Report on the status of *Legionella* and legionellosis in the pan-European region

ZERO DRAFT

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Executive summary

Introduction

Ensuring provision of safe water, sanitation and hygiene (WASH) is fundamental for the prevention of diseases and the promotion of health and well-being of the population. Sustainable Development Goal (SDG) target 6.1 requires countries to ensure "safely managed" drinking-water services for all in all settings. SDG 3 (targets 3.3 and 3.9) call for preventing waterborne diseases and reducing the number of deaths and illnesses from water contamination. The WHO's global and regional programmes of work are aligned with the SDGs and set strategic priorities to address determinants of health.

Reducing and preventing water-related disease is a core obligation under the WHO Europe/UNECE Protocol on Water and Health[1]. The dedicated programme area (PA2), led by Belarus and Norway, focuses on surveillance and outbreak management of water-related disease and risk-based approaches to drinking water quality surveillance. The Meeting of the Parties at its 5th Session[2] introduced *Legionella* prevention among the activities of this programme area and this commitment was reinforced in the next programme of work for 2023-3025[3].

Legionellosis is the one of the emerging water-related pathogens in the pan-European region. Legionellae proliferate in built water environments, such as domestic hot water systems, cooling towers, spa pools, where warm (20-50 °C), intermittently stagnant water is present. Inhalation or aspiration of *Legionella* containing aerosol may lead to legionellosis infections. Clinical presentation ranges from a mild flu-like illness (Pontiac fever) to severe atypical pneumonia (legionnaire's disease). Outbreaks of legionellosis cause a high level of morbidity and mortality. *Legionella pneumophila* is also one of the priority pathogens causing healthcare acquired pneumonia, particularly in vulnerable and immunocompromised patients. Although legionellosis is a well-recognized problem in high income countries, data are scarce from low- and middle-income countries in the WHO European Region, mainly due to insufficient surveillance and diagnostic capacities in such countries. Even in high income countries, where *Legionella* is considered the most relevant waterborne pathogen, legionellosis is assumed to be underdiagnosed and underreported. Therefore, the true burden of legionellosis in the Region is unknown.

[1] https://www.who.int/europe/initiatives/protocol-on-water-and-health

[2] https://unece.org/environmental-policy/events/fifth-session-meeting-parties-protocol-water-and-health

[3] https://unece.org/environmental-policy/events/fifth-session-meeting-parties-protocol-water-and-health

The recast drinking water directive EU 2020/2187 of the European Union[4] introduces for the first time a supranational regulation for the prevention of *Legionella* in building water systems. It requires member states to identify priority buildings for *Legionella* risk and introduced a parametric value of 1000 CFU/L in drinking water systems. Defining monitoring and risk management requirements is the responsibility of member states. Many EU member states are in the process of developing or revising their regulation to comply with the EU requirements.

This report supports the prevention and control of *Legionella* infections in the Region by strengthening the evidence base on the burden of legionellosis and the prevalence of *Legionella* in the Region. The report also reviews the governance framework and enabling environment in the countries of the Region to identify good practices and potential gaps in regulation.

[4] DIRECTIVE (EU) 2020/2184 OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 16 December 2020 on the quality of water intended for human consumption

Enabling environment – regulatory and governance framework

A sound governance framework is the basis of prevention and control of legionellosis. Different regulatory approaches exist globally, including legally binding and non-binding standards on risk assessment, risk management and monitoring of various risk environments[5]. Both depth and scope of the regulation can vary by country. Since the publication of the WHO guideline on *Legionella* and the prevention of legionellosis[6], which was the last comprehensive overview of regulatory frameworks, several countries in the region introduced some form of regulation, often in response to the first major legionellosis outbreak.

According to the survey conducted in 2021 (Box 1), most countries in the pan-European Region have some form of regulation in place: either in their legislation or in non-binding standards or guidelines. For the ease of reading, this report is hereon is using the term "legislation" for all legally binding documents and "guidelines" for all advisory documents, including standards and best practice guidance. Regulation refers to both types of documents jointly.

Box 1. Survey of *Legionella* regulation in the pan-European Region under the Protocol on Water and Health

[5] Van Kenhove, E., Dinne, K., Janssens, A., & Laverge, J. (2019). Overview and comparison of Legionella regulations worldwide. *American journal of infection control*, *47*(8), 968–978. https://doi.org/10.1016/j.ajic.2018.10.006

[6] World Health Organization. *Legionella* and the prevention of legionellosis. Available from: www.who.int/water_sanitation_health/emerging/legionella.pdf. Accessed December 3, 2021.

To collate information on the existing *Legionella* regulations in the pan-European Region, and online survey was prepared using LimeSurvey™ in Russian and English (Appendix A). The questionnaire was sent to all countries of the WHO European Region. Data request was addressed to the focal point of the Protocol on Water and Health in those countries which are party or signatory to the Protocol. In other countries, potential respondents were identified through multiple channels: JMP contacts, previous WHO meeting participants, members of the EU drinking water committee, the European Microbiology Expert Group or ENDWARE. Respondents were encouraged to liaise internally with experts from other fields to obtain a comprehensive picture of country situation. Questions addressed the scope and format of *Legionella* regulation, including the regulated risk matrices and corresponding requirements, risk assessment and risk management practices, environmental surveillance, clinical surveillance and implementation.

47 responses were received, including two declining participation (Turkey and Monaco). Answers from 45 responding countries were analysed. Most respondents represented government organizations, public health institutes or national authorities, while universities, health care facilities, laboratories and local authorities were only involved in 1-3 countries. Accordingly, respondents had expertise primarily in developing regulation and standards, outbreak investigation, environmental surveillance and risk assessment. Environmental expertise was better represented than the clinical field (clinical surveillance, diagnosis and treatment). Further information was collected through semi-structured interviews with Belarus, Bulgaria, Georgia and Germany were carried out and Lithuania.

Only five countries (Azerbaijan, Georgia, Serbia, Tajikistan and Ukraine) reported that they have not yet introduced regulation for *Legionella* and legionellosis. However, limited data is available from the Eastern part of the region.

Seven countries have only legislation (Andorra, Armenia, Iceland, Kazakhstan, Montenegro, Portugal and the Republic of North Macedonia) and seven countries only guidelines (Albania, Bulgaria, Croatia, Israel, Italy, Luxembourg, Romania). More than half of the countries (24/45) implement *Legionella* control through a combination of legally binding and advisory regulation.

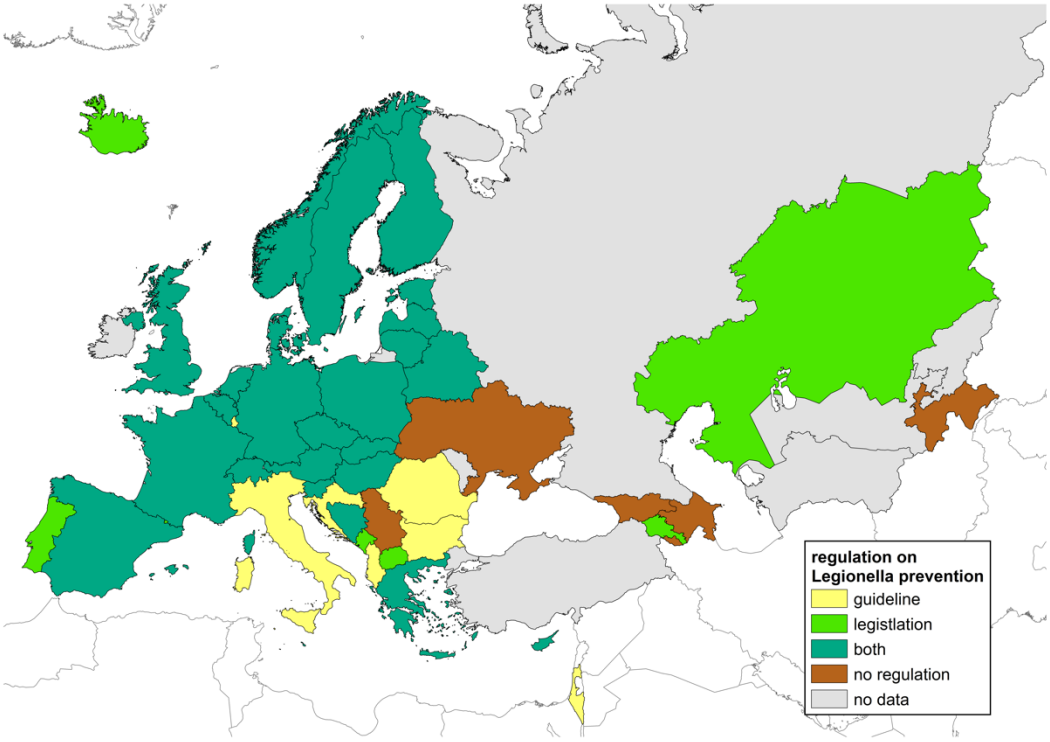


Figure 1. *Legionella regulation in the pan-European region*

Legionella prevention is a complex issue, combining tasks of engineering, operation and maintenance, infection prevention and control and occupational health, thus it requires cooperation across sectors. There are different approaches in identifying lead organisations, depending on the prioritised aspect. In the countries of the pan-European Region, the responsibility for *Legionella* control and prevention lies primarily with the ministries for health, or responsibilities are shared between several ministries (Fig. 2) Only one country (United Kingdom) reported that the ministry for labour is the lead organisation. Other involved ministries include Ministry of Social Affairs, ministries responsible for building or housing, and national or regional public health institutions.

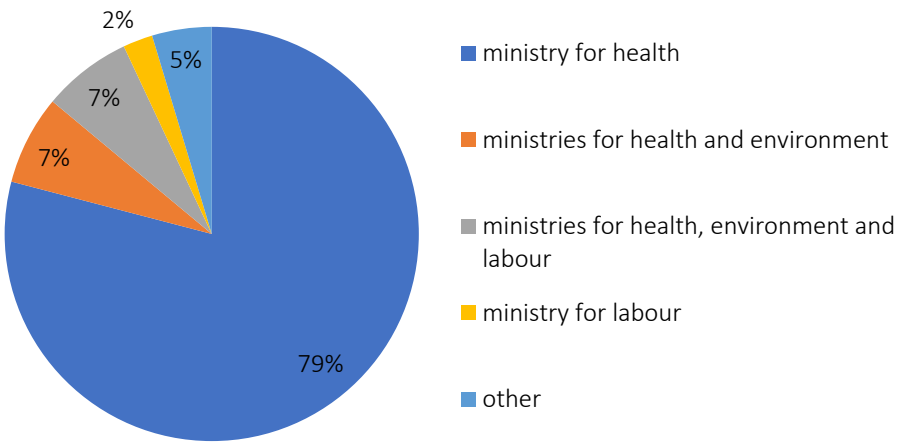


Figure 2. *Ministries responsible for the prevention and control of* Legionella

Scope of the regulation and the partitioning of various obligations between legislation and guidelines varies between the countries, but the key elements are almost universally covered (Fig 3.). Roles and responsibilities of stakeholders (78%), risk assessment (71%), risk management (81%) and environmental surveillance (74%) are the most frequently addressed topics in regulation, while requirements for the qualification and training of operators and the registration of risk facilities are included less frequently (19% and 31%, respectively).

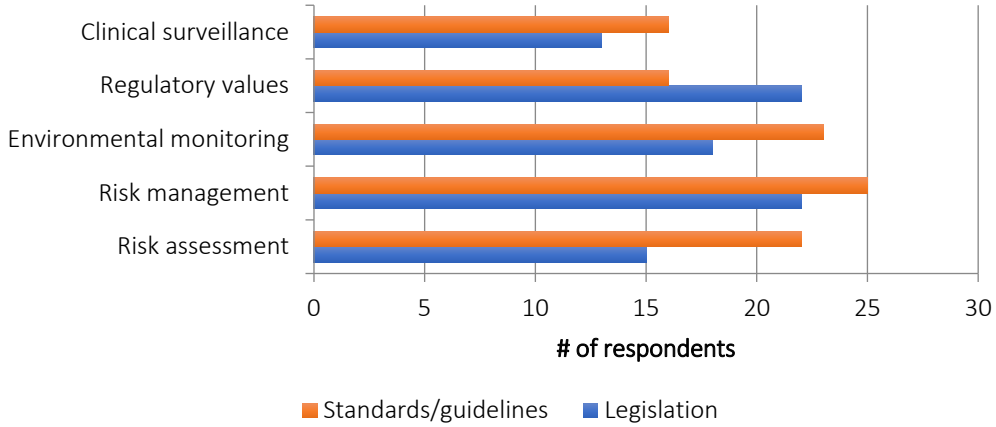


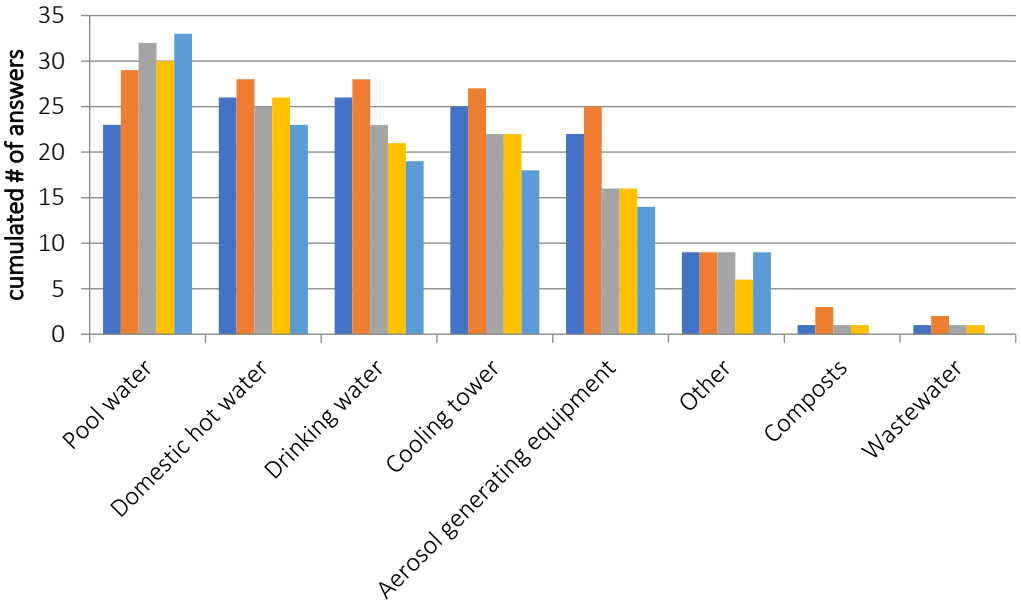
Figure 3. *Areas of Legionella regulation in legislation and advisory documents*

Detailed requirements on risk assessment and risk management are generally included in guidelines, rather than legislation (Fig. 3). This provides a more flexible option to follow technical development and regularly update the guidance, and allows for a higher level of detail.

Regulated risk matrices and risk facilities reflect national priorities, often based on the prevalence of recognised infections or outbreaks associated with a certain environmental source. Most regulations address drinking water and domestic hot water, pool water and cooling water (Fig. 4a). Pool water regulations place the highest emphasis on regular monitoring requirements and intervention values, while risk assessment and risk management is in the focus of potable water and cooling water regulations. Drinking water and hot water requirements do not apply to all buildings: healthcare facilities and hotels (or other accommodation facilities) are within the scope of the regulation in every country, schools, industrial settings/workplaces and domestic settings are less frequently addressed (Fig. 4b). Aerosol generating equipments are regulated to some extent in the majority of the countries. Composts, which in other regions (especially in Australia) are considered significant source of infection, are not recognised as an important risk matrix in the European Region. Neither is wastewater, in spite of the increasing evidence on its association with community-acquired cases of legionellosis. Additional risk matrices and risk

environments regulated in some countries include social care homes, passenger ships, car-wash facilities, hairdressers, public gatherings, fire sprinklers and reused water.

a.



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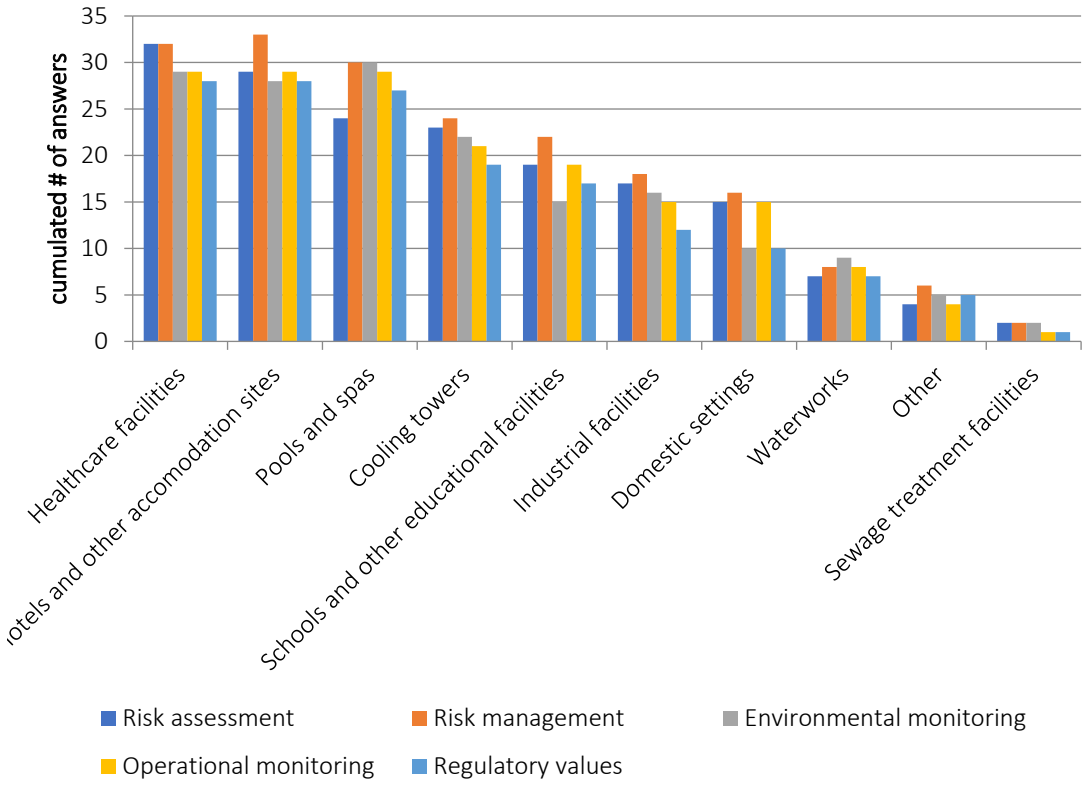
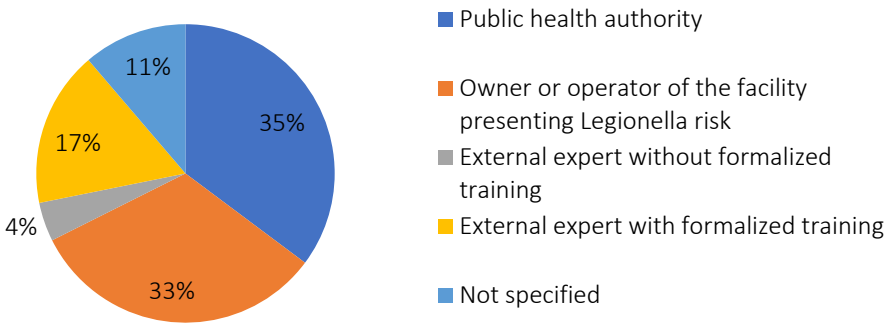


Figure 4. *Risk matrices (a) and risk facilities (b) covered by legislation in the European region*

Risk assessment requirements

Risk assessment of environmental premises is a core provision in the prevention of legionellosis, addressed by most countries in legislation or guidelines (see Fig. 3). Risk assessment entails a detailed description of all risk matrices in a facility, identification of the potential exposure routes and the exposed people, including vulnerable populations, and characterisation of the risk associated with each risk matrix. The quality of risk assessment relies predominantly on the expertise of the person undertaking the assessment. Most countries regulate who can carry out risk assessment, mainly specifying public health authorities or the operators of risk facilities (Fig. 5a). External experts – usually with a specified degree or certification – are also involved in 21 % of the countries. Though generally the latter have the most in-depth technical knowledge, involvement of the operators is indispensable as they have better knowledge of the systems and for adequate implementation of risk management measures specified through the risk management procedure. The contents of the risk assessment are specified in regulation in 61% of the responding countries (Fig. 5b).

a.



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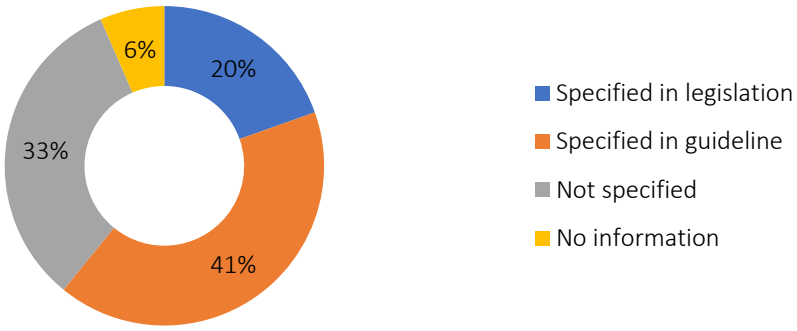

Figure 5. *Specification of responsibilities of Legionella risk assessment and its contents in the regulation of the countries of the pan-European Region (n=*

External auditing is a quality control measure to ensure that risk assessments are realistic and adequately address the risks associated with a facility. Risk assessments are only audited in 13 of the responding countries, generally by the public health authorities. Regular revision of the risk assessment is critical in maintaining the level of protection to the users of the facilities. Risk assessments are usually updated if there are changes in the system (50% of the responses) or if legionellosis cases are linked to a facility (61%), but regular revision (yearly or in every 2-3 years) is only required in 7 countries.

Risk management requirements

A well-developed risk assessment defines appropriate interventions to prevent or reduce the risk of *Legionella* colonisation and exposure. Risk management measures are critical for the prevention of *Legionella* colonization in water system and the exposure of vulnerable populations. Some countries require continuous management practices in selected facilities, while in others, measures are prompted by the outcomes of the risk assessment (Fig. 6a). Interventions are almost invariably necessary if cases or clusters of legionellosis are linked to the facility. Measures are mostly specified for hotels and other accommodation sites, cooling towers, healthcare facilities and pools (Fig. 6b), but additional targeted sites include schools, industrial and domestic facilities in multiple countries, passenger ships (in Estonia), cleaning vehicles, sprinklers, foggers, fire systems, ornamental fountains (in Andorra).

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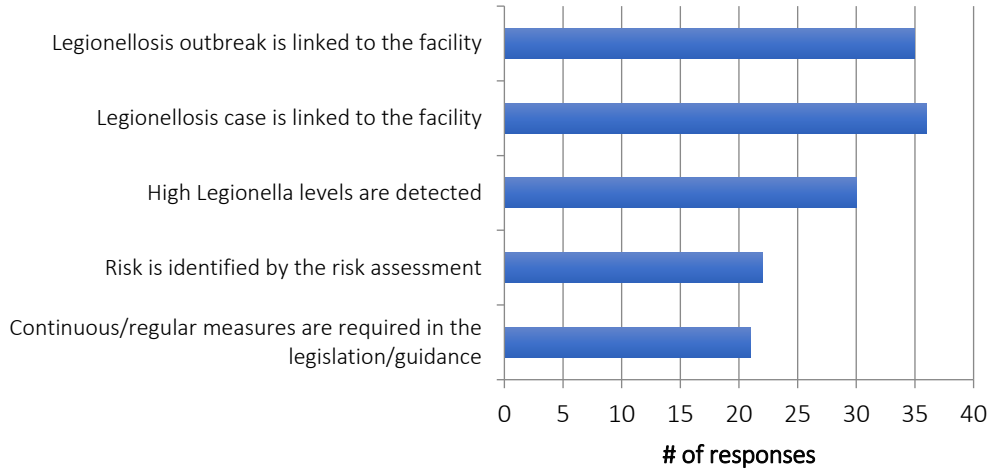

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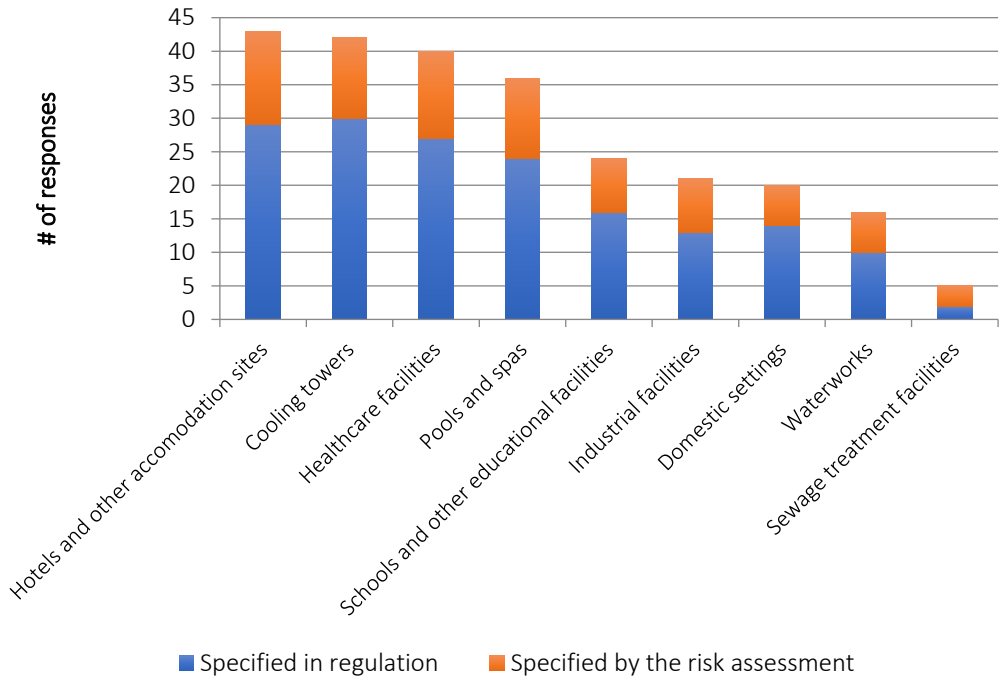

Figure 6. *Requirements for Legionella risk management measures (a. conditions prompting intervention b. regulated settings) in the countries of the pan-European Region.*

Environmental surveillance and monitoring

Monitoring of *Legionella* in water environments is complementary tool to risk assessment and provides an insight into the colonization levels in water systems. It also serves as a verification of identified risk levels, although a negative result does not prove the absence of colonisation.

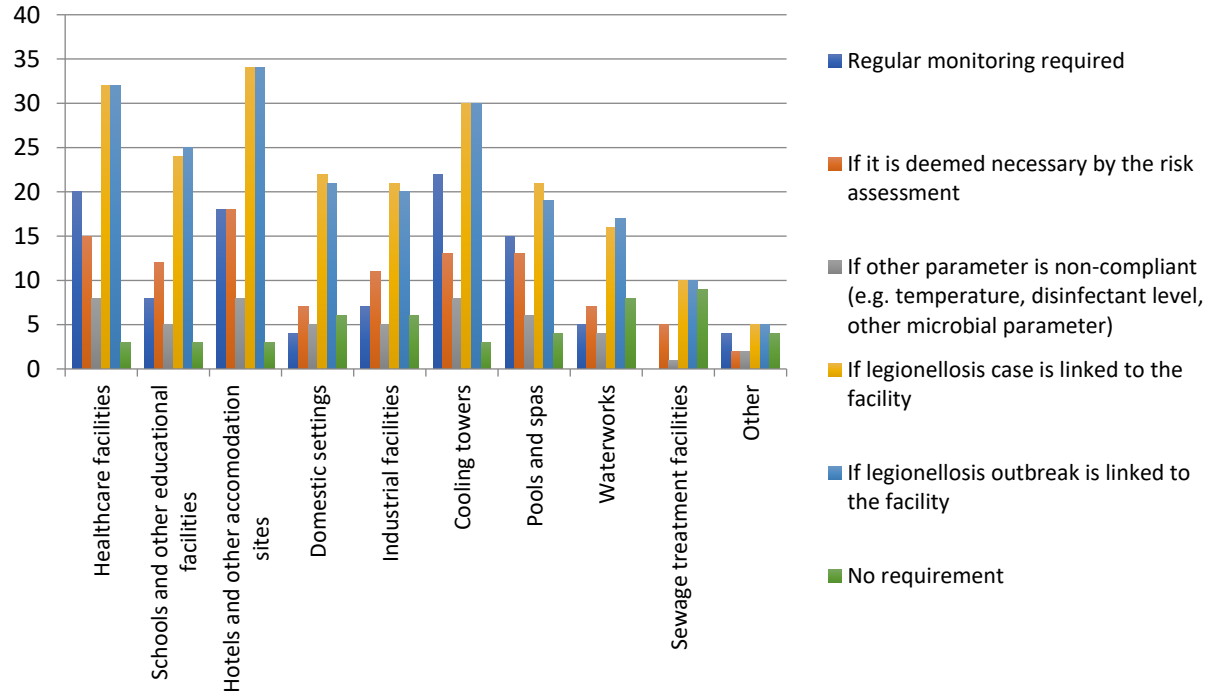

Figure 7. *Reported conditions requiring environmental monitoring of* Legionella

Countries usually limit regular monitoring requirements to a few specified risk settings, primarily cooling towers, healthcare facilities and hotels (Fig. 7). However, specific conditions prompt monitoring in other countries and locations as well. Legionellosis cases or clusters almost unanimously call for environmental sampling and analysis in the potential infection source locations.

In most countries, monitoring is the task of the public health authority or the joint responsibility of the authority and the operator of risk facility (Fig. 8a).

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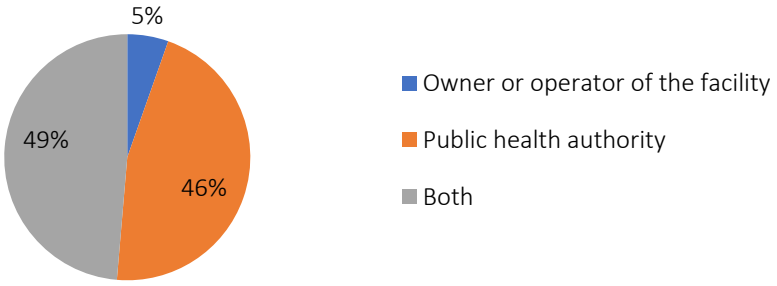

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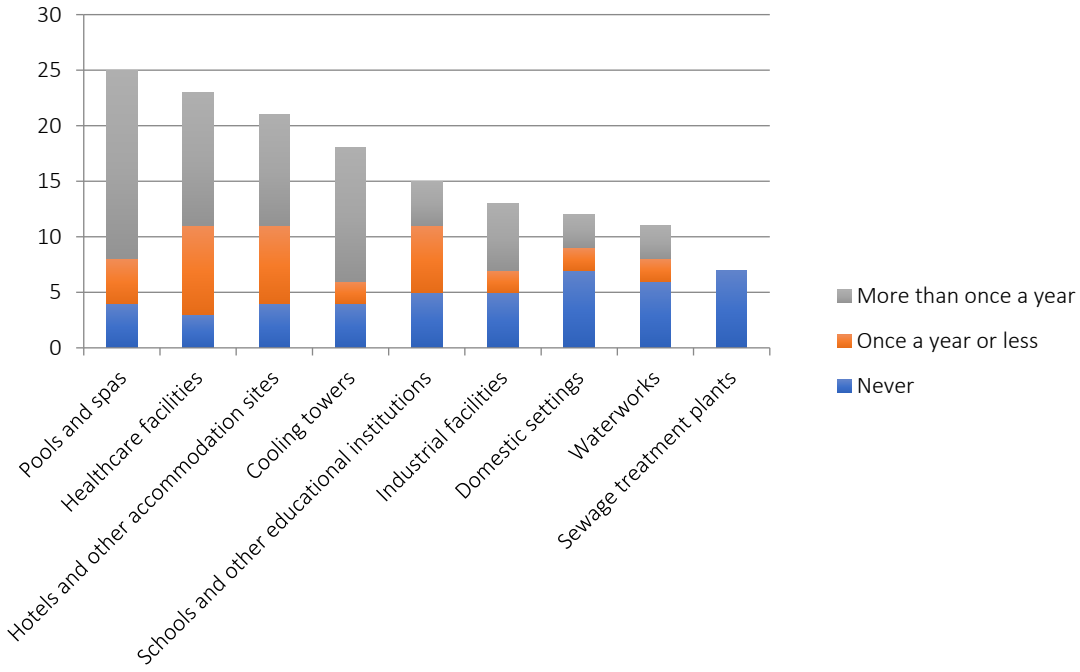

Figure 8. *Responsibilities (a) and frequencies (b) of monitoring legionellae in risk facilities*

Most frequent monitoring (monthly or several times a year) is required in pools and spas and cooling towers, where *Legionella* levels can change rapidly in relation to the concentration of disinfectants (Fig. 8b). Domestic settings and waterworks are monitored only in a few responding countries, and sewage treatment plants are not yet monitored in the region. Monitoring frequencies may vary depending on the outcomes of the risk assessment.

Laboratory detection of *Legionella* is more challenging than other water quality indicators, such as *E. coli* or heterotrophic plate count. It is a slow growing organism, culture-based methods generally require 7-10 days, and the recognition of *Legionella* colonies on selective media requires expertise. Therefore, the choice of the method and quality assurance system of the laboratories is critical in data interpretation. Most countries (73%) specify the laboratory method for environmental surveillance. The most widely used methods are ISO 11731 (a culture-based method, 62%) and ISO/TS 12869:2019 (qPCR, 24%). Laboratories performing environmental monitoring should be accredited and/or certified by a competent authority in 67% of the countries. Monitoring data is reported on a national (24%) or local level (7%), or made available to the authorities at sanitary visits (40%, Fig. 9).

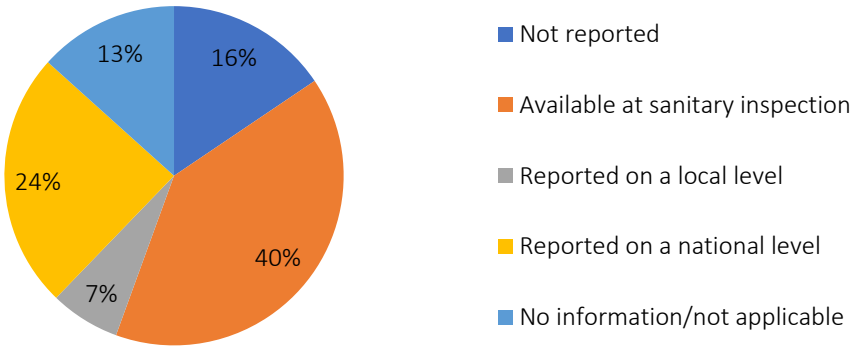

Figure 9. *Reporting of environmental Legionella monitoring data in the responding countries*

If representative data is available from environmental surveillance, it can serve as a basis for decision-making on a local or national level. According to the responses, data is used to obtain an overview of the situation, to identify the main sources of *Legionella* exposure, to develop risk management strategies, and to communicate the risks to the stakeholders and the community (Fig. 10).

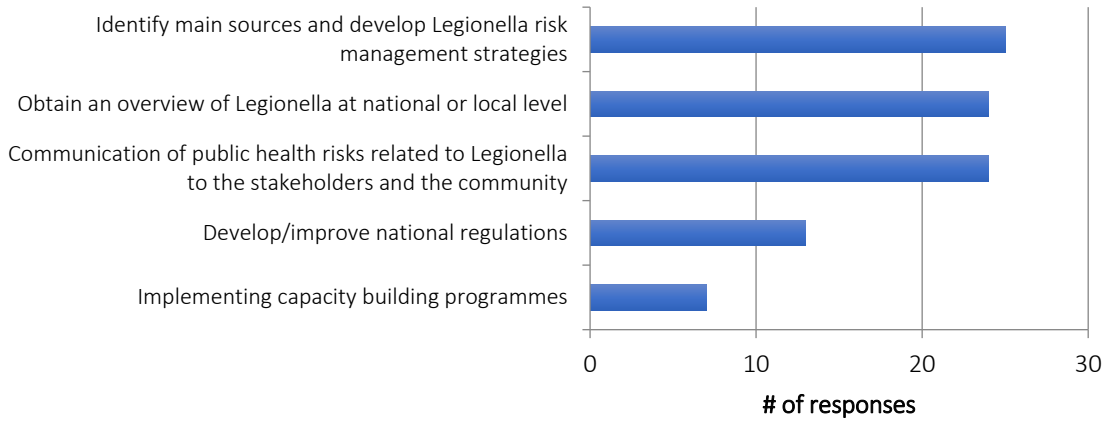

Figure 10. *Utilisation of environmental Legionella monitoring data*

Clinical surveillance

Clinical surveillance is generally the first step of identifying the relevance of an emerging disease. Including a condition into the list of reportable diseases raises awareness of the physicians and allows for the estimation of national incidence rates. However, legionellosis is assumed to be underreported even in countries with advanced clinical surveillance and reporting system.

In the survey, 80% of the respondents indicated that legionellosis is a mandatory reportable disease in their country. 92% of these require reporting every case of legionnaire's disease, but only 30% include also cases of Pontiac fever.

Average reported yearly incidence rates between 2016 and 2020 ranged from 0 to 12 cases/100,000 population.

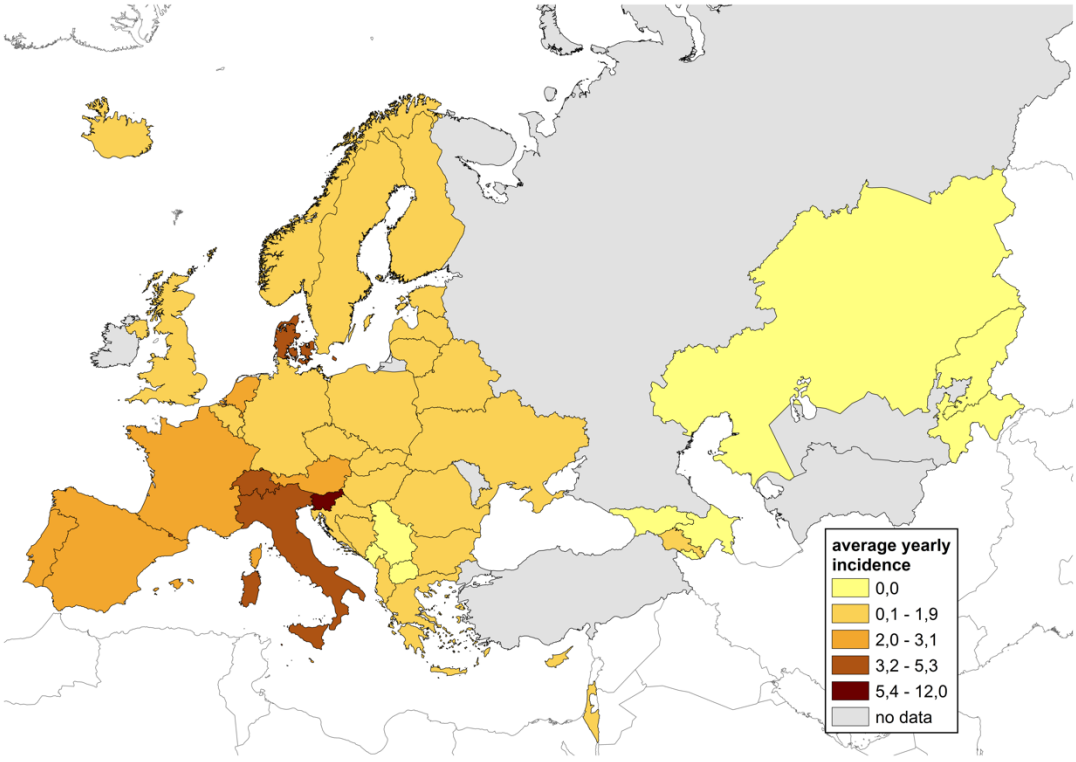

Figure 12 -suggest to delete *Reported yearly average incidence rates by 100,000 inhabitants between 2016-2020 in the pan-European region. Data for Belgium, Cyprus, Greece, Italy, Malta and United Kingdom was obtained from ECDC Legionnaires' disease Annual Epidemiological Report for 2019 (average incidence in 2015-2019)*

Only half of the respondents indicated to have protocols for legionellosis testing: most of these (12 countries) only test hospitalized patients, others atypical pneumonias (5) or suspected Pontiac fever cases (5), and only 2 countries reported testing every pneumonia. Ten countries indicated that it is the decision of the physician, depending on the clinical diagnosis.

Most countries use several different methods for laboratory diagnosis of legionellosis (Fig. 11). Urinary antigen testing is the most common method, followed by culture and taxon specific PCR. Urinary antigen tests, however, only detect *Legionella pneumophila*

sg 1. While this serotype is the most common cause of severe legionellosis, other serogroups and over 20 other species have also been associated with human disease. This practice therefore leads to underdetection of legionellosis cases.

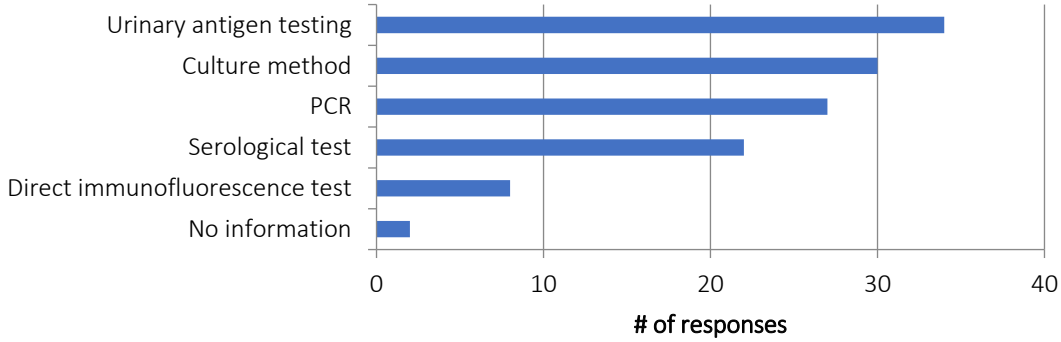

Figure 11. *Laboratory test methods used for the diagnosis of legionellosis in pan-European region*

Following the identification of a legionellosis case, epidemiological investigation is carried out in two-third of the countries (Fig. 12a). Some respondents only investigate clusters of cases (6 countries), travel associated (2) or nosocomial (2) cases.

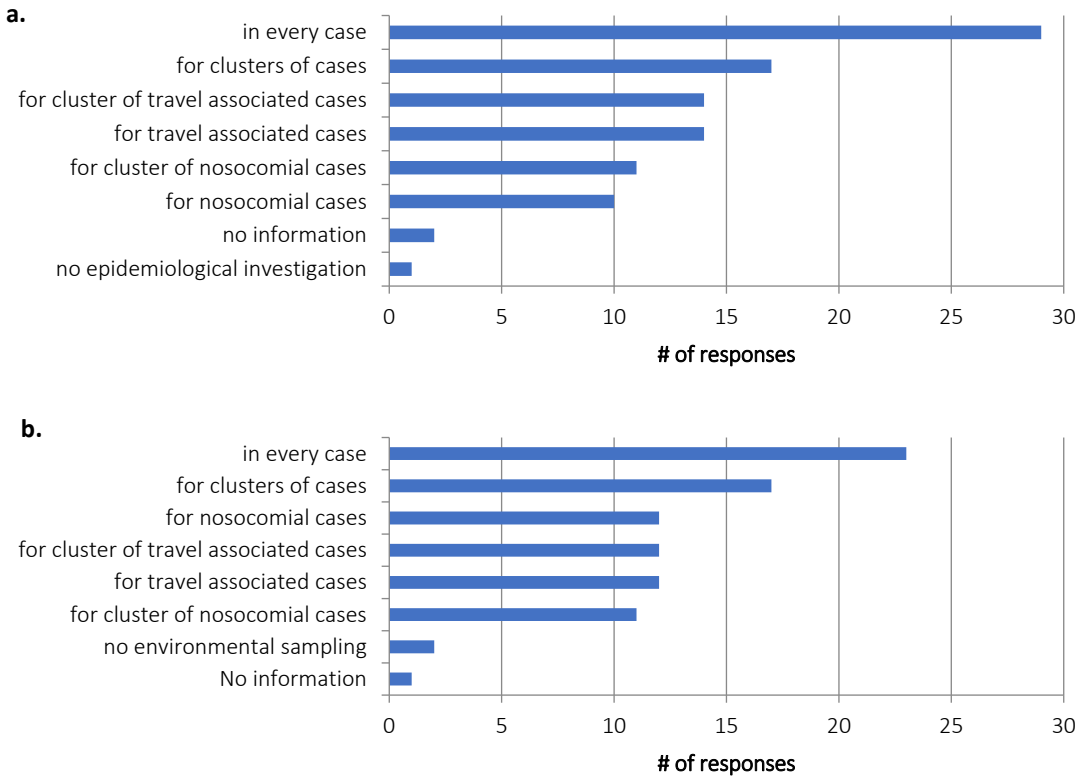

Figure 12. *Country protocols for epidemiological investigation of legionellosis cases (a), including environmental monitoring (b)*

Majority (82%) of the countries performing epidemiological investigation have standardized protocols or checklists. Investigation usually also involves environmental

sampling (Fig. 12b). Over half of the countries type the *Legionella* isolates for identification of the potential infection source, either in every case (6 countries), or under specified circumstances (19 countries).

Clinical surveillance data is not only used to confirm diagnosis and support treatment, but also for decision making on a wider scale. The most common use of the data is tracking the burden of disease of legionellosis (Fig. 13).

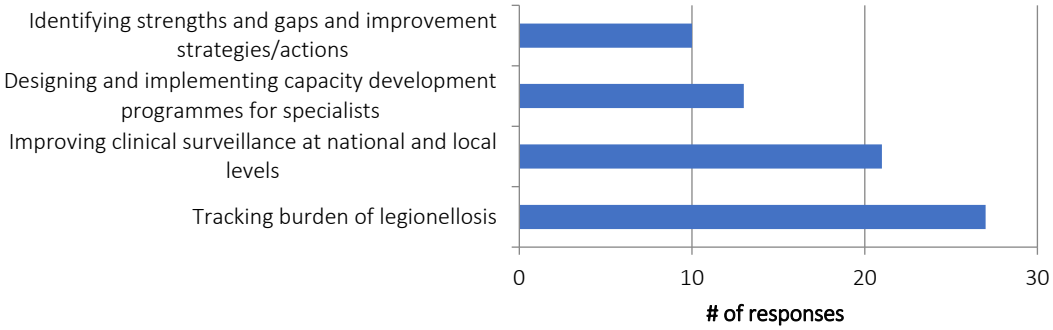

Figure 13. *Use of clinical legionellosis surveillance data in decision making*

Implementation

Subjective perspective of the respondents was asked to assess rate the level awareness of legionellosis in different groups of the public, as well as the availability of financial and human resources for the implementation of the regulation. Answers were scored 1-5, indicating increasing compliance.

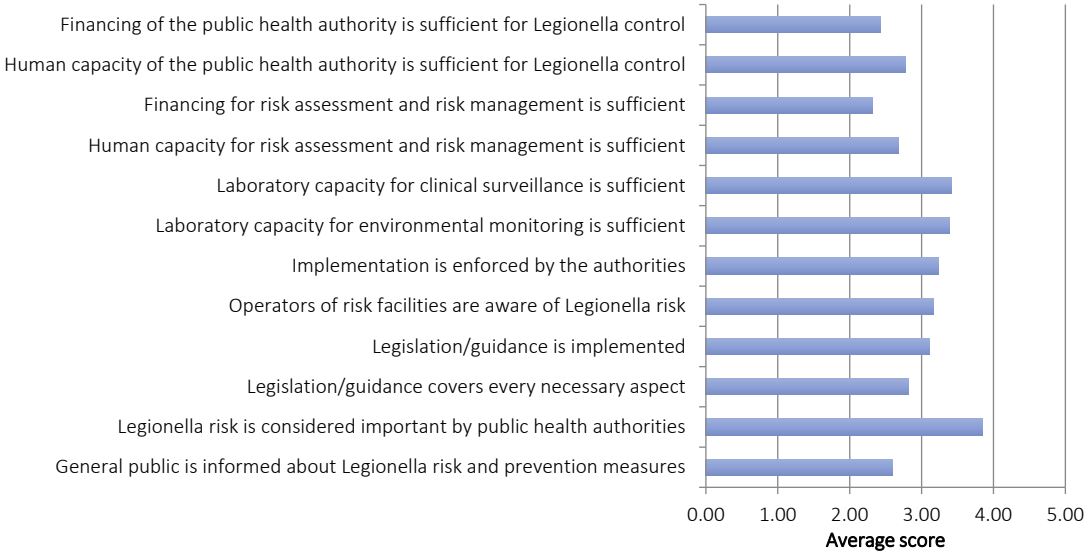

Figure 16. *Average scores on the level of implementation of the regulation, availability of resources and Legionella awareness according to the survey respondents*

The highest average score was given to the awareness of public health authorities (3.8), while the lowest to the availability of finances for risk assessment and risk management (2.3) and for the public health authorities (2.4) (Fig. 16). Laboratory capacities are less limiting factors than financing or human capacities.

Country averages ranged from 1 to 5. Average scores by countries were mostly between 2 and 4, only 4 countries fell below, and 6 countries were above this range (Figure 17).

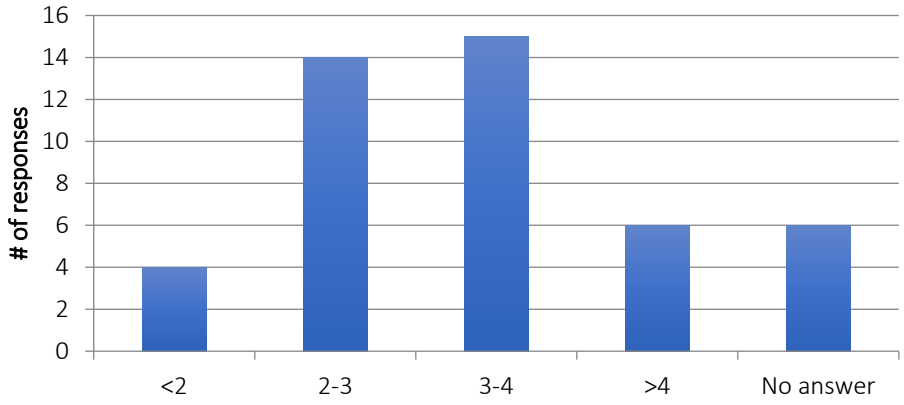

Figure 17. *Average country scores on the implementation of Legionella control*

Case examples of *Legionella* regulation and status in selected countries

Belarus

Respondent: Alena Drazdova, Republican Scientifical-Practical Centre of Hygiene

Belarus has a legally binding regulation on the control of *Legionella.* The first regulation, issued in 2014 by the Ministry of Health, addressed drinking water and hot water systems and pools in hotels and other accommodation sites (http://www.svetlcge.by/wp-content/uploads/2014/04/post_mz-rb_110-24.12.2014.pdf). The scope was extended to healthcare facilities in the 2021 hygienic norm of the Council of Ministers on "Drinking water safety indicators" (https://pravo.by/document/?guid=3961&p0=C22100037). The main focus of the recent regulation is centralised drinking water supply and domestic hot water system. There was no major outbreak preceding the development of the regulation. First investigations were initiated from scientific interest, leading ultimately to the development of guidelines.

The legal regulation includes the monitoring requirements for drinking water and pools in hotels and other accommodation sites and healthcare facilities, the intervention values of *Legionella* and the sanitary epidemiological measures. The complementing guidelines outline instructions on performing monitoring programmes, describe the analytical methods, and the hygienic assessment of results. There is also guidance available on clinical diagnosis and treatment of legionellosis and the application of disinfectants against *Legionella.*

The implementation of the regulation is still in early phase since the norm is very recent. Monitoring is the responsibility of the operators of risk facilities, but it is conducted by the laboratories of the sanitary epidemiological service under the Ministry of Health. Monitoring results are expected to be collected on a national level. Monitoring data is not yet available, but previous research data indicates low rates of non-compliance.

There is currently no formalised training on *Legionella* prevention. However, the national authority organises series of workshops on different topics, to various audience. The workshop for public health officers dedicated to water hygiene will include introduction to the implementation of the new regulation.
Legionellosis is a rare diagnosis in Belarus, physicians seldom think of it. Therefore it is likely to be underdiagnosed and underreported. However, currently legionellosis is not considered a priority among waterborne diseases.

Bulgaria

Respondent: IskraTomova, National Center of Infectious and Parasitic Diseases

The Bulgarian guideline on Legionella prevention and control were issued in 2003, following a cluster of travel associated cases in the Black Sea holiday region, involving citizens from four countries. It is a transposition of the European Guidelines for Control and Prevention of Travel Associated Legionnaires' Disease. The procedures outlined in the guideline are only mandatory if a case of legionellosis is identified, otherwise it is only a recommendation for the operators of risk environments (mainly hotels and other accommodation sites and healthcare facilities). The drinking water regulation includes a minimum level of free chlorine in drinking water (0.3-0.5 mg/l). While this requirement does not specifically address Legionella, it could support the prevention of colonisation in building water systems if there are no other risk factors (stagnation, poor temperature regime, etc) . Some international hotel chains/offices have additional their own internal requirements for the control of Legionella. Risk facilities, such as cooling towers are not registered.
Implementation of the guidelines is enforced in every setting, where a case of legionellosis is identified. Most investigated cases are travel associated. Healthcare associated cases are rarely identified, probably due the lack of testing and of human capacities. In some other instances, the reluctance of the operator of the concerned facility to cooperate can also hinder the epidemiological investigation.
Advancing the prevention of legionellosis would require higher awareness of the problem on decision-making level and coordinated action of various ministries, including the ministry responsible for construction (so buildings, like hotels or office buildings are designed to prevent Legionella colonisation). The Ministry of Health would need to undertake Legionella competent education of different sectors to raise awareness of legionellosis and its prevention.
There are no regular trainings for the operators of risk facilities or engineers. The National Center of Infectious and Parasitic Diseases organises trainings for the health inspectorates. The four days session covers the basics of different aspects : from ecology of legionellae, through clinical presentations of legionella infections, microbiological diagnosis to environmental investigations.
Regular monitoring is not required by the guideline. As part of the investigation of recognised cases, health inspectorates carry out two samplings in the concerned facilities to assess the initial level of colonisation and to confirm the efficiency of risk mitigation measures. These samplings are required by the international network on travel associated cases of legionellosis (ESLD-Net). Some hotels continue monitoring at least in the same season, but after that it very much depends on the dedication of the operator of the facility. Some international hotel chains require monitoring in their

facilities four times a year according to their internal regulation. In case of increased colonisation, operators seek advice from the National Laboratory. Monitoring results are not collected, laboratory data indicates very variable rates of colonisation, depending on the operating practices of the individual facilities.
Legionellosis is likely to be underdiagnosed and underreported in Bulgaria. Physicians seldom think of it as a potential diagnosis. The laboratories don't have sufficient funding to carry out test for the detection of Legionella. Legionellosis is considered to be the most important waterborne pathogen due to its low recognition rate and the lack of targeted interventions.

Georgia

Respondents: Gela Mgeladze and Nana Gabriadze, National Centre for Disease Control and Public Health

Georgia has currently neither legally binding nor advisory legislation on *Legionella* prevention and control. However, requirements apply to prevent travel associated cases of legionellosis. Such cases are investigated, and hotels in Tbilisi and the seaside resort area are subject to regular monitoring requirement.
Sample analysis (and usually sampling as well) are carried out by the official laboratories under National Center for Disease Control and Public Health. Hotels are monitored monthly or quarterly, depending on the facility. Investigations cover every risk matrix: drinking water and hot water systems, pools and cooling towers, where present. Though monitoring data is available at the national laboratories, information is confidential, national reports are not available. The general impression is that *Legionella* is seldom isolated from environmental samples. There is no information whether international hotel chains have internal requirements for the control of *Legionella.*
There is no monitoring requirement for healthcare facilities. Clinics in Georgia are usually private and are not inclined to deal with the problem of *Legionella* prevention. Regular trainings are not organised for operators or health inspectors. In case of positive samples, NCDC conducts trainings in the facility in question.
Legionellosis is not a notifiable disease in Georgia, and patients are generally not tested for it. In a test period between 1988-1997, a pilot study was carried out to assess the prevalence of legionellosis. It was identified in 7% of chronic and 5% of acute pneumonias.
Legionella is considered a lower priority compared to other waterborne pathogens. There is currently no capacity to develop regulation for the control of *Legionella* due to other, more pressing problems. But if the process would start, the first step would be strengthening clinical surveillance and including legionellosis in the list of notifiable diseases.

Germany

Respondent: Benedikt Schaefer, Umweltbundesamt

Legionella regulation has 30 years of history in Germany. The first voluntary technical rules were adopted in 1992 for large drinking water systems (>400 m^3 storage or more than 3 L water in the pipelines.) Regulation first covered healthcare facilities and

nursing homes, then it was extended to hotels and sporting facilities and finally to all large public buildings and buildings for rent.
Voluntary implementation of the technical rules was not as good as expected, therefore in 2011 it was transposed in the drinking water ordinance (https://www.gesetze-im-internet.de/trinkwv_2001/index.html, amended several times since).
Legionella has been added as a parameter in the regulation for pools 15 years ago issued as national standards. Filling water and filtered water should meet the requirements for drinking water. Cooling tower regulation is the most recent, it is in force since 2018; it also covers evaporative condensers and scrubbers (https://www.gesetze-im-internet.de/bimschv_42/). According to the regulation, evaporative condensers, scrubbers and cooling towers are registered in a register which is accessible for the responsible public agencies.
Cooling tower regulation was issued in response to major outbreaks. Pools or drinking water systems have not yet been associated with outbreaks, regulation is a preventive measure.
Risk assessment is required for cooling tower and drinking water systems, including system assessment, scheme of the pipelines and list of deviations from the technical guidelines. Environmental sampling is also mandatory in cooling towers and large drinking water systems.
Sampling and analysis are carried out by officially authorised accredited laboratories. Data on non-compliant drinking water samples is reported to the public health authorities directly by the laboratories, but it is not collected on a national level. The current regulation does not define a health-based parametric value, only an action level for *Legionella.* Non-compliance rate is estimated to be 5-8%, which is a significant improvement compared to the initial 30%. However, it also depends on the type of facility: while hotels are usually compliant, smaller operators are more likely to have problems.
Legionella control is not included in graduate curriculum, and no dedicated trainings are organised by the national authority. Some professional organisations offer trainings for engineers.
The major challenge in implementation is the decentralised government system. Federal states have different approaches and different level of implementation, it is not harmonised on a national level. The other difficulty is to make the concept of risk assessment understandable to operators and the public. Currently a lot of effort and resource is invested into the control of *Legionella*, without a large number of cases.
Despite of the existing regulatory framework, legionellosis is likely to be underreported in Germany. There are large geographical differences in the number of reported cases, that is probably associated with the awareness of the local physicians and public health authorities. On national level, 1500 cases/year are reported, but extrapolating the estimates from a recent outbreak – where 6% of lung diseases of unclear aetiology were diagnosed as legionellosis – the actual number of cases is likely to be 30,000/year.
Legionellosis is considered the only relevant drinking water related disease in Germany. Infections associated with faecal ingress are extremely rare, while 25 % of legionellosis cases are estimated to be drinking water related.

Lithuania

Respondents: Simona Žukauskaitė-Šarapajevienė, National Public Health Center under the Ministry of Health; Asta Razmienė, National Public Health Center under the Ministry of Health; Ingrida Skridailienė, National Public Health Center under the Ministry of Health; Miglė Janulaitienė, National Public Health Surveillance Laboratory

In Lithuania, legionellosis received more attention since 2003. The Lithuanian Hygiene Standard for Drinking water safety and quality requirements was approved in 2003, setting requirements for hot water temperature and thermal and chemical disinfection. Complementing methodological recommendations for legionellosis diagnosis, treatment, epidemiological surveillance and control have been published in 2004. Further provisions for *Legionella* control are included in hygiene standards for specific settings: swimming pools (2005), accommodation services (2011), sports club services (2013), inpatient social care institutions for adults (2019), personal health care institutions (2020).

Regulation was developed in response to increasing knowledge on legionellosis and its control, increasing incidence internationally and first identified cases nationally, and the participation in the European Legionnaire' disease Surveillance Network (ELDSNet, formerly EWGLINET).

Hygienic standards are legally binding documents approved by the Minister of Health. These include the key provisions, e.g. safe water temperature ranges (hot water in consumer taps >50 ° C, cold water < 20 ° C; monitoring requirements, including regular and extra samples (after reconstruction or reopening, or if legionellosis cases are identified), action levels depending on *Legionella* concentration in water, requirements for thermal and chemical water distribution system disinfection and cleaning. Hot water temperature requirements are also set for residential buildings by the Building Code, approved by the Minister of Environment (the temperature of the circulating hot water must not fall below 50 ^{o}C).

Advisory methodological recommendations address epidemiological surveillance, prevention and control, including guidelines for management and prevention of travel associated cases, and on the preparation of legionellosis prevention plans (http://www.ulac.lt/uploads/downloads/legionelizes%20rekom%20atnaujintos_redGZ.pdf,https://nvsc.lrv.lt/uploads/nvsc/documents/files/Rekomendacijos%2Blegioneliozes%2Bprofilaktikos%2Bplano%2Brengimui.pdf).

Oversight of the implementation is the responsibility of health authorities. Their tasks in epidemiological surveillance and control of Legionnaires' disease are laid down in legislation.

The development of legislative and advisory instruments covering a very wide range of prevention and control of legionellosis is a great achievement. There are still some missing elements (e.g. action levels (1000–10000 or > 10000 CFU per liter) are similar for all settings without excluding sensitive settings; no requirements for plumbing system installation (e.g. safe distance from the hot water mixing valves to users), operators sometimes don't comply with provisions on hot water temperature due to the associated water heating cost. This challenge is addressed by organising trainings for water system operators and their controlling bodies (municipalities, State Energy Inspectorate) by the National Public Health Center under the Ministry of Health (NPHC). Informing and educating the population is also an important measure.

Periodical trainings are not organised, only when problems are identified (such as gaps in the installation and maintenance of hot water systems or cases of legionellosis). Trainings for hotels were organized before various events (e.g. basketball championship, visit of the Pope).
Yearly monitoring of the water systems is mandatory in hospitals, social care facilities, pools and spas water systems yearly, in hotels and other accommodation sites more than once a year. Monitoring is the responsibility of the owner or operator of the facility. Monitoring results are not reported, but records are available for public health inspectors or other authorities.
NPHC also carries out inspection in some institutions (healthcare facilities, social care facilities, education facilities or economic providers, such as hotels, pools, hostels, sports, etc.). During routine and planned inspections, the temperature of the supplied water, records of the regular *Legionella* monitoring and compliance with the other health safety requirements are checked. NPHC also organizes environmental investigation when legionellosis cases are diagnosed.
Legionellosis is a mandatory notifiable disease in Lithuania. Cases of legionellosis are reported by physicians to NPHC. Rate of reporting has not been evaluated, but underreporting cannot be ruled out. One of possible factors is early antibiotic therapy in pneumonia cases. If the treatment is efficient, the patient is not tested for *Legionella.* Usually urinary antigen tests are used, thus non-sg1 and non-pneumophila cases are missed.
Legionnaire' disease is the leading disease related to drinking water in Lithuania.

Environmental prevalence of *Legionella* – evidence from the pan-European region

Information on the prevalence of legionellae in various risk settings was retrieved from the scientific literature. While this information is not exhaustive, it reflects the priorities and gives an indication on the awareness of *Legionella* risk in the countries of the pan-European region.
A total of 345 scientific papers in English were retrieved from the last 10 years (2015-2024), that address environmental surveillance or environmental prevalence in the region (Fig. 14.) Two-thirds of the reports originated from 6 countries (France, Germany, Italy, Netherlands, Spain and United Kingdom), while very limited number of studies were available from the Baltic and Balkan countries and none (in English) from the EECCA countries. In Russian, 82 scientific papers were available on legionellae in general, about half of which included information on environmental samples as part of source investigation of legionellosis cases. Russian research papers referred primarily to studies conducted in Russia, with a few additional papers addressing Belarus (6) and Kazakhstan (1).
These regional differences reflect multiple challenges in *Legionella* prevention. Some countries have limited laboratory capacities either for human diagnostics or for environmental monitoring. Lack of capacities lead to underdiagnosis of legionellosis cases and lack of information on environmental prevalence, which in turn results in low awareness of the associated risks. In other countries, other water related diseases (e.g. enteric diseases) are prioritized over legionellosis due to higher burden of disease.

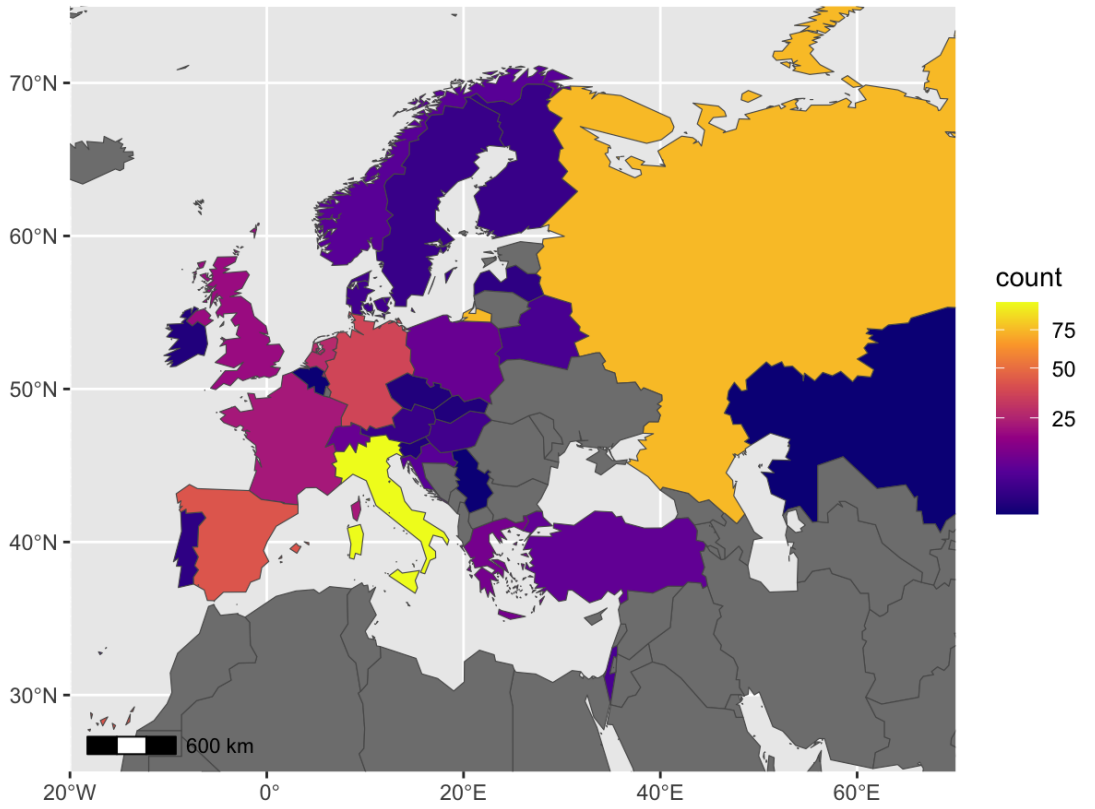

Figure 14. *Geographical distribution of scientific papers on environmental prevalence of Legionella in the pan-European region. Studies on Belarus, Kazakhstan, Russia were published in Russian (n=82), reports from other countries the region in English (n=350).*

Vast majority of the scientific papers focuses on drinking water and hot water systems (Fig. 15). Although major outbreaks in the region were associated with cooling towers (see Chapter x), colonisation of premise plumbing poses a long-term risk for the users of the facility, especially in healthcare facilities.

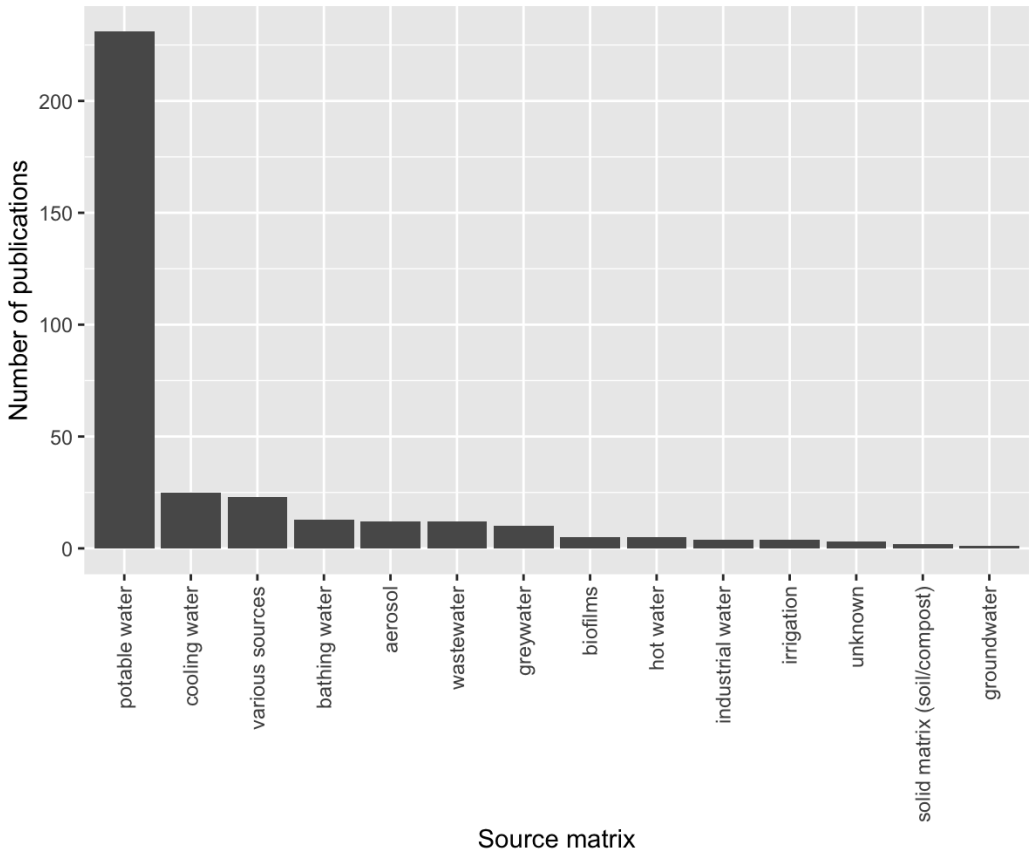

Figure 15. *Distribution of English scientific papers according to the investigated risk matrices (n=350)*

Healthcare facilities

Hospital water systems are a public health priority due to the presence of immunocompromised patients and are therefore in the focus of research (Fig. 16). Studies on Legionella prevalence in hospital premise plumbing revealed diverse rates of colonisation both within and between countries, ranging from 12% to 72%. The most commonly isolated species was *Legionella pneumophila* serogroups 2–14.

High water temperature was identified as a critical control factor in colonisation. Samples with water temperatures ≥55°C had significantly lower contamination rates. However, elevated water temperature in itself was not always sufficient. Design or operational problems leading to low or no flow sections within the premise plumbing increased colonisation rates significantly. Non-conventional reservoirs, such as toilet flushing cisterns were also identified.

Long-term studies of hospitals, such as reported from Italy, showed that combined interventions in a Water Safety Plan (WSP) approach, including site-specific risk assessment, continuous monitoring and often additional chemical disinfection were efficient in reducing or preventing *Legionella* colonisation.

Monochloramine, chlorine dioxide, copper-silver ionization, and hyperchlorination were applied in the studies as chemical disinfectants. Continuous chemical disinfection generally proved effective, maintaining low *Legionella* levels over several years, though some persistent contamination by *Pseudomonas aeruginosa* was noted. Shock disinfection methods, such as hyperchlorination or thermal shock often had only temporary effects. Innovative approaches, such as fixed time flush taps also contribute to reducing *Legionella* levels.

Hotels

Hotels and other accommodation sites have also been investigated extensively (Fig. 16.). Travel associated legionellosis is only second to nosocomial (see Chapter x). This phenomenon was associated with the increased vulnerability of people to the distinct microbial communities in their travel destination compared to their residence.

