was found that almost 50% of the surveyed buildings lack in trained drift personnel.

Records that would confirm that the temperature of tap hot water and Hot Water Circulation-systems (HWC-systems) was regularly measured have not been found in 90% of the surveyed buildings.

Instructions for drift and hot water production were missing in 60% of the surveyed buildings and in 70% of investigated small houses.

Technical drawings were missing in 60% of buildings. None of the small houses have such drawings whilst 50% of row houses and public premises could present technical drawings.


## Factors related to installations

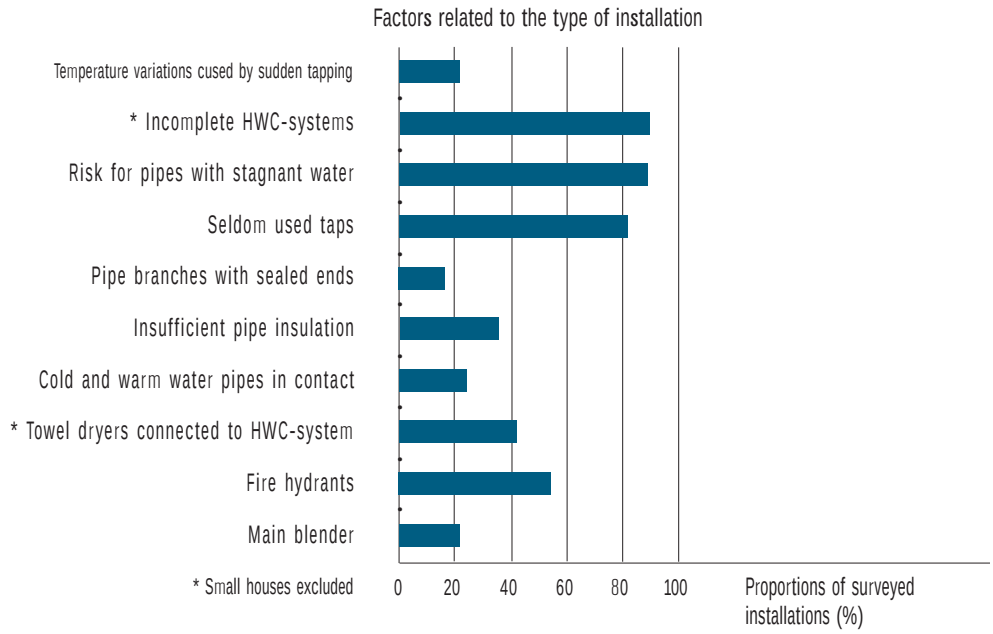
Installations with risk for stagnant water were found in 80% of investigated buildings.

With the exception for small houses HWC-systems were incomplete in almost 90% of investigated buildings.

Pipes for distribution of hot water were either in contact with pipes for distribution of cold water or had insufficient insulation in 25-35% of cases. In over 60% of investigated installations cold water could be warmed up to over 18°C.

Towel dryers were found to be connected to HWC-systems in 40-50% of public premises and apartments and 20% of row houses.

Significant temperature variations of hot water caused by sudden flushing (high rate of consumption) were estimated to occur in 60% of investigated public premises.



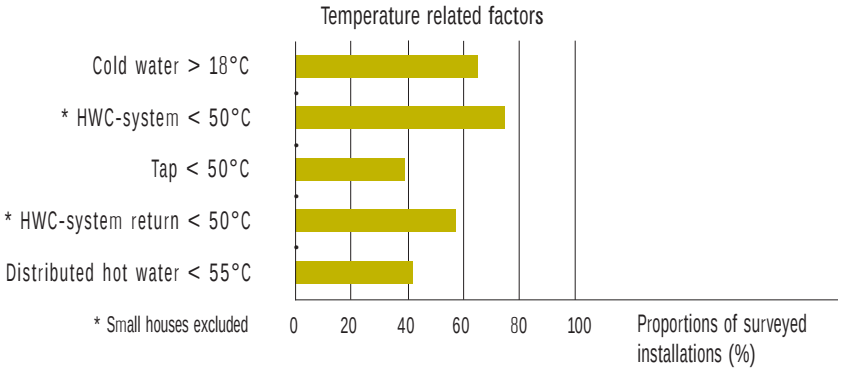

## Factors related to the temperature

Temperature of outcoming hot water lower than 55 oC was measured in 20% of row houses and apartments buildings and in 60% of public premises (40% overall).

All of the investigated small houses were found to have hot water temperature below 55°C.

This finding was the single major risk factor for legionellae growth. Corresponding findings for the temperature in return water in HWC-systems were 60% of row houses and apartments buildings and in 40% of public premises (60% overall).

It was estimated that in over 60% of all investigated buildings cold water could be warmed up to over 18°C.




### Bubble pools

One professional workout (GYM), one villa and two hotels had a bubble pool. In all these cases estate owners did not know how these pools should be maintained. Routines for maintenance as well as skilled drift personnel were missing in both hotels and the gym. Here the legionellae was found in very high numbers (>100 000 CFU/100ml).

