



Risk management, hygiene and Legionella in water systems in hospitals - Relevance for Facility Management and Facility Services

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INTRODUCTION

To guide readers properly, it is necessary to say that this article is part of an ongoing research project. It is divided into four sections. For the purpose of introducing into the topic, a concise summary of the contextual framework and theoretical background is presented first. Here the authors introduce on the topic of hygiene, *Legionella* and risk management in the context of Facility Management and Facility Services. After sharing the perspective from the research project's context, section two reveals findings of a literature review, which worked out a potential search strategy for people new to the topic. It is also useful for people responsible, who wish to get deeper knowledge about the topics 'responsibility of stakeholders' and the 'process' of *Legionella* prevention. With the contents of section three shifting from research to (legal) practice, some responsibilities of stakeholders and the 'process' of *Legionella* prevention are presented. As the field work of the research project is still running, and participants (interview partners) are still needed, the last section of this article informs briefly about characteristics of the research project.

Hygiene and risk management in FM in healthcare

The term "hygiene", which has grown historically and developed since, does not only represent a set of responsible processes and tasks, but also expects a certain level of understanding and commitment of stakeholders in order to get achieved (Exner et al., 2001). The discipline facility management (FM) is confronted with issues, which differ in their complexity regarding hygiene in healthcare settings (Anonymous, 2013; Freije, 2005; Gamage S.D. et al., 2016; Liyanage & Egbu, 2005). Hygiene must be understood as an interdisciplinary task. However, the responsibility for the effectiveness of the quality management, to which the rate of hygiene contributes essentially, is also assigned to the management level. The ISO 9001:2015 (Quality Management) emphasises that. It combines the process approach with risk-based thinking using the Plan-Do-Check-Act (PDCA) cycle at all levels in the organisation. Top management is therefore obliged to take managerial responsibility. For certain issues and in certain contexts, FM can work out and return value-added solutions for an organisation. In the present article one of the various possible areas of responsibility (water safety) will be scrutinised, in which special demands on hygiene arise, and which are important not just solely to the FM (Hübner et al., 2012).

For the surveillance of (drinking) water supply systems and the identification of risk factors, there is a need for an early estimation of the risk of *Legionella* contamination within a building. It requires the use of efficient and assessable parameters to estimate hazards and to prioritize risks. The precision, accuracy and effectiveness of ways of estimating the risk of higher *Legionella* numbers (temperature, stagnation, pipe materials, etc.) have only rarely

been empirically assessed in practice, although there is a broad consensus about the impact of these risk factors. Furthermore the definition of a process chain for *Legionella* prevention in healthcare water systems with respect to the different stakeholders involved, their tasks, collaboration and indication of overlapping (or missing) duties seems to be mandatory. From the perspective of FM, the ongoing research project "*Legionella* and water systems in healthcare (HC) facilities" tries to bridge some gaps. Strained infrastructure, which had been sufficient in the past, may be in the need of being transformed into 21st century context for the tough and competitive demands of health care organisations. Gaps must be uncovered carefully, get closed and (sometimes costly) measures, where necessary, must be supported by appropriate resources from the management.

However, there is a necessity to collaborate interdisciplinarily. Already in 2005 Freije argues, that "hospitals should have a waterborne pathogens team that includes members from facilities management, infection control, risk management, administration, and the medical staff. The team should write a management plan that paints a clear picture of the overall risk reduction strategy and outlines detailed preventive measures for potable water systems and cooling towers, and then meet periodically to ensure that the plan is being implemented, to review results, and to consider revisions" (Freije, 2005).

Indeed, one important component for effective water safety in healthcare is the establishment of a multidisciplinary team, consisting of facility experts and stakeholders. Within the organisation, a dedicated water safety committee can focus on the various water management priorities in the healthcare setting. Furthermore routine and goal-driven communication between FM and clinical staff is seen as essential to implement actions and to perform follow-up inspections. The committee is the right body for discussions of physical (e.g. control monitoring), environmental (e.g. *Legionella* testing), and clinical (e.g. case surveillance) data for trending of integrated information over time (Gamage et al., 2016). Commonly, evidence-based experience helps to shape a prospective development of the various fields of activity, in which hygiene-relevant issues occur or procedures are needed.

When talking about the management of processes we must not forget about the key personnel responsible, who, by collaboration with other people within the process chain, take responsibility. But on closer demand who are those people responsible? On page 11 in their "Guide to *Legionella* Risk Assessment" the Water Management Society (WMSoc) differentiate between four types of key personnel. They are "duty holder", "responsible person", "deputy responsible person" and "other key persons". Briefly explained they characterise differently as follows:

- Duty holder
"Described in L8 (the Approved Code of Practice, 4th

edition 2013) as the employer, the self-employed person or the person in control of the premises. [...] in cases of shared accommodation, there may well be a shared responsibility. The duty holder cannot delegate his duty, but he can delegate managerial responsibility to the responsible person [...]"

- Responsible person
"L8 states that the responsible person (or persons) should have sufficient authority, competence and knowledge of the installation to ensure all operations are carried out in a timely and effective manner [...]"

- Deputy responsible person
"a person appointed to take over the duties of the responsible person in his absence [...]. This person needs to be fully aware of the requirements and duties of the responsible person [...]"

- Other key persons
"These will include the people appointed to implement the strategies and day-to-day control of the systems. They should be informed, instructed, trained and their suitability assessed. They must be properly trained to a level that ensures tasks are carried out in a safe, technically competent manner and receive regular refresher training [...]"

The responsible person for the building is liable for maintaining the hygienic quality of drinking water throughout the building. This person is affected by the associated requirements and responsibilities. In order to fulfill this, the water systems/installations must properly be planned, set up, operated, serviced and maintained according to generally accepted engineering standards.

In terms of hygiene for water systems in buildings there is a risk of contamination of drinking water in the final meters to the consumers (WHO, 2011). *Legionella* and *Pseudomonas* are the most prominent pathogens, which can become a problem in water systems/installations (Völker et al., 2010).

As part of the self-control it is necessary to limit appropriately, and to establish appropriate control and intervention measures, according to hazard potentials. At the beginning of preventive measures (as regards *Legionella*) an individual risk assessment of the building's water systems should be performed (Kruse et al., 2016; Völker et al., 2016).

For the future is important to define an effective and in practice viable self-control of drinking water systems and water systems in buildings. Various national guidelines and standards can be used for guidance. But merely complying with existing legislation and guidance does not necessarily mean that a system is safe or operates reliably. Particularly for buildings with complex water systems and variation in water consumption, as for example may be the case for hospitals (Demirjian et al., 2015; Dyck et al., 2007), such water-associated hazards and associated measures are to be considered carefully and scrutinised (Anonymous, 2013).



A potential literature search strategy

In a recently published journal article we shared and discussed a literature search strategy, which might be of interest for FM/FS people responsible for water safety of water systems in hospitals (Leiblein et al., 2016). The idea of the described way of systematically collecting and analysing topic-specific literature was born during a current research project. The project investigates the roles and duties of persons responsible for the built environment. The focus of the project is risk management of water systems and *Legionella* prevention. An important novelty aspect of the research project is taking a FM perspective considering FM and FS related aspects of business organisation, processes and legal aspects (Hungenberg, 2014). Epidemiological and environmental aspects were also taken into account.

Publications were searched and analysed with respect to an already elaborate research design. Four fundamental areas were defined to be considered simultaneously to comply with the research project design (Fig. 1). The four dimensions were "Legionella", "Hospital", "Risk management" and "FM/built environment". While elaborating a comprehensive theoretical background, it was noticeable that scientific publications with a FM perspective were rarely found. To check what type of information available in scientific publications is provided most frequently, data from citation databases of peer-reviewed literature were collected including 29 journals, using a number of search terms (keywords). A total of 13 keyword clusters (Tab. 1) was defined and a search was performed using different Boolean operators. Initial search found articles with abstracts of 177 journal articles, subjected to certain topic-specific inclusion and exclusion criteria. Of these only 116 publications met selection criteria and were considered for analysis.

A consequent, step-wise search and analysis strategy was defined, considering:

- 1) Selection and availability of sources (journal subscription)
- 2) Selection of journals
- 3) Selection criteria for publications to be considered for analysis
- 4) Selection process for analysis (three consecutive steps)
- 5) Specific focus (four dimensions)
- 6) Keywords and keyword clusters were defined according to 5)
- 7) Relevance of keywords was discussed (different technical terms in different fields of research)
- 8) Variations of search by Boolean operators 'OR' and 'AND'

Table 1: Abstracts – numbers of keywords counts in 177

Keyword cluster	Total number of keyword counts in 177 abstracts
Legionella	543
LD (Legionnaires' Disease)	165
a) Healthcare b) Health Care	69 a) 39 b) 30
Hospital	211
Environment	99
a) Facilities b) Facility	76 a) 46 b) 30
a) Water b) Water system c) Water distribution system	585 a) 467 b) 92 c) 26
Waterborne	10
a) Nosocomial b) HAI hospital/healthcare health care acquired infection	97 a) 43 b) 54
Prevention	33
Surveillance	25
a) Risk b) Risk assessment c) Risk management	165 a) 144 b) 16 c) 5
Stakeholder	1

For the final results three rank lists with different analysis background were compiled. A final rank list contains ten principal reference articles.

Analysis suggests, with respect to the methodology of this bibliographic research, that the interconnected perspective of the terms "water systems", "*Legionella*" and "hospitals" seems to be underrepresented in scientific literature in the field of the built environment and FM. Interestingly the term 'stakeholder', which would refer to decision-makers or key people serving processes, was not found more than once.

Some keywords originated from the technical side, others from HC or management disciplines. A common understanding about the wording or the importance of some words preferred to others can be a motivator to tackle interdisciplinary topics with an interdisciplinary perspective.

Additional sources to those 29 journals in the article represent professional literature for FM. Such are for example the 'Facilities Management Journal', 'Property Management', 'Building Operating Management', 'Facility Maintenance Decisions' or 'Health Facilities Management Magazine'. In this study they were not considered.

The reason for this is to better understand, reflect and assess the perspective on the recognition of FM's/FS's affinity to this topic by considering relevant research in the microbiologists' scene and including the clinical researchers' view on FM/FS. Based on the findings, it may be found necessary to draw a common picture on the process of *Legionella* prevention in practice. This has to be done with respect to different stakeholders being involved serving responsibly for an environment in need of protection.

The outlined article on a potential search strategy on *Legionella* prevention singled out a technical and organisational structure-specific reference to FM. With the help of appropriate literature, a professional and focused introduction to the topic hygiene of water systems can generally be found (Leiblein et al., 2016). The topic of *Legionella* in water systems in health care has a clear link to the FM and prevention, which can be regarded as part of an active risk management (Shohet & Lavy, 2004).

Apart from the problems of historically grown building structures and their changing infrastructure (such as water systems/installation, HVAC systems), hygiene-related issues are perceived and discussed from different sides. According to the existing requirement, the scope of action aligns itself in the competitive relationship of those being responsible. Alongside "classic" microbiological topics even social or psychological characteristics play a role in hospital hygiene, which are also relevant, accompanying instructional and economic considerations. They can be found in appropriate organisational structures with their functional managers, processes and related services, but also within building structures and technical systems to varying degrees and intensity (Gamage S.D. et al., 2016; Spagnolo et al., 2013).

FM can synergistically support where there is perceived and recognised need by decision makers. Building age, materials, proper handling, compliance and consistency along defined process chains with associated implementation objectives are just as authoritative as an appropriate, forward-looking review and adjustment of safety goals and requirements. They need to be incorporated strategically. Especially in complex systems, trade-spanning skills and the need for interdisciplinarity have the greatest importance. Therefore a common and mutual understanding at the operational and strategic levels between different disciplines is essential to achieve jointly recognised and mandatory objectives.

Responsibility of stakeholders and the 'process' of *Legionella* prevention as integrated part of an organisation's risk management strategy

Legionella contaminated water systems in facilities are a serious and a topical issue, which needs to be addressed. This can be recognised with past reports on hospitals that were fined for insufficient precautions on *Legionella* risk assessment and thus, prevention. Besides the threat of economic or image losses on the facility, the risk to people is undeniable. Potentially affected are people being exposed to open water systems or the apertures of water systems (i.e. all variations of water outlets). Hazards arise from contaminated small-size water droplets, termed aerosols. Individuals need to be more aware of the potential contamination risks of their environment, especially in FM contexts, where managers (e.g. operators or any other duty holders) may be responsible for building associated facilities as water systems are (Anonymous, 2015). Understanding the context is the first step towards precisely defining actions against hazards such as *Legionella* (Arvand et al., 2011).

One tragic example of a *Legionella* outbreak, which is associated with a particular FM Service Provider, can be recognised in a case in Germany in 2009. The city of Ulm recorded over 65 cases and several deaths (von Baum et al., 2010). The outbreak was caused by *Legionella* infected aerosols from a cooling tower of a thermal block-type power station. The case took several years in court until prosecution stayed the investigation procedure due to the lack of sufficient evidence (Mayer, 2013).

To counteract potential threats caused by *Legionella* contamination, organisations should consider a mandatory scope statement as part of their risk management. But not always the legal framework or potential threats are identified sufficiently. Duty holders may fail to determine appropriate strategies to counteract *Legionella* (Gollnisch et al., 2003). Considering parameters specific to the organisation must be a mandatory part of the risk assessment. An infected water system is a problem for a building and reduces the value of a facility. Professionals with operator's duties must bear that in mind.

The following short selection of current national guidelines and standards, which are relevant in the United Kingdom, are used to guide people responsible for water systems in terms of *Legionella* risk management. They also give advice to deduce and implement appropriate prevention strategies:

- Health Technical Memorandum 04-01: Safe water in healthcare premises (2016)
 - Part A: Design, installation and commissioning
 - Part B: Operational Management
 - Part C: Pseudomonas aeruginosa – advice for augmented care units
- HSE Legionnaires' disease: Technical guidance (2013)
 - Part 1: The control of *Legionella* bacteria in evaporative cooling systems
- HSE Legionnaires' disease (2014)
 - Part 2: The control of *Legionella* bacteria in hot and cold water systems
- HSE Legionnaires' disease: Technical guidance (2013)
 - Part 3: The control of *legionella* bacteria in other risk systems
- WMSoc
 - W043: A guide to *Legionella* risk assessment
 - W045: Legionnaires' disease – knowing you responsibilities and avoiding prosecution

Present stage of the research project "Legionella and water systems in healthcare (HC) facilities"

In the hospital environment, various stakeholders work in the complex and interdisciplinary field of health care. Obligations and responsibilities against third parties are perceived, such as for example with regard to the quality of the water in drinking water and technical systems. This includes *Legionella* monitoring and prevention. Among the stakeholders, Facility Management (FM) and service providers are also active in technical areas (Facility Services / FS). Their responsibilities include tasks from risk management. Such tasks are e.g. "maintenance of technical systems", "monitoring", "risk assessment" and "prevention" of contamination. Whether being covered internally or externally: In order to be able to carry out the necessary tasks reliably, roles and duties must be known to the duty holder and be defined clearly. In the professional environment, examples of a 'best practice' provide guidance with regard to the process steps to be implemented in the context of *Legionella* risk management. Therefore examples for good practice are searched for this research. The aim of the research project is to create a 'reference system' guiding people responsible in HC organisations to identify, understand and properly take action for *Legionella* prevention of water

systems (Fig. 1). To accomplish that goal, eight main objectives were defined to be achieved in case studies. The research project is divided into several consecutive stages. At the ongoing stage of field study research (Phase 1), interview partners are needed. Phase 2 (online survey) is then a consequence of Phase 1. The characteristics are:

Phase 1 (interviews)

- For three countries (United Kingdom, Switzerland, Germany) we're recruiting interview partners in healthcare facilities (hospitals) with responsibility for facilities. You meet criteria if you are either:
 - a) Director/Head of Estates and Facilities, or
 - b) Responsible for water systems (head of technical service, technical FM, FS), hygienist with responsibility for water systems

Phase 2 (online-survey)

- Questionnaire study with extended group of participants serving for water quality / water hygiene

The research helps to better understand the process and demands of *Legionella* prevention in water systems in the hospital environment. From the stakeholders' point of view, this is an interdisciplinary task. It requires a more detailed picture of individual process steps as well as the roles and responsibilities of persons involved. Interested organisations are invited to make contact.

For detailed information on the objectives and on the project, please visit: tleiblein.wixsite.com/legionella-fm



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Figure 1: Research project design and contextual framework.