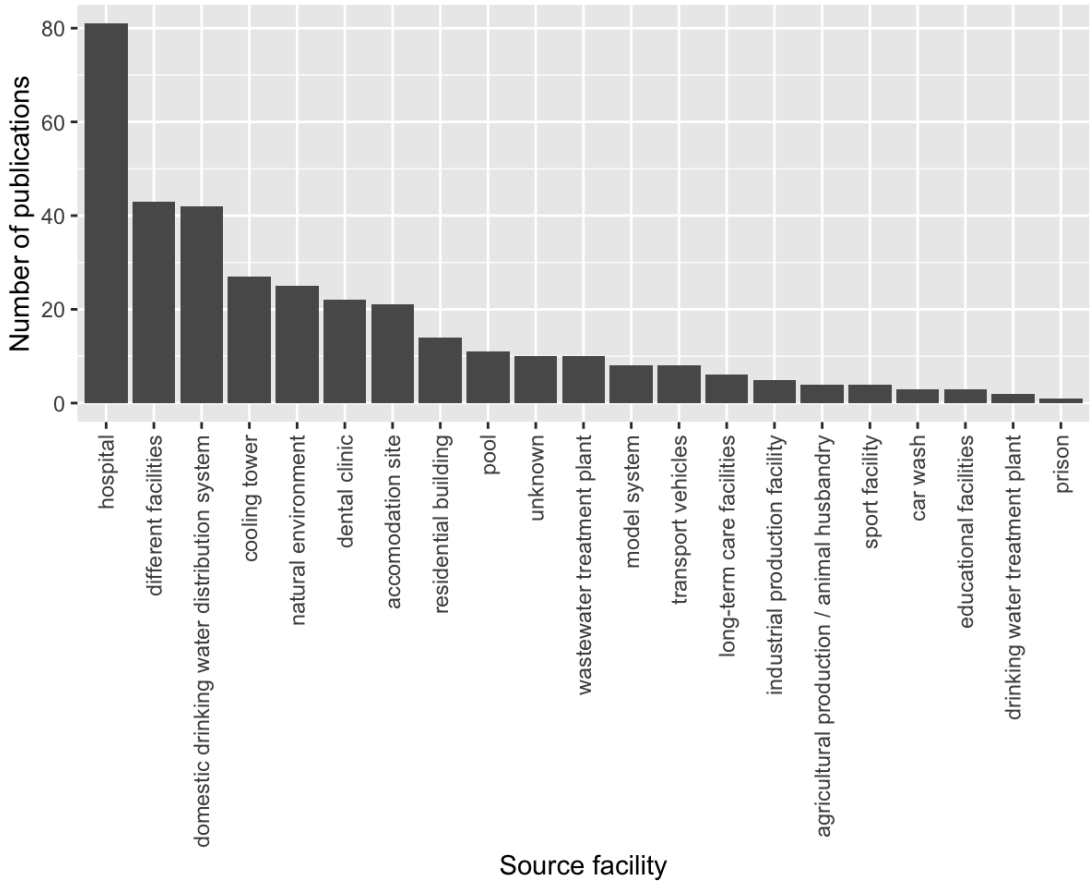

Figure 16. *Distribution of English scientific papers according to the investigated facilities (n=350)*

Several studies conducted across Europe, including Spain, Croatia, Latvia, Italy and Turkey, have revealed consistently high rates of colonization (25-59%), underscoring the need for rigorous risk assessment and effective control strategies. *Legionella pneumophila* is the most commonly isolated species, though other species, including novel ones, were also detected. The COVID-19 pandemic further increased risks of colonisation in hotels affected by the lockdowns. Adequate reopening protocols are necessary after extended period of closure. As in hospitals, continuous chemical disinfection (e.g hydrogen-peroxide and polyphosphates, Neutral Electrolysed Oxidising Water) reduced *Legionella* levels in hotels. The efficiency one-off thermal shock disinfection was limited, but the superheat-and-flush method is a recognised and efficient preventive measure.

Residential buildings

Residential buildings were slower to gain attention, but recent studies show that domestic water systems may play a critical role in community-acquired legionellosis). Surveys across Europe demonstrate the widespread presence of *Legionella* in

household distribution networks (ranging from 8-56% in different countries), especially hot water systems, though drinking water pipes may also be colonised. *Legionella* prevalence was associated with the age of the building, infrequent use of taps or showers, inadequate cleaning, low chlorine levels, low or fluctuating temperature and solar or central water heating in different locations. Genomic epidemiology revealed the presence of diverse strains, including ones with high pathogenicity in residential buildings. Studies confirmed the increase of cell counts from the point of entry to the building towards distal pipe sections, underscoring that monitoring strategies should focus on distant taps as sampling locations.
Data on *Legionella* prevalence in residential buildings are primarily from targeted one-off sampling campaign. Only a handful of countries require regular monitoring in all residential buildings or a subset of homes (e.g. rentals) (see also Chapter y). The example of Germany where several years of monitoring data (millions of records) are available failed to demonstrate a clear association of *Legionella* prevalence in residential buildings and community acquired legionellosis case numbers, challenging the usefulness of regular monitoring in these settings.

Dental unit waterlines

The water quality of dental unit waterlines (DUWLs) is an increasingly recognised health risk, due to the frequent formation of biofilms and subsequent microbial proliferation in the waterlines of the dental chairs. Consistently high counts of *Legionella* spp., *Pseudomonas aeruginosa*, various fungi and free living amoebae were detected in the output water. Since dental handpieces generate fine aerosol, DUWL water potentially exposes both patients and dental staff to the risk of infection.
Design of DUWLs and the type of water used in the device are critical factors in prevention. The lack of anti-retraction valves and poor adherence to maintenance and disinfection protocols lead to increased colonisation rates. Biofilm formation may occur even before the first use but increases over time in the absence of adequate disinfection. Shock disinfection protocols using hydrogen peroxide, chlorine dioxide, or silver ion-based solutions have been employed with varying degrees of success.
Safe operation of DUWLs entails continuous or periodic disinfection, good operation practices to reduce stagnation and retraction, regular monitoring and increased awareness of the dental staff to water related risks.

Cooling towers

Cooling towers, essential components of heating, ventilation, and air-conditioning (HVAC) systems, have been consistently identified as significant risk settings for the proliferation of *Legionella* and other opportunistic pathogens. Their semi-open water basins provide ideal conditions for microbial growth, including biofilm formation, and have been repeatedly associated with extensive outbreaks of Legionnaires' disease (see Chapter x).
Recent microbiological analyses of cooling tower water revealed that the bacterial diversity is lower than in natural freshwater systems but characterized by opportunistic pathogens such as *Legionella, Mycobacterium*, and *Pseudomonas*. Seasonal variations significantly impact the microbial community dynamics, and free-living protists, such as amoebae and nematodes, were found to play an important role as reservoirs and transmission vectors for *Legionella*. Non-pneumophila legionellae (e.g. *L. anisa* and *L. jordani*) were detected more frequently in cooling water than in other waters.

Legionella counts can reach extreme levels in cooling waters, and prevalence is not reliably indicated by heterotrophic plate count. Continuous disinfection was demonstrated to be necessary to limit the growth of opportunistic pathogens in cooling towers, and the choice of disinfectant is critical in reaching adequate disinfection efficiency.

Pools and spas

Compared to the relevance of pools and spas as sources of legionellosis outbreaks (see Chapter x), the number of environmental prevalence studies is relatively low. Majority of the reports are case investigations including source identification. These studies usually highlight the need for good operation practices and adequate disinfection for the prevention of recreational water related infections. Monitoring of swimming pools (Croatia) indicated lower colonisation rates than in Turkish baths (Turkey) or sit baths in hospitals (used for hygienic, rather that recreational purposes) (Italy).The COVID-19 lockdown lead to water quality deterioration in recreational facilities, including higher *Legionella* prevalence. Using multiple barriers (microfiltration, UV, superheating, frequent descaling) in a WSP approach was demonstrated to be suitable for *Legionella* control in a hydrotherapy facility (Italy). Use of rainwater as a sustainable solution in splash parks may introduce increased risk of infection and should therefore meet rigorous quality standards.

Alternative water sources (greywater/rainwater)

Greywater and rainwater systems are increasingly explored as alternative water sources to alleviate the pressure on potable water supplies. However, they present new public health challenges, particularly related to the proliferation of opportunistic pathogens like Legionella pneumophila.

Studies have shown that Legionella can survive and proliferate in both greywater and rainwater systems, often reaching concentrations comparable to or even exceeding those found in potable water. Treatment and disinfection can reduce these risks for non-potable uses such as toilet flushing and garden irrigation. In household rainwater tanks, *Legionella* was almost universally detected, suggesting that fine spray irrigation using collected rainwater can pose a risk of infection. Legionellosis outbreaks have been associated with urban sprinkler systems in multiple locations in Spain. In urban stormwater storage features legionellae were less prevalent and probably low risk compared to other (e.g. fecal) pathogens collected in the run-off.

Wastewater

Wastewater is increasingly but relatively recently recognized as a potential source of legionellosis infections thus the evidence is limited and mainly focuses on outbreak investigations. Legionella prevalence was associated with the temperature and composition of the wastewater, while exposure (i.e. generation and particle size of the aerosol) with the design of the wastewater treatment plant.

Detection methods for legionellae

While the literature search was focusing on environmental prevalence, on the sidelines other aspects have also emerged which bear relevance for *Legionella* monitoring and control.

The standard culture-based methods for *Legionella* detection on selective media require 7 to 10 days, which is an obstacle in timely response to non-compliances or outbreak investigation. The presence of viable but non culturable legionellae leads to to underestimation of contamination rates and the associated risk. Complex matrices, such as greywater and wastewater are especially difficult to monitor by standard methods.

The divergence of molecular and culture method can be striking, especially in waters with high organic matter content and microbial count. For example, in a study of wastewater samples, 100% and 7%, in cooling water 68% and 0% were found to be positive for *Legionella* by PCR-based methods and culture, respectively. Molecular methods and other suggested alternative (e.g. immunomagnetic separation) methods are significantly faster, yielding results in hours rather than days. Most regulatory values (including the one set by the EU DWD), however, are still linked to culture-based methods. Molecular methods, including sequence-based techniques also support genetic epidemiology, source identification and genetic characterization of antimicrobial resistance.

Risk management

Despite the diversity of settings and matrices, the recommendations for preventive and risk management measures have many elements in common in the studies.

Water safety planning and risk-based surveillance has been strongly recommended for all risk settings as the cornerstone of *Legionella* prevention and control. While optimising engineering aspects in design and operation of water systems is critical, and "keeping hot water hot and cold water cold" limits *Legionella* proliferation, in most settings an adequate disinfection scheme is indispensable. Cleaning and maintenance to prevent or reduce biofilm formation is also an important element of risk management.

Incidence and outbreaks of legionellosis in the pan-European region

Data collection and reporting of legionellosis (as for other infectious diseases) in most countries carried out through multiple system: case-based or event-based surveillance systems discriminate between sporadic and outbreak related cases. In case of legionellosis, community acquired, travel-associated and hospital-acquired infections might be reported and analysed separately by national public health surveillance systems.

For example, the European Center for Disease Control (ECDC) collects legionellosis surveillance data through three different schemes: annual Legionnaires´ disease cases reported in EU Member States, Iceland and Norway; annual outbreak events detected and reported in EU Member States, Iceland and Norway; and travel-associated cases through the European Legionnnaires´ diseases surveillance network (ELDSNet), including reports from countries outside the EU/EEA.

The present overview also collates information on legionellosis incidences and outbreaks from different sources that might in some instances lead to discrepancies in the data derived from different reporting systems.

National summary reports (2019) submitted by the Parties to the fifth session Meeting of the Parties of the Protocol on Water and Health

Under the Protocol on Water and Health, parties are requested to provide summary reports giving an overview of the national situation with water, sanitation, hygiene and health every three years. For the reporting cycle 2019 a total of 34 countries submitted summary reports. An overview about the reported incidences per 100,000 population and the number of outbreaks reported per EURO country is provided in Table 1.
Information about legionella incidences were provided by 18 parties (Azerbaidjan, Croatia, Czechia, Estonia, Finland, France, Germany, Hungary, Israel, Latvia, Lithuania, Malta, Netherlands, Norway, Portugal, Russian Federation, Ukraine, Uzbekistan). Malta, France and the Netherlands reported the highest incidences with 2.5, 2.4 and 2.27 cases/100,000 population respectively. The lowest incidence has been reported by the Russian Federation with 0.01 in 2018.

Four EECCA countries indicated cases of legionellosis over the past 5 years: Belarus (3 cases of legionellosis, 2 in 2018, one in 2016); Russian Federation (incidence): 0.02 in 2017; 0.01 in 2018 (up to 27 cases per year); Ukraine (2 cases of legionellosis (2017, 2014) and Republic of Moldova (one case of legionellosis between 2013-2018).

Several countries reported water-related outbreaks (not limited to legionellosis). Germany reported 10 water-related outbreaks for 2018 and Finland (2017) and Portugal (2018) three outbreaks each. 12 countries (Azerbaidjan, Belgium, Croatia, Estonia, Israel, Malta, Norway, Russian Federation, Ukraine, Uzbekistan) reported zero outbreaks and additional five countries didn´t provide information on the water-related outbreaks.

Additonal information related to surveillance of water-related outbreaks and legionellosis are provided by 16 countries (Azerbaidjan, Belarus, Belgium, Estonia, Finland, France, Germany, Hungary, Israel, Latvia, Netherlands, Norway, Portugal, Republic of Moldova, Spain, Switzerland, Ukraine) (table4). The information provided covers a range of topics. It is additional information about number of cases (e.g. France), outbreaks (e.g. Finland) or legislation related to legionella prevention and control (e.g. Belgium). Other additional information refers to national surveillance measures (e.g. Netherlands). For the Russian language countries, only Azerbaijan indicated target dedicated to legionellosis: “Improve the potential for detection, epidemiological investigation of legionellosis)” (2020).

Table 3- Incidences and numbers of outbreaks as reported by countries in the national summary report under the Protocol on Water and Health.

		Incidence to 100,000 (all exposure routes)			Number of outbreaks (related to water)		
Country	National report?	Baseline*	Value reported in the previous reporting cycle*	Current value*	Baseline*	Value reported in the previous reporting cycle*	Current value*
Albania	YES	no information provided			no information provided		
Andorra	YES	no information provided			no information provided		
Armenia	Yes	no information provided			no information provided		
Austria	NO						
Azerbaijan	YES	0 (2005)	0 (2015)	0 (2018)	0 (2005)	0 (2015)	0 (2018)
Belarus	YES	n.d. (2009)	n.d. (2015)	n.d. (2018)	n.d. (2009)	n.d. (2015)	n.d. (2018)
Belgium	YES	not stable	not reported	no information	0	0	0
Bosnia and Herzegovina	YES	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
Bulgaria	NO						
Croatia	YES	0 (1985)	1.17 (2015)	1.84 (2018)	n.d. (1985)	0 (2015)	0 (2018)
Cyprus	NO						
Czechia	YES	0,088 / 9 (2005)	1,138 / 120 (2015)	2,008 / 213 (2018)	0 (2005)	0 (2015)	0 (2018)
Denmark	NO						
Estonia	YES	0,4 (2009)	0,5 (2015)	1,4 (2018)	0 (2009)	0 (2015)	0 (2018)
Finland	YES	n.d. (2005)	n.d. (2014)	0,5 (2017)	n.d. (2005)	n.d. (2014)	3 (2017)
France	YES						
Whole of France		2,0/100.000	2,1/100.000	2,4/100.000	no information provided		
Brittany		0,8/100.000	1,0/100.000	0,8/100.000	no information provided		
Franche-Comté		5,9/100.000	4,8/100.000	4,2/100.000	no information provided		
Georgia	YES	n.d. (2005)					
Germany	YES	503 (1.1/100.000) (2009)	880 (1.1/100.000) (2015)	1,443 (1.7/100.000) (2018)	6 (2009)	5 (2015)	10 (2018)
Greece	NO						
Hungary	YES	0,3* (2008)	0,3 (2014)	0,6 (2017)	n.d. (2008)	n.d. (2014)	n.d. (2017)
Iceland	NO						
Ireland	NO						
Israel	YES	0.82 (2015/16)	0.8 (2016)	0.8 (2017)	0 (2015/16)	0 (2016)	0 (2017)
Italy	NO						
Kazakhstan	NO						
Kyrgyzstan	NO						
Latvia	YES	0 (2005)	1,1 (2015)	1,9 (2018)	0	0	0
Lithuania	YES	0,36(2016)	0,52(2017)	0,74(2018)	n.d	n.d	n.d
Luxembourg	YES	no information provided					
Malta	YES	1.8 (2014-2018)	not reported	2.5 (2018)	0 (2014-2018)	0 (2015)	0 (2018)
Monaco	NO						
Montenegro	NO						
Netherlands	YES	n.d	n.d	2.27 (2017)	n.d	n.d	n.d
North Macedonia	NO						
Norway	YES	2.4(2004)	0.4(2015)	0.6(2018)	0(2005)	0(2015)	0(2018)
Poland	NO						
Portugal	YES	0.52 (2005)	0.28 (2015)	2.05 (2018)	n.d (2005)	1 (2015)	3 (2018)
Republic of Moldova	YES	n.d	n.d	n.d	n.d	n.d	n.d
Romania	YES	n.d	n.d	n.d	n.d	n.d	n.d
Russian Federation	YES	0.02 (2017)		0.01 (2018)	0 (2017)		0 (2018)
San Marino	NO						
Serbia	YES	n.d	n.d	n.d	n.d	n.d	n.d
Slovakia	YES	n.d	n.d	n.d	n.d	n.d	n.d
Slovenia	YES	no information provided			no information provided		
Spain	YES	n.d	n.d	n.d	n.d	n.d	n.d
Sweden	NO						
Switzerland	YES	n.d	n.d	n.d	n.d	n.d	n.d
Tajikistan	YES	n.d	n.d	n.d	n.d	n.d	n.d
Turkey	NO						
Turkmenistan	NO						
Ukraine	YES	0.002(2014)	0.002(2017)	0.0(2018)	1(2014)	1(2017)	0(2018)
United Kingdom of Great Britain and Northern Ireland	NO						
Uzbekistan	YES	0 (2005)	0 (2009)	0 (2018)	0 (2005)	0 (2009)	0 (2018)

Table 2- Information on activities and target for legionella as reported by countries in the national summary report under the Protocol on Water and Health.

Country	National summary report	Content
Albania	YES	No information provided for Legionella or Legionellosis
Andorra	YES	No information provided for Legionella or Legionellosis
Armenia	YES	No information provided for Legionella or Legionellosis
Austria	NO	
Azerbaijan	YES	- Improved potential for detecting the incidence of legionellosis -National strategy for combating helminthes infections was prepared and implemented. Currently preparing guidelines for strategy. Improved potential for detecting the incidence of legionellosis cryptosporidiosis and giardiasis. - Launched the preparation of sanitary norms and rules on the safety of drinking water
Belarus	YES	On the basis of the results of R&D, regulatory requirements to legionellosis monitoring were prepared. Approaches to enterovirus infection monitoring and methods for laboratory control were improved. On the basis of the republican unitary enterprise "Scientific and Practical Centre for epidemiology and microbiology", regional reference laboratory on viral pathogen detection operates in the republic.
Belgium	YES	The prevention of Legionella growth in collective warm water systems with the possibility of aerosol formation and a potential risk for Legionella infection, as showers and hot whirlpools, is regulated by the specific Legionella legislation of 09/02/2007. This legislation fits within the framework of the Flemish prevention decree and has been in operation since 04/05/2007. Public swimming pools are classified as low-risk institutions. This means that they must draw up and comply with a risk analysis and a Legionella management plan. The supervision is done by the the Flemish Agency for Care and Health, Department Prevention. Concerning 'wet' cooling towers, special conditions for the prevention of legionella are included in the environmental permit; a management and maintenance plan must be drawn up witch contains information about the treatment program, checks carried out and frequencies of the analyses.
Bosnia and Herzegovina	YES	No information provided on Legionella or Legionellosis
Bulgaria	NO	
Croatia	YES	No information provided on Legionella or Legionellosis
Cyprus	NO	
Czech Republic	YES	No information provided on Legionella or Legionellosis
Denmark	NO	
Estonia	YES	Since 2009, the diagnosis of legionellosis and the advanced system of legionellosis have improved significantly. As a result, the number of cases has been diagnosed with a (continuous) growth trend. In the past years a lot of attention was paid to the diagnosing and registration of legionnellosis.
Finland	YES	During the reporting period, Legionella bacteria have caused several illness cases via contaminated water systems. Hot and cold water systems in a swimming hall, in a hospital and in a dredger have caused totally six cases of Legionnaires' Disease. In addition, legionella in a waste water scrubber sickened two employees. During the reporting period 2016–2018, there were three small pool water outbreaks in which nearly 50 bathers fell ill. Private jacuzzi contaminated by Pseudomonas aeruginosa caused
France	YES	About 1,200 cases of legionellosis are reported every year in France (1630 cases of legionellosis were reported to Regional Health Agencies in France in 2017 when 1218 had been reported in 2016). A study on the geographical (east-west) gradient factors of legionellosis on the territory has been conducted to meet one of the targets established by the National Health and Environment Plan (PNSE). For almost a decade, a training on legionellosis prevention has been included in the annual continuous training program of the School for Higher Education in Public Health (Ecole des hautes études de santé publique (EHESP)). France has published recent recommendations for the management of legionellarelated risks and legionellosis prevention (High Council for Public Health – Haut Conseil de la santé publique (HCSP), Legionellosis-related Risks, Guide on investigation and management support). Given the number of legionellosis cases reported in France in the past few years, further action could be considered on this matter in the context of a new National Health and Environment Plan (PNSE 4).
Georgia	YES	No information provided on Legionella or Legionellosis
Germany	YES	(a) The Robert Koch-Institute developed a system for automatic detection and reporting of case clusters using surveillance data. The system and its reports are provided to health authorities on a weekly basis to facilitate outbreak detection and response. This specifically includes legionellosis and other potentially water-borne pathogens. (b) The Robert Koch-Institute maintains and provides several guidance documents for public health authorities and clinicians to facilitate early diagnosis of cases and adequate response to outbreaks (e.g., for legionellosis: https://www.rki.de/DE/Content/InfAZ/L/Legionellose/OEGD/Dokumente_Tab.html).
Greece	NO	
Hungary	YES	Among the pathogens associated with premis plumbing Legionella sp. Is responsible for msot cases. Number of cases is low 3-4 cases/1 million inhabitants/year. As a proactive measure to prevent outbreaks Ministerial decree 49/2015 (XI. 4.) on public health requirements of Legioneall risk environment was adopted. Underthe Decree, all public facilities are required to assess the risk of Legionella colonisation, and
Iceland	NO	
Ireland	NO	
Israel	YES	Legionella control in Israel is achieved through water supply regulation that mandates purification and inspection of drinking water, and also defines the means to apply in every public facility (especially when a sensitive population, such as children, elders, or immunosuppressed, is concerned). Hence, reported outbreaks are rare in Israel, and annual prevalence is 0.6/100,000.
Italy	NO	
Kazakhstan	NO	
Kyrgyzstan	YES	no information about legionella and legionellosis provided
Latvia	YES	In 2017 research on drinking water risk assessment framework and water safety plans in line with Latvian conditions in accordance with EU legislation and WHO water safety plan guidelines was carried out and a tool for risk assessment was developed (https://www.bior.lv/lv/valsts-delegetas-funkcijas/dzerama-udens-riskanovertesana). Since the last reporting period Laboratory Investigation Module of National Surveillance Information System has been improved. Health Inspectorate uses this system to create reports about drinking water quality. A tool for drinking water monitoring data results report was developed in to National Surveillance Information System which can be used by water providers. The system allows water providers to send data about their water quality via internet to the Health Inspectorate. (https://www.latvija.lv/lv/Epakalpojumi/EP184/Apraksts) Health inspectorate is publishing annual reports on its website and they are available to the public. There are also challenges in relation to Legionella spp. risks in water supply systems of residential buildings, namely the maintenance of hot water temperature and related issues with maintenance of water pipelines (old infrastructure).
Lithuania	YES	no information about legionella and legionellosis provided
Luxembourg	Yes	no information about legionella and legionellosis provided
Malta	NO	
Monaco	NO	
Montenegro	NO	

Country	National summary report	Content
Netherlands	YES	The RIVM annually reports on the number of recreational water, swimming Pool related disease incidents and Legionella incidents. Data for these reports are obtained from the authorities responsible for bathing water quality, i.e. the provinces and Regional Water Authorities, and from the Public Health Authorities (GGD) In 2017, 2.27% of the samples taken for legionella failed the national standard (38 Out of 1,670) RIVM has been involved in Legionella research for many years. Regulation and legislation is focused on drinking water, bathing water and cooling towers. In relation to waste water there is no legionella legislation. Recent development in research and technoiogies for treatment of waste water show that favorable conditions for Legionalle growth are being created. That bas resulted in legionella infections in people living near water water treatment plants, near multiple locations. Yet, other sources of legionella have also been discovered. Continued research is warrented, especially also in relation to climate chaneg effects. (https://www.rivm.nl/legionella) A map with the known cooling towers (that are a risk for spreading legionella through the air) is made available for the public in 2016. People who think they see a cooling tower that is not on the map, can report it in a simple way to the authorities. See www.atlasleefomgeving.nl!nattekoeltorenkaart - Drinking Water Act 42 , Drinking Water Decree 43 , Drinking water Regulation 44 , Legionella Regulation 45 . See also a recent RIVM report: https://www.rivm.nl/publicaties/risicoanalyse en risicomanagement-van-drinkwaterproductie-in-nederland
North Macedonia	NO	
Norway	YES	- In some cases, disease due to Legionella bacteria has been registered as a result of the inhalation of aerosols contaminated with the bacteria. In 2001, 28 persons were registered ill and in 2005 103 persons were registered ill due to Legionella, where the source of infection was water cooling towers and air scrubbers. • Examples of measures: - Supervision including the reviewing of internal control routines. - Monitoring of microbiological parameters (intestinal bacteria, Legionella, etc.).
Poland	NO	
Portugal	YES	
Republic of Moldova	YES	-**(From National program report):** In 2005-2015 there no cases were recorded in Moldova of extremely dangerous infectious diseases caused by water, such as cholera and typhoid. During this period (2014), one epidemic outbreak of viral hepatitis A transmitted through water and as a result of failure to comply with hygiene rule was recorded in Straseni, with 88 cases. As shown in Table 5, there has been a clear trend of decreasing incidence of infectious diseases potentially conditioned by water per 100 thousand people, including a reduction of cases of dysentery and rotavirus infection by over 10 times (in particular by introducing mandatory immunization with antirotaviral vaccine for children), except viral hepatitis A, where the incidence is higher than in 2012 but lower than the baseline since the entry into force of the Protocol, and morbidity is cyclical. A decrease has also been recorded in the incidence of giardiasis (1.8 times) and cryptosporidiosis (8.5 times). In the last 5 years was one single case of 22. Legionellosis has been recorded. It should be noted that data collection is conducted both by the number of cases as well as the number of outbreaks. - ***(From summary report)*** : As shown in Table 7, in the Republic of Moldova there is a decreasing trend in some infectious diseases, potentially water related per 100 thousands population, including a decrease in the number of cases of rotaviral infection more than 10 times (in particular, after the introduction of compulsory rotavirus vaccine immunization of children), except for cases of hepatitis A, where the level of diseases is higher than in 2012, but lower than the initial value since the Protocol started to be implemented, and the morbidity has a cyclical pattern. In addition, the incidence of Giardiasis and Cryptosporidiosis have decreased. Over the past 5 years there has been only one case of Legionellosis. It should be noted that data collection is carried out both by the number of cases and by the number of outbreaks.
Romania	YES	No information provided about Legionella or Legionellosis
Russian Federation	YES	No information provided about Legionella or Legionellosis
San Marino	NO	
Serbia	YES	No information provided about Legionella or Legionellosis
Slovakia	YES	No information provided about Legionella or Legionellosis
Slovenia	YES	No information provided about Legionella or Legionellosis
Spain	YES	**In 2019 protocol report:** Legionella mentioned under urban use of water, Agricultural use of water as**: Other contaminants: Legionella spp 100 CFU/L (risk of aerosolization) From 2020 Protocol targets reprot:** -Regarding the mineral-medicinal waters that govern hot springs and spas, the control of legionellosis, Royal Decree 865/2003, establishes the hygienic-sanitary criteria for its prevention and control. Even so, due to advances in technical and scientific knowledge, an update of said regulation is necessary. - **Legal/ regulatory a**ctions: • Royal Decree 742/2013, September 27, which establishes the technical-sanitary criteria for swimming pools. • Royal Decree 865/2003, of July 4, which establishes the hygienic-sanitary criteria for the prevention and control of legionellos**is.** - **The targets set in Spain according to current le**gislation are: • To improve control and prevention against legionellosis by 2025, responsibility of the M**inistry of Health** - **Proposed measures to achi**eve targets and target dates • Update national regulation for the prevention of legionellosis by **2022 by th**e Ministry of Health. - Indicators: Publication of a new prevention regulation against legionellosis
Sweden	NO	
Switzerland	YES	**From 2017 target** report: No information about legionella and legionellosis provided **From** 2019 report: water-related disease surveillance and early warning systems is included in the detection of food born diseases. An early warning system is actually in development in order to identify more precisely the food related diseases. It is not yet evident to differentiate between food related and water related diseases, except for specific microorganisms like legionella
Tajikistan	YES	no information about legionella and legionellosis provided
Turkey	NO	
Turkmenistan	NO	
Ukraine	YES	- **From 2019 Protocol report:** Indicator 4.1: Incidences of diseases in absolute values(all transmission factors) among the population in 2025 will be: -Legionella disease – 0
United Kingdom of Great Britain and Northern Ireland	NO	
Uzbekistan	YES	no information about legionella and legionellosis provided

European Legionnaires' Disease Surveillance Network (ELDSNet), coordinated by the European Centre for Disease Prevention and Control (ECDC)

European Legionnaires´Disease Surveillance Network (ELDSNet) collects information on community acquired and travel-associated cases of legionellosis. Member States of the European Union also report outbreaks of legionellosis to the ELDSNet. The data can be accessed online by Member States and the ECDC is also providing summary reports.

According to the annual report of 2019, 28 countries reported a total of 11,298 cases of legionellosis (Table 3). The number of notifications per 100,000 population remained stable at 2.2, which is the highest notification rate ever observed by ECDC. In the last five years, the notification rates have nearly doubled in the EU/EEA, from 1.4 in 2015 to 2.2 per 100,000 population. France, Germany, Italy and Spain, accounted for 71% of all notified cases, although their combined populations only represent approximately 50% of the EU/EEA population.

Table 5: Distribution of Legionnaires' disease cases and rates per 100,000 population by country and year, EU/EEA, 2015–2019 (Source: Legionnaires´disease -Annual Epidemiological Report for 2019, ECDC)

Country	2015		2016		2017		2018		2019		
	Number	Rate	Number	Rate	Number	Rate	Number	Rate	Number	Rate	ASR
Austria	160	1,9	161	1,9	219	2,5	237	2,7	255	2,9	2,6
Belgium	118	1,1	157	1,4	235	2,1	270	2,4	224	2,0	1,8
Bulgaria	1	0,0	0,0	0,0	2	0,0	11	0,2	5,0	0,1	0,1
Croatia	48	1,1	31	0,7	33	0,8	43	1,0	-	-	-
Cyprus	2	0,2	3	0,4	1	0,1	5	0,6	4	0,5	0,5
Czechia	120	1,1	147	1,4	217	2,1	231	2,2	277	2,6	2,3
Denmark	185	3,3	170	3,0	278	4,8	264	4,6	270	4,7	4,2
Estonia	6	0,5	14	1,1	16	1,2	18	1,4	12	0,9	0,8
Finland	17	0,3	15	0,3	27	0,5	24	0,4	44	0,8	0,7
France	1389	2,1	1218	1,8	1630	2,4	2133	3,2	1816	2,7	2,5
Germany	842	1,0	974	1,2	1278	1,5	1446	1,7	1545	1,9	1,6
Greece	29	0,3	31	0,3	43	0,04	65	0,6	45	0,4	0,4
Hungary	58	0,6	66	0,7	62	0,6	74	0,8	113	1,2	1,1
Iceland	1	0,03	3	0,9	2037	3,4	3018	5,0	3143	5,2	4,2
Ireland	11	0,02	10	0,02	25	0,5	25	0,5	21	0,4	0,5
Italy	1572	2,6	1733	2,9	2037	3,4	3018	5,0	3143	5,2	4,2
Latvia	22	1,1	24	1,2	31	1,6	37	1,9	42	2,2	2,1
Liechtenstein	.	.	.	.	.	.	.	.	.	.	.
Lithuania	7	0,2	11	0,04	14	0,05	21	0,7	17	0,6	0,6
Luxemburg	5	0,9	3	0,5	9	1,5	10	1,7	14	2,3	2,3
Malta	6	1,4	8	1,8	11	2,4	13	2,7	5	1,0	0,8
Netherlands	419	2,5	454	2,7	561	3,3	584	3,4	566	3,3	3,0
Norway	60	1,2	43	0,8	52	1,0	69	1,3	65	1,2	1,2
Poland	23	0,1	24	0,1	38	0,1	70	0,2	74	0,2	0,2
Portugal	145	1,4	197	1,9	232	2,3	211	2,1	201	2,0	1,7
Romania	3	0,0	2	0,0	19	0,1	62	0,3	19	0,1	0,1
Slovakia	14	0,3	14	0,3	14	0,3	54	1,0	85	1,6	1,6
Slovenia	106	5,1	93	4,5	117	5,7	160	7,7	195	9,4	8,3
Spain	1024	2,2	951	2,0	1363	2,9	1513	3,2	1542	3,3	2,9
Sweden	142	1,5	145	1,5	189	1,9	198	2,0	182	1,8	1,6
United Kingdom	412	0,6	383	0,06	504	0,08	532	0,8	517	0,08	0,07
EU-EEA	**6947**	**1,4**	**7085**	**1,4**	**92602**	**1,8**	**11403**	**2,2**	**11298**	**2,2**	**1,9**

Source: Country reports
ASR: age-standardised rate.
.: no data reported
-: no rate calculated

Legionella outbreaks reported in the scientific literature

Outbreaks reported in the English language scientific literature occurred in 34 of the 53 countries of the WHO EURO Region between 2011 and 2021. Aside from outbreak reports also publications related to Legionella and legionellosis were found (Figure 18). The Information from EECCA countries is sparse and only a single outbreak report

outside the targeted timeframe is available from the Russian Federation (2007) A reference list of all the 113 English language and 94 Russian language articles is provided in the Annex.

An analysis of the number of published articles per country revealed that, Portugal 11 (Camoes et al. 2021; Almeida et al. 2021; Russo et al. 2018; Lopes und Araujo 2017; Borges et al. 2016; Amann et al. 2015; Dias et al. 2017; Cysneiros et al. 2015; Dias et al. 2015; Shivaji et al. 2014; Branco et al. 2016), Spain 9 ((March et al. 2019; Cebrian et al. 2018; Abad Sanz et al. 2014; Romay-Lema et al. 2018; Sanchez-Buso et al. 2014; Vanaclocha et al. 2012; Consuegro et al. 2017; Coscolla et al. 2014; Gomez-Barroso et al. 2011), UK 7 (Othieno et al. 2014; Potts et al. 2013; Irons et al. 2013; McCormick et al. 2012; Buckley et al. 2018; Bennett et al. 2014; Wise 2014; Ahmed und Mustfa 2014; Ahmed et al. 2013; Coetzee et al. 2012; McAdam et al. 2014; Crook et al. 2020), and Germany 7 (Essig et al. 2016; Lueck et al. 2015; Lueck et al. 2013; Gonser 2011; Burckhardt et al. 2016; Maisa et al. 2015; Exner 2012) are publishing most with 7 to 9 scientific publications about legionella outbreaks during the period of 2011-2021 (Figure 4). Italy 6 (Scaturro et al. 2021; Faccini et al. 2020; Scaturro et al. 2015; Montagna et al. 2014; Montagna et al. 2012; Fasciana et al. 2019), Netherlands 4 (Loenenbach et al. 2018; Euser et al. 2012; Brandsema et al. 2014; van Loenhout et al. 2014), France 4 (Hasni et al. 2020; Couturier et al. 2020; Saliou et al. 2016; Sobral et al. 2011), Switzerland 3 (Zanella et al. 2018; Conza et al. 2013; Fischer et al. 2020), Sweden (Lof et al. 2021; Ulleryd et al. 2012), Scotland 6 (Potts et al. 2013; Cameron et al. 2016; Irons et al. 2013; Othieno et al. 2014; McCormick et al. 2012; McAdam et al. 2014) ,Norway 2 (Simonsen et al. 2015; Dybwad et al. 2016), Ireland 2 (Kelly et al. 2016; Ryan et al. 2012), Poland (Karczewski 2020; Gladysz et al. 2021), Slovenia 2 (Skaza et al. 2012; Yu und Stout 2012) and Greece (Alexandropoulou et al. 2015; Fragou et al. 2012) published between two and 6 articles in the analysed 10 year period. For Belgium (Hammami et al. 2019) Cyprus (Yiallouros et al. 2013), Denmark (Krojgaard et al. 2011b), Lativa (Rozentale et al. 2011), , and Turkey (Erdogan und Arslan 2013) one publication each was found.

The predominant species responsible for outbreaks is *Legionella pneumophila* serogrop 1. But also *L. longbeachae* (Cameron et al. 2016; Potts et al. 2013) was reported. There is a strong variation in the number of cases (2 - >800) and the duration that the outbreaks lasts (one month to more than a year). Looking at the sources responsible for outbreaks, the majority of published articles reporting about outbreaks were those associated with cooling towers as the source of the outbreak (29) (Potts et al. 2013; Hammami et al. 2019; Burckhardt et al. 2016; Essig et al. 2016; Gonser 2011; Lueck et al. 2013; Maisa et al. 2015; Almeida et al. 2021; Scaturro et al. 2021; Scaturro et al. 2015; McCormick et al. 2012; Ulleryd et al. 2012; Zanella et al. 2018; Othieno et al. 2014; Lueck et al. 2015; Alexandropoulou et al. 2015; Hasni et al. 2020; Borges et al. 2016; Lopes und Araujo 2017; Russo et al. 2018; Cebrian et al. 2018; Consuegro et al. 2017; Walser et al. 2014; Conza et al. 2013; Crook et al. 2020; Irons et al. 2013; McAdam et al. 2014; Reuter et al. 2013). Water supply systems in buildings as a source for an outbreak were published in 11 articles (Montagna et al. 2014; Pancer 2013; Fragou et al. 2012; Krojgaard et al. 2011a; Fasciana et al. 2019; Rozentale et al. 2011; Skaza et al. 2012; Vanaclocha et al. 2012; Erdogan und Arslan 2013; Buckley et al. 2018; Saliou et al. 2016), while spas and pools (4) (Montagna et al. 2012; Ahmed et al. 2013; Ahmed und Mustfa 2014; Coetzee et al. 2012), fountains (2) (Faccini et al.

2020; Abad Sanz et al. 2014), showers (March et al. 2019; Euser et al. 2012) and wastewater treatment plants (3) (Loenenbach et al. 2018; Hartmann et al. 2019; Nogueira et al. 2016) were less represented in the literature. There were five publications where not a single source for the outbreak could be detected during the investigations (Sobral et al. 2011; Exner 2012; Macfarlane und Worboys 2012; Kelly et al. 2016; Ryan et al. 2012) and in 11 publications other sources (Bennett et al. 2014; Simonsen et al. 2015; Dabrera et al. 2017; Lof et al. 2021; Wise 2014; Brodhun et al. 2019; Villanueva und Schepanski 2019; Yiallouros et al. 2013; Couturier et al. 2020), such as an asphalt paving machine (Sanchez-Buso et al. 2014) or potting soil (Lindsay et al. 2012)were described.

Some outbreak reports investigate the outbreak strains on a molecular level and compare them with strains of *L. pneumophila* obtained from the environment to reveal or confirm the environmental source of the outbreak (Svarrer und Uldum 2012; Sanchez-Buso et al. 2014; Reuter et al. 2013; Ginevra et al. 2012; Petzold et al. 2017b). Other authors work on diagnostic tools to improve the detection of Legionella (Jorgensen et al. 2015; Petzold et al. 2017a; Spies et al. 2018; Sartory et al. 2017; Garcia-Nunez et al. 2013; Gruas et al. 2014; Gruas et al. 2013; Prucha 2016), the clinically relevant biological features of the pathogen (Palusińska-Szysz et al. 2019; Kowalczyk et al. 2021; Noah et al. 2013; Ragull et al. 2011; Katsiaflaka et al. 2016; Petzold et al. 2017a). Beaute et al. (2016) provide an overview on short-term effects of weather conditions on the notification rate in four European countries and also Conzan et al (2013) addresses meteorological risk factors (Beaute et al. 2016; Conza et al. 2013) while other author focus on tools to improve outbreak response and management and risk management (Bull et al. 2012; Gleason et al. 2017; Freudenmann et al. 2011; Hartmann et al. 2019; Sansom et al. 2013; Veenstra und van Steenbergen 2014; Hadjichristodoulou et al. 2013; Hancock et al. 2014; Marchesi et al. 2011; Borella et al. 2016) including methods for water and soil desinfection (Laird et al. 2014) and water droplet splashing (Koch und Grichnik 2016).

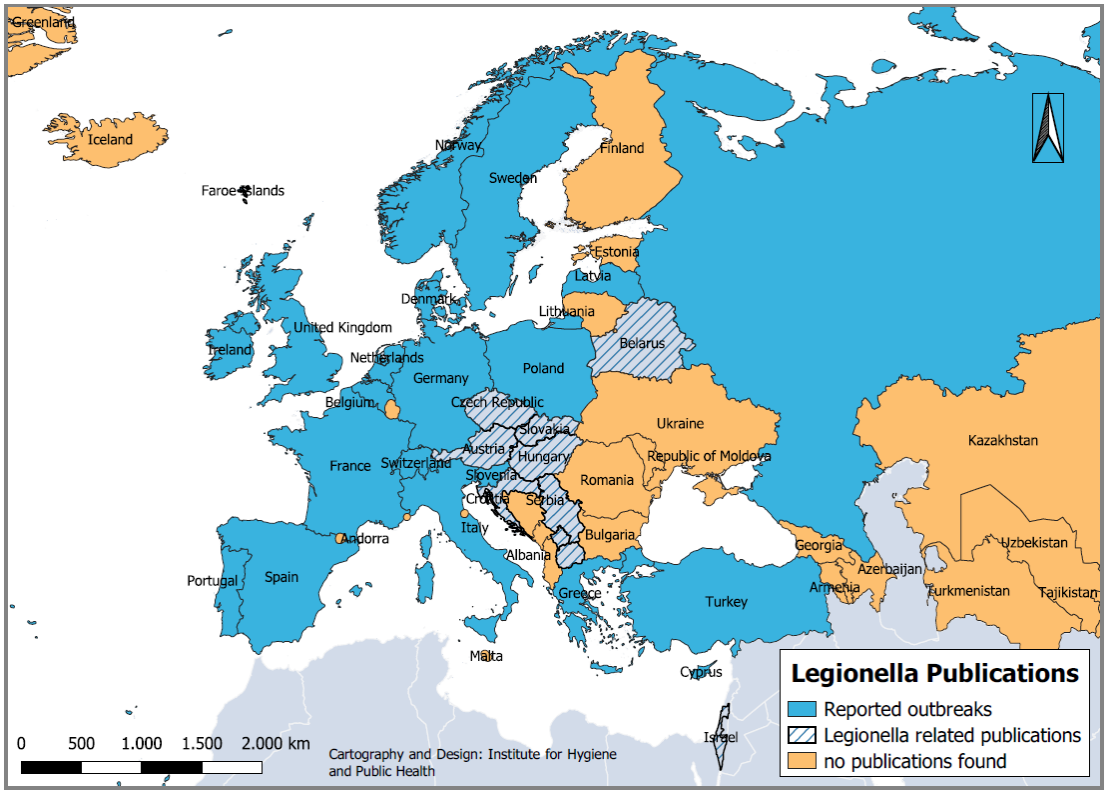

Figure 17: Map displaying countries in the WHO European Region that have published about legionella outbreak or other legionella related topics.

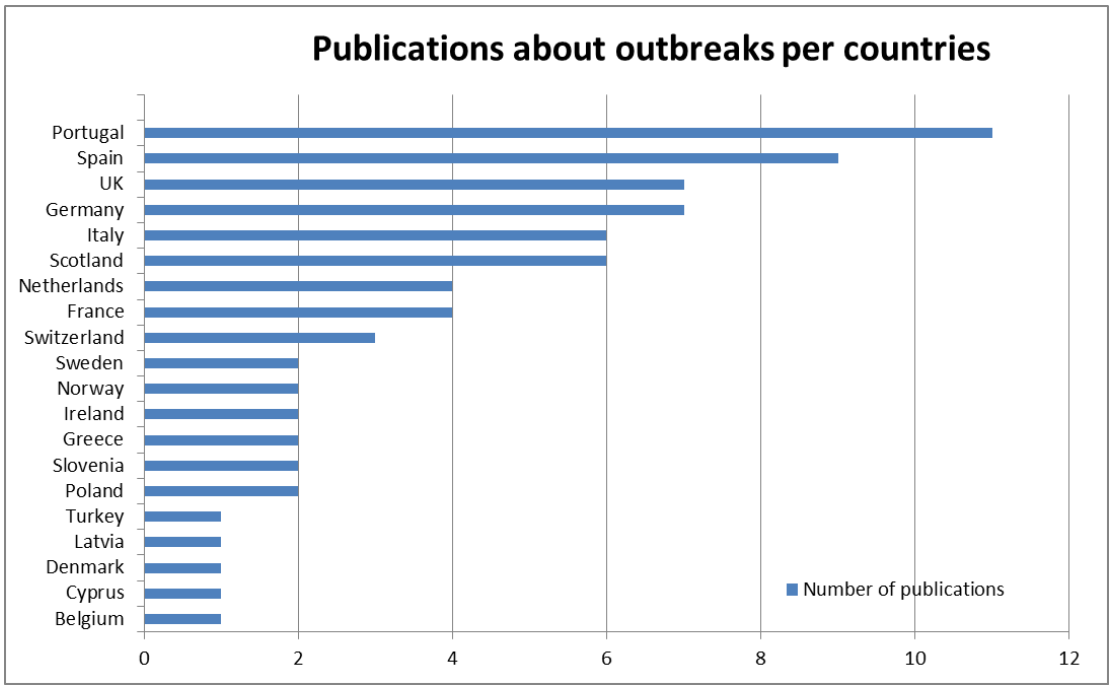

Figure 18: Diagram showing the publications about legionella outbreaks per country

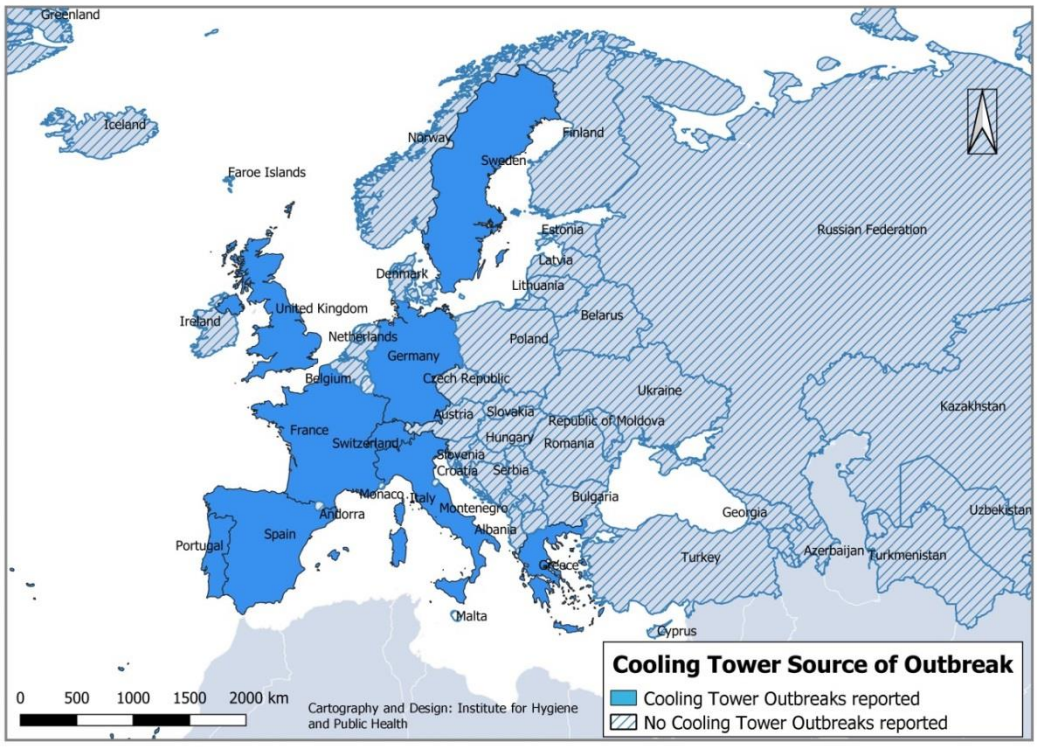

Figure 19: Map displaying countries in the WHO European Region that have published an legionella outbreak caused by cooling towers

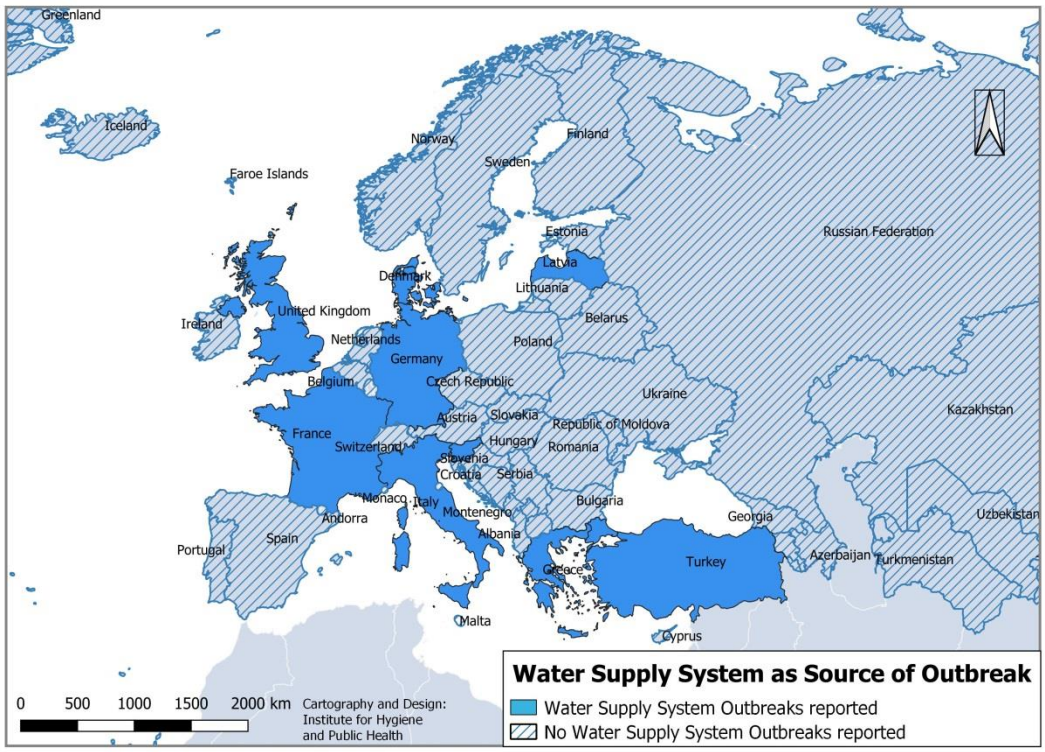

Figure6 : Map displaying countries in the WHO European Region that have published an legionella outbreak caused by the water supply system of a building

In the Russian language articles, no outbreak reports were found. There have been articles published continuously over the past ten years with peaks in 2012 and 2015 (Figure 20). The last recognized outbreak in the Russian Federation occurred in 2007 in Verkhnyaya Pyshma (Middle Urals), accounting for 160 cases and 5 deaths.

During the period 2011-2021, 22 publications were obtained, which in total described 72 cases of sporadic legionellosis. In 68 cases *L. pneumophila* was isolated, in 4 cases *Legionella* spp. The majority of cases of legionellosis occurred between 2010 and 2015. Epidemiological analyses of official statistic data were provided in 18 publications.

The majority of Russian language publications covered environmental water research for legionella detection (41 publications) and many articles provide information about laboratory methods for the detection of legionella (table 7).

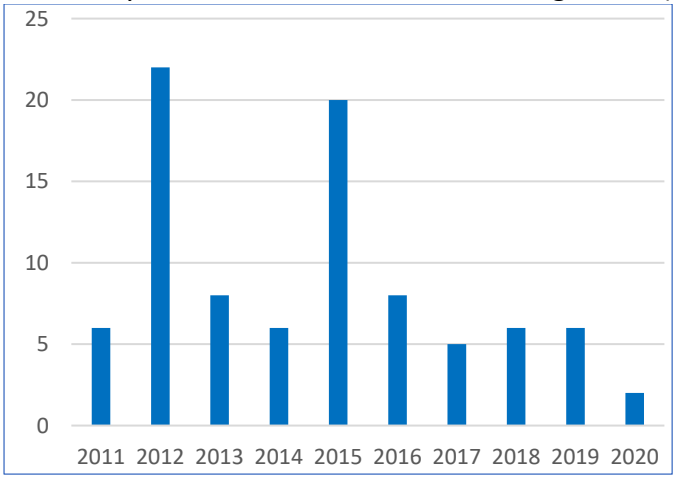

Figure 20: Distribution of numbers of articles published over years in Russian language publications

Table 6– Geographic distribution of publications on legionella since 2011 in EECCA

Geographic region	Articles (n)
Moscow	50
Saint-Petersburg	7
Saratov	7
Minsk	6
Ufa	2
Rostov-on-Don	2
Nizhny Novgorod	1
Sochi	1
Stavropol	1
Novosibirsk	1
Almaty	1
Tula	1
Krasnodar	1
Vladivostok	1

Table 7 - Characteristics of publications on legionella research since 2011 in EECCA

Characteristics	Number of articles

Laboratory methods for detection of legionella (diagnosis of legionellosis):	33
-Bacteriological	31
- PCR	13
- Immunochromatographic	6
- Serological -	2
- ELISA test	1
- Multilocus sequencing, time-of-flight mass spectrometry (MALDI-ToF-MS) and atomic force microscopy	1
- electron microscopy	1
- MLST	1
- Immunochromatographic - Binax Now Legionellosis	1
- Western Blot test	12
The most common combination of methods: PCR + bacteriological	
Experimental articles (Legionella research, development of nutrient media)	17
Laboratory tests with Legionella strains isolated from patients and the environment	47

Conclusions

The relevance of legionellosis prevention in the pan-European region is unquestionable. In high income countries, where public drinking water supply is widely available and the ingress of fecal pollution is rare, it is considered the most important water related disease. In other parts of the region, it is secondary priority compared to gastrointestinal diseases.

Most countries of the region have regulation in place for the environmental control of *Legionella*, either legally binding instruments or guidelines, or a combination of the two. However, the Eastern part of the region was underrepresented in the survey, and among those participating, fewer countries had regulation than in other sub-regions.

Most commonly regulated risk facilities are healthcare facilities, hotels, pools and cooling, though the scope of the regulation varies. Other potential sources, such as composts or wastewater, which are gaining scientific relevance, are not addressed. The responding countries usually apply a risk-based approach, requiring risk assessment and management measures as well as environmental monitoring. Monitoring results are generally not reported on a national level but made available to the public health authority on sanitary visits. Data is used to obtain an overview of the situation, to identify the main sources of *Legionella* exposure, to develop risk management strategies, and to communicate the risks to the stakeholders and the community.

Clinical surveillance is also in place in most countries. Most respondents assume that legionellosis is underdiagnosed and underreported in their country, regardless of the widely different incidence rates (0-12 cases/100,000 inhabitants). According to one estimate, actual case numbers are 20-fold higher than the reported. The reason for underreporting is the low awareness of physicians, they don't think of legionellosis as a potential diagnosis. Identified cases are investigated; data is used to track the burden of disease of legionellosis.

The level of implementation of the regulation on *Legionella* control varies between the countries. Respondents named the lack of financing for risk assessment and risk management as the main challenge in implementation. They also see a wide gap between the awareness of the public health professionals and the general public on the risk of *Legionella.*

Regulation of *Legionella* prevention usually starts with clinical surveillance. The recognition of cases or an outbreak can prompt the development of regulation, but it is not the only factor. International networks such as ECDC and international guidelines on travel associated cases also provide a pressure. But the introduction of a regulation in itself is not sufficient, if it is not implemented and enforced. Further action is needed in the region to raise awareness of healthcare professionals and the general public.

The scientific evidence on environmental prevalence of legionellae is unbalanced both geographically (very limited data from the EECCA countries and more than 2/3 of the reports only from 6 countries) and by risk settings, with a dominance of hospital plumbing systems. The evidence nevertheless calls for wider application of water safety planning and risk-based surveillance in the management of *Legionella* and the improvement of detection methods.

The most comprehensive legionella surveillance system in the WHO European Region is hosted by the European Centre for Disease Prevention and Control (ECDC). Here, community acquired and travel-associated legionellosis cases are recorded and EU member states notify the ECDC about outbreaks taking place. Although many

countries provide summary reports under the Protocol on Water and Health, some of those from EU countries do not include all information that that countries provide to ECDC.

In the EU, 29 outbreaks were reported by France, Germany, Italy, the Netherlands and the United Kingdom in 2019 (ECDC). Many countries in the WHO EURO region have national surveillance systems that work well and reports on incidences and outbreaks are published in national languages. The highest incidences reported were retrieved from Slovenia with 8.3 cases per 100,000 individuals followed by Switzerland with 6.3 cases per 100,000 individuals and Denmark and Italy with 4.2 cases per 100,000. Available publications in Russian language literature were mainly focusing on laboratory detection methods or reporting case studies.

Both the regulatory status, scientific evidence and disease reporting show strong geographic disparities in the region. While many EU countries consider legionellosis the most relevant water-related disease, for most EECCA countries *Legionella* is currently low priority.

During the expert meeting on Legionella which took place virtually from 30 November to 2 December 2021 a number of challenges for the surveillance of legionella and its associated diseases were expressed by the participants.

- *Capacity building:* Countries lack the laboratory capacity and epidemiological outbreak detection capacities. Currently, other diseases (e.g. typhoid fever, hepatitis A) are targeted by public health authorities due to their higher priority
- *Legislative implementation of surveillance and risk assessment:* There is a need to strengthen the implementation of existing laws as well as the surveillance systems.
- *Communication with water professionals; intersectoral cooperation*: Water-related diseases and especially legionellosis demand for an interdisciplinary approach in order to allow efficient risk assessment and management.
- *COVID19 – implications for Legionella prevention:* As a result of the COVID19 pandemic increased risks for the transmission and development of legionellosis can be seen. Water stagnation during times of shut downs promote multiplication of Legionella and patients with COVID19 infection are more susceptible for acquiring a legionellosis.
- *Making best practices available:* There is still a lack of exchange in best practices and countries should be given opportunities to learn from each other and share experiences in the surveillance and management of legionella and legionellosis.

Recommendations

Appendix A – English questionnaire

Survey on the national requirements and practice for *Legionella* surveillance

Introduction

The health concerns related to *Legionella* have been identified as an area of increased public health significance globally, as outbreaks of legionellosis cause a high level of morbidity and mortality. Legionellosis is one of the emerging water-related diseases in the WHO European region. Although *Legionella* is a well-recognized problem in high income countries, data are scarce from low- and middle-income countries and the true burden of legionellosis in the Region is unknown. At the 5th session of the Meeting of the Parties to Protocol on Water and Health, the Parties and other states decided to address this concern as part of the programme area "Preventing and reducing water related disease", lead by Norway and Belarus.

This questionnaire aims to collect information on the regulation and practice of *Legionella* risk assessment and management, including environmental and clinical surveillance. To obtain a complete picture, it might be necessary to involve more experts with different expertise. Please provide a consolidated response through the online submission form by June 30, 2021.

Your country

Your organization (if more people were involved in the questionnaire, please tick all that applies)

- Government organization
- Non-government organization
- Public health institute
- Academic institution
- National authority
- Local authority
- Healthcare
- Other
- Name of the organization(s)

Are you/your organization involved in any of the following? (multiple choice, if more people were involved in the questionnaire, please tick all that applies)

- Setting national policies, regulations and/or standards
- Diagnosis and treatment
- Research
- Health promotion and community education
- *Legionella* risk assessment
- *Legionella* management
- Environmental monitoring and surveillance
- Clinical surveillance
- Outbreak investigation and management
- Other(please specify):

Part A. Regulation

1. Which organization(s) are responsible for regulating the control and prevention of *Legionella* in your country? (multiple choice)

Ministry responsible for health

Ministry responsible for environment

Ministry responsible for labor

Other (please specify)

2. Do you have national legislation and/or regulation addressing the control and prevention of *Legionella* in your country?

Yes No

Please provide the title/reference of the legislation and regulation and link (if available)

2a. If yes, what are the requirements covered? (multiple choice)

Roles and responsibilities of relevant stakeholders

Risk assessment

Risk management

Environmental monitoring

Regulatory values

Clinical surveillance

Registration of facilities posing *Legionella* risk (e.g. cooling towers, spa pools)

Qualification and training of operators (building water systems, devices, etc.)

2b. If yes, what **risk matrices** do the requirements apply to?

	Risk assessment	Risk management	Environmental monitoring	Operational monitoring	Regulatory values	Other
Drinking water						
Domestic hot water						
Pool water						
Cooling tower						
Wastewater						
Aerosol generating equipment (air conditioners, humidifiers, dental units)						
Composts						

Other, please specify						

2c. If yes, which **risk environments** do the requirements apply to?

	Risk assessment	Risk management	Environmental monitoring	Operational monitoring	Regulatory values	Other
Healthcare facilities						
Schools and other educational institutions						
Hotels and other accommodation sites						
Domestic settings						
Industrial facilities						
Cooling towers						
Pools and spas						
Waterworks						
Sewage treatment plants						
Other (please specify						

3. Do you have non-legislative national requirements (e.g. standards, technical codes, guidelines) for the control and prevention of *Legionella* in your country?

Yes No

Please provide the title/number of the national standard/technical code/guideline and link (if available)

3a. If yes, what requirements are covered by the standard/technical code? (multiple choice)

Risk assessment

Risk management

Environmental monitoring

Regulatory values

Clinical surveillance

3b. If yes, what **risk matrices** do the requirements apply to?

	Risk assessment	Risk management	Environmental monitoring	Operational monitoring	Regulatory values	Other
Drinking water						
Domestic hot water						
Pool water						
Cooling tower						
Wastewater						
Aerosol generating equipment (air conditioners, humidifiers, dental units)						
Composts						
Other, please specify:						

3c. If yes, which **risk environments** do the requirements apply to?

	Risk assessment	Risk management	Environmental monitoring	Operational monitoring	Regulatory values	Other
Healthcare facilities						
Schools and other educational institutions						
Hotels and other accommodation sites						
Domestic settings						
Industrial facilities						
Cooling towers						
Pools and spas						
Waterworks						

Sewage treatment plants						
Other (please specify						

Part B Risk assessment and management

4. Who is authorized to carry out a *Legionella* risk assessment?

Not specified

Owner or operator of the facility presenting *Legionella* risk

External expert without formalized training

External expert with formalized training (e.g, with a certain degree or certificate)

Public health authority

Other *Please specify "Other"*

No information

5. Are the contents of the risk assessment specified?

Specified in legislation

Specified in standard/technical code/guideline

Not specified

No information

6. Are risk assessments audited?

Yes No

6a. If yes, who performs the audit?

Not specified

External expert without formalized training

External expert with formalized training

Public health authority

Other (Please specify*)*

No information

7. Is the risk assessment subject to regular review?

Yes No

7a. If yes, how often?

Yearly

Every 2-3 years

Less frequently than 2-3 years

In case of changes in the system

In case of legionellosis incidents

Not specified

No information

8. Are concrete risk management measures specified for the following risk settings?

	Specified in legislation	Specified in standard, technical	Specified by the risk assessment	Not specified

		code, guideline		
Healthcare facilities				
Schools and other educational institutions				
Hotels and other accommodation sites				
Domestic settings				
Industrial facilities				
Pools and spas				
Cooling towers				
Waterworks				
Sewage treatment plants				
Other (please specify)				

Please give further details in the box (max 200 words)

9. What promts risk management measures?

Continuous/regular measures are required in the legislation/guidance

Measures are required if risk is identified by the risk assessment

Measures are required if high *Legionella* levels are detected

Measures are required if legionellosis case is linked to the facility

Measures are required if legionellosis outbreak is linked to the facility

No information

Part C Environmental monitoring

10. When is it required to monitor *Legionella* in the following risk settings?(please tick all that applies)

	Regular monitoring required	If it is deemed necessary by the risk assessment	If other parameter is non-compliant (e.g. temperature, disinfectant level, other microbial parameter)	If legionellosis case is linked to the facility	If legionellosis outbreak is linked to the facility	No requirement
Healthcare facilities						
Schools and other educational institutions						
Hotels and other accommodation sites						
Domestic settings						
Industrial facilities						
Pools and spas						
Cooling towers						
Waterworks						
Sewage treatment plants						
Other (please specify						

11. If regular monitoring is required, how frequently?

	Regularly, monthly	Regularly, more than once a year	Regularly, yearly	Regularly, less then once a year	Occasionally	Depending on risk/level of colonisation	Never
Healthcare facilities							
Schools and other educational institutions							
Hotels and other accommodation sites							

Domestic settings							
Industrial facilities							
Pools and spas							
Cooling towers							
Waterworks							
Sewage treatment plants							
Other (please specify							

12. Who is responsible for monitoring? (multiple choice)

    Owner or operator of the facility

    Public health authority

    Other *Please specify "Other"*

    No information

13. Is the method for detecting *Legionella* in an environmental sample specified?

    Specified in legislation

    Specified in standard/technical code/guideline

    Not specified

    No information

14. Which of the methods below are accepted in the country? (multiple choice)

    ISO 11731:1998

    ISO 11731-2:2004

    ISO 11731:2017

    ISO/TS 12869:2019 (qPCR)

    Legiolert

    Other (please specify)

    Not specified

    No information

15. Are there requirements for laboratories performing *Legionella* testing in environmental samples?

    Laboratories should be certified (e.g. accredited) and authorized

    Laboratories should be certified

    Other requirement (please specify)

    Not specified

    No information

16. How many laboratories perform *Legionella* testing in environmental samples?

    Approximately:

No information

17. Is there a quality assurance programme (round robin, interlaboratory trial) in place for the testing laboratories?

Yes No

18. Are *Legionella* monitoring results reported?

Yes, on a national level

Yes, on a local level

No, but made available to the authority on sanitary visits

Not reported

No information

19. How the results of environmental monitoring and surveillance used? (multiple choice)

Develop/improve national regulations

Obtain an overview of *Legionella* at national or local level

Identify main sources and develop *Legionella* risk management strategies

Communication of public health risks related to *Legionella* to the stakeholders and the community

Implementing capacity building programmes

Other (please specify)

Part D Clinical surveillance

20. Is legionellosis a mandatory reportable disease?

Yes No

If the answer is no, please go to question 21.

20a. Which cases are reported?

Single case of Pontiac fever

Single case of legionnaire's disease

Cluster of Pontiac fever cases

Cluster of legionnaire's disease cases

Travel associated Pontiac fever cases

Travel associated legionnaire's disease cases

Nosocomial Pontiac fever cases

Nosocomial legionnaire's disease cases

No information

20b. How many cases were reported in the past 5 years?

2020

2019

2018

2017

2016

No information

21. If not, is there plan to include legionellosis in the list of notifiable diseases?
Yes No

22. Which cases are tested for *Legionella?*

Every pneumonia

Every atypical pneumonia

Every pneumonia requiring hospital care

Every atypical pneumonia requiring hospital care

Suspect cases of Pontiac fever

Only in special cases

No testing

No information

23. What methods are used in clinical surveillance for laboratory diagnosis? (multiple choice)

Culture method
PCR
Urinary antigen testing
Direct immunofluorescence test
Serological test
Other (please specify)
No information

24. How many laboratories perform clinical *Legionella* testing?

Approximately:
No information

25. Are legionellosis cases subject to epidemiological investigation?

Yes, in every case
Yes, for clusters of cases
Yes, for travel associated cases
Yes, for cluster of travel associated cases
Yes, for nosocomial cases
Yes, for cluster of nosocomial cases
Only in special circumstances (please specify)
No
No information

26. Are there standardized investigation protocols/checklists for epidemiological investigation?

Yes No

27. Is environmental sampling and analysis part of epidemiological investigation?

Yes, in every case
Yes, for clusters of cases
Yes, for travel associated cases
Yes, for cluster of travel associated cases
Yes, for nosocomial cases
Yes, for cluster of nosocomial cases
Only in special circumstances (please specify)
No
No information

28. Do you type isolates (by any typing method) to compare environmental and clinical samples as part of epidemiological investigation?

Yes, always
Yes, in some cases
No
No information

29. How the clinical surveillance data analyzed and used (multiple choice)
    Tracking burden of legionellosis
    Improving clinical surveillance at national and local levels
    Designing and implementing capacity development programmes for specialists (e.g. clinical, epidemiological, environmental health)
    Identifying strengths and gaps and improvement strategies/actions

Part E implementation

Please indicate on a scale 1-5 if the statements below are true for your country

General public is informed about *Legionella* risk and prevention measures

Legionella risk is considered important by public health authorities

Legislation/guidance covers every necessary aspect

Legislation/guidance is implemented

Operators of risk facilities are aware of *Legionella* risk

Implementation is enforced by the authorities

Laboratory capacity for environmental monitoring is sufficient

Laboratory capacity for clinical surveillance is sufficient

Human capacity for risk assessment and risk management is sufficient

Financing for risk assessment and risk management is sufficient

Human capacity of the public health authority is sufficient for *Legionella* control

Financing of the public health authority is sufficient for *Legionella* control

Part F

Please add here other important aspects that you feel relevant in relation to *Legionella* prevention and control in your country (maximum 150 words)

Would you or one of your colleagues participating in the completion of the questionnaire be available for a follow-up interview? If yes, please give your name and contact information (email) below

Appendix B – Russian questionnaire

Обследование для выяснения национальных требований и практики в области эпидемиологического надзора за легионеллёзной инфекцией

Введение

Во всем мире проблемы здоровья, связанные с легионеллёзной инфекцией, определяются как область повышенной значимости для общественного здоровья, поскольку вспышки легионеллёза вызывают высокий уровень заболеваемости и смертности. В Европейском регионе ВОЗ легионеллёз является одним из новых заболеваний, связанных с водой. Хотя легионеллёзная инфекция является давно признанной проблемой в странах с высоким уровнем доходов, по странам с низким и средним уровнем доходов данных очень мало и истинное бремя легионеллёза в Регионе остается неизвестным. На Пятой сессии совещания Сторон Протокола по проблемам воды и здоровья Стороны и другие государства приняли решение заниматься этой проблемой в рамках программной области "Профилактика и снижение заболеваемости болезнями, связанными с водой", ведущими странами в которой являются Норвегия и Беларусь. Предлагаемый вопросник предназначен для сбора информации о нормативном регулировании и практике оценки риска и борьбы с легионеллёзной инфекцией, включая экологический и клинический эпиднадзор. Для того, чтобы получить полную картину, может возникнуть необходимость привлечь больше специалистов из разных областей знаний и практики. Мы просим представить сводный ответ в онлайновой форме подачи данных к 30 июня 2021 г.

Ваша страна

Ваша организация (если в ответах на вопросник участвовало несколько человек, отметьте, пожалуйста, все, что относится к вашему случаю).

Государственная организация
Негосударственная организация
Институт общественного здравоохранения
Академическое учреждение
Центральный орган государственного управления
Местный орган управления
Лечебно-профилактическая организация
Другое
Название организации (организаций)

Участвуете ли вы/ваша организация в каком-либо из следующих видов деятельности? (если в заполнении вопросника участвовали несколько человек, возможен выбор сразу нескольких вариантов ответа; пожалуйста, отметьте галочкой все, что относится к вашему случаю)

Установление национальных правил, норм и/или стандартов
Диагностика и лечение
Научные исследования
Укрепление здоровья и просвещение населения
Оценка риска заражения легионеллёзом
Борьба с легионеллёзной инфекцией
Мониторинг окружающей среды (экологический мониторинг) и эпидемиологический надзор
Клинический эпидназдор
Расследование вспышек и борьба со вспышками
Другое (укажите, пожалуйста):

Часть А. Нормативное регулирование

1. Какая организация (или организации) отвечает за нормативное регулирование контроля и профилактики легионеллёзной инфекции в вашей стране (возможен выбор нескольких вариантов ответа)

Министерство, отвечающее за здравоохранение
Министерство, отвечающее за охрану окружающей среды
Министерство, ведающее вопросами труда
Другое (укажите)

2. Имеются ли в вашей стране национальное законодательство и/или нормативные документы, касающиеся контроля и профилактики легионеллёзной инфекции?

Да Нет

Укажите, пожалуйста, название/номер и дату принятия закона и нормативного документа и ссылку в интернете (если имеется)

2a. Если да, какие требования в них охватываются? (выбор нескольких вариантов)

Роли и обязанности заинтересованных сторон
Оценка рисков
Минимизация и устранение рисков (управление рисками)
Мониторинг окружающей среды
Нормативные величины
Клинический эпиднадзор
Регистрация объектов, создающих риск инфицирования легионеллёзом (например, градирни, бассейны спа)
Квалификация и обучение операторов (системы водоснабжения в зданиях, устройства и приборы и т.д.)

2b. Если да, на какие **матрицы рисков** распространяются требования?

	Оценка рисков	Минимизация и устранение рисков	Мониторинг окружающей среды	Оперативный мониторинг	Нормативные величины	Другое
Питьевая вода						
Бытовая горячая вода						
Вода в бассейнах						
Градирня						
Сточные воды						
Генерирующее аэрозоль оборудование (кондиционеры, увлажнители воздуха, стоматологические установки)						
Компосты						
Другое (укажите)						

2c. Если да, на какие **среды рисков** распространяются требования?

	Оценка рисков	Минимизация и устранение рисков	Мониторинг окружающей среды	Оперативный мониторинг	Нормативные величины	Другое
Лечебно-профилактические учреждения						
Школы и другие учреждения образования						
Гостиницы и другие объекты проживания						

Бытовая обстановка						
Промышленные объекты						
Градирни						
Бассейны и спа						
Водопроводные сооружения						
Станции очистки канализаицонных стоков						
Другое (укажите)						

3. Имеются ли в вашей стране подзаконные национальные требования (например, стандарты, технические нормы и правила, методические указания) для контроля