## 2.2.2 Outcome of the collection of technical data

### Administrative factors

Instructions for drift work as a manual for installations' function and drift. They should clearly point out which temperature outcoming tap hot water and HWC-system's return pipe must have. There should also exist routine protocols for checking and adjustment of the temperature.

Many installation networks, particularly large ones, are quite complex constructions and any malfunction in such a systems is almost impossible to locate without having a detailed technical drawings and descriptions at hand.

All types of buildings should have drift instructions adjusted to the skills of drift personnel as well as updated technical drawings and descriptions. In the cases of small houses and smaller apartment buildings, real estate owner should be able to understand such documentation even if he/she does not have a particular knowledge on installations.

Well trained drift personnel represent a significantly high safety level when it comes to understanding the complex of temperature in hot water production, its distribution and also the importance of avoiding and dealing with segments of the system with stagnant water. Such personnel can easily respond to any malfunction, especially regarding

decrease of water temperature at any point of the system. This is very important since the users, which seldom use water warmer than 40°C, cannot detect low water temperature within the system.

To have skilled personnel is particularly important for complex installation systems like those in swimming centres and large apartment buildings.

### Factors related to the type of installation

Distribution pipes with stagnant water are often those pipes that are connected to no longer in use or even disengaged taps. Such sealed pipes are quite common in larger systems.

Apartments and other premises can be unoccupied for shorter or longer periods of time.

If older persons dwell in two floor houses they can stop use the upper floor facilities for various health related reasons. Installation in these places will stand still.

Within the pipes with stagnant water optimal growth temperature for legionellae occurs regularly. Low or non-flow at all also benefits the growth. This was established through earlier studies of legionellae issues.

HWC-system that functions well can easily provide with the hot water with temperature above 50°C in all distribution pipe braches, which significantly reduces the risks of legionellae growth.

In large installation networks HWC-systems are in use in order to shorten the time needed to actually deliver hot water at the point of use. Only in last decades the importance of HWC-systems in reducing the risks posed by legionellae has became clear.

Since the main function was just to shorten the time of delivery there are today many tap water installations where this system is in use for only a fraction of distribution pipes.

Since The National Board of Housing, Building and Planning have sharpen the demand on delivery time to 10 seconds, the importance of HWC-systems in for entire pipe network is now even more articulated.

Poorly insulated hot water pipes are warming up the cold water pipes directly as well as through the up warmed ambience. The closer the two pipe systems are mounted the faster the transfer of heat energy will occur. The whole process can than lead to increased cold-water temperature (up to 30°C), which is promoting temperature for legionellae growth.

Pipes insulation most often does not exist in the buildings constructed in 1950's. Pipes in newer buildings are often insufficiently insulated. It is not uncommon that buildings from constructed in 1955 and onwards have so called “pipe-within-the-pipe-system” in plastics.

Hot and cold water pipes are mounted within outer “protective” pipe but the isolation between hot and cold pipes is often missing.

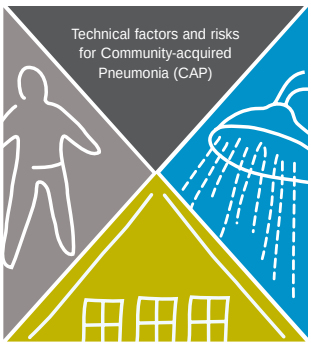
Two problems when towel dryers are connected to the HWC-system arise: low temperature and stagnant water. The whole hot water system cools down fairly quickly. Hence the risk for legionellae growth becomes apparent. This represents significant problem within larger installation systems. Particularly so if the distribution pipes network is improperly designed or/and not properly adjusted, so that constant temperature above 50°C is often not achieved. If, for example, a tenant feels like the temperature in his/her apartment is too high he/she will shut down the district heating causing water to reach stagnant flow.

## Factors related to the temperature

As it was pointed out earlier too low water temperature poses the main risk for legionellae growth. Too low temperature within the HWC-systems means that larger parts of hot water distribution system delivers insufficiently hot water and that this would probably be more permanent state. All that can be a result of improperly designed network, poorly or not at all performed adjustments and also tower dryer connected to the system.

Users cannot control the temperature within the installation system by themselves. It is, therefore, crucial that either estate owner understands the importance of having hot water properly heated or that there are skilled personnel, equipped with clear routine protocols, who can run the system.

Improperly designed/constructed installations can easily lead to warming up the cold water distribution pipes (up to 30°C). If legionellae is present in cold water pipes cooling the system (by flushing the cold water system) will not guarantee elimination of legionellae. Namely, as soon as the cold water tap is shut, process of warming up continues.




Financial contribution

SBUF

The complete Report is available in Swedish at:

Swedish Institute for Infectious Disease Control • www.smi.se

The National Board of Housing, Building and Planning • www.boverket.se

The Swedish Association of Contractors, Plumbing and HVAC • www.vvsi.se