



Section

Fields (of activity)

Style sheet (Bitte die Vorlage direkt mit Ihrem Text überschreiben / veuillez substituer le texte du modèle par votre texte)

LeCo, *Legionella* Control in Buildings

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Key words

Legionella, Legionnaires' disease, water quality, building plumbing, showers, drinking water, water quality

Aim of the study

The LeCo project was a multi-disciplinary research project covering a broad range of *Legionella*-related topics including risk assessment, epidemiology, quantification, ecology and environmental response. The overall aim was to investigate these topics with an emphasis on (eventual) practical translation of the results.

Material and methods

Research included laboratory-scale, pilot-scale and full-scale experiments using state-of-the-art methods and facilities, as well as Swiss-wide population-based sampling campaigns. The experimental work was further complemented by extensive literature reviews, bioinformatic analysis of publicly available data, and expert consultations. Due to the broad and diverse nature of the different project sub-sections, experimental details are not provided here.

Results and significance

Sampling and analysis: We optimised and established protocols for sample collection and rapid PCR analysis, to improve standardisation across national laboratories, and applied a meta-analysis of current literature to inform on the interpretation of PCR data in relation to conventional cultivation methods. These methods were disseminated via the SVGW method collections and incorporated in further education training courses. ***Legionella* diversity:** Sequencing of biofilms revealed multiple *Legionella* species co-occurring in real shower hoses, while analysis of publicly available genomes showed broader diversity within the *Legionellaceae* family than previously recognised. Given the divergence between environmental *Legionella* diversity and the limited diversity observed in Legionnaires' disease cases, we argue that Swiss guidelines would benefit from focusing specifically on *L. pneumophila*, rather than all *Legionella* species, to better allocate resources to higher-risk cases. **Risk assessment:** We developed and conducted a risk assessment modelling the relationships between showers, their characteristics, and the risk of acquiring Legionnaires' disease. We demonstrated shower characteristics that significantly impact risk, such as water temperature, which influences both *L. pneumophila* contamination and droplet formation during use. Behavioural interventions such as using colder showers, decreasing aerosol concentrations, and controlling *L. pneumophila* levels can reduce the infection risk. **Epidemiology:** Paired with a national case control study (SwissLEGIO), we demonstrated the substantial challenges in linking Legionnaires' disease cases with *Legionella* found in environmental samples. This translated into advice for stakeholders on how/where to sample during case investigations and how whole genome sequencing can and should be used in the future. The need for looking beyond buildings for alternative *Legionella* sources furthermore motivated a new Eawag project that characterises *Legionella* diversity and abundance in Swiss wastewater. **Environment:** We demonstrated how the final non-circulating meters in building plumbing become a critical zone where design and operation enable water temperatures favourable for *Legionella* growth, irrespective of hot water temperatures in the boiler. We developed and tested alternative plumbing designs to alle-

viate the problem, and we initiated a new SNSF-funded project to investigate the impact of temperature on *Legionella* growth and diversity. *Ecology*: We isolated and identified several bacteria with antagonistic properties that vary across different *Legionella* species, and identified biosurfactants as the most likely class of compounds produced by these organisms. These findings motivated a new Innosuisse project aiming to translate laboratory findings to practical application. *Disinfection*: From an in-depth literature assessment we concluded that the legally allowed disinfectant concentrations in current Swiss guidelines probably do not suffice to control *Legionella* in buildings. We recommended clarifying the guidelines with respect to disinfectant compounds and concentrations to allow more possibilities in dealing with contaminated buildings, particularly where at-risk users are exposed.

Publications, posters and presentations

At the time of reporting, the project research contributed to 10 publications in peer reviewed journals, four that are submitted and in various stages of the review process, and a further 10 publications in technical journals. Several further publications are expected in the foreseeable future. All current publications are listed here:

<https://blog.hslu.ch/leco/2025/05/19/veroeffentlichungen-aus-dem-leco-projekt/>; below are five examples representing some of the different work packages:

1. Rhoads et al. (2022): Variable *Legionella* response to building occupancy patterns and precautionary flushing. *Microorganisms*, 10. <https://doi.org/10.3390/microorganisms10030555>
2. Cavallaro et al. (2023): *Legionella* relative abundance in shower hose biofilms is associated with specific microbiome members. *FEMS Microbes*, 4, p.xtad016. <https://doi.org/10.1093/femsmc/xtad016>
3. Fischer et al. (2023): Legionnaires' disease in Switzerland: rationale and study protocol of a prospective national case-control and molecular source attribution study (SwissLEGIO). *Infection*. <https://doi.org/10.1007/s15010-023-02014-x>
4. Sylvestre et al. (2024): Quantification of *Legionella pneumophila* in building potable water systems: a meta-analysis comparing qPCR and culture-based detection methods. *PLOS Water* 4(1): e0000291. <https://doi.org/10.1371/journal.pwat.0000291>
5. Tang et al. (2024): Applications of quantitative microbial risk assessment to respiratory pathogens and implications for uptake in policy: A state-of-the-science review. *Environ Health Perspect*, 132: 56001. <https://doi.org/10.1289/EHP12695>

In addition to these publications, LeCo project researchers contributed to > 100 poster and platform presentations at a variety of national and international events.

Project 4.20.01

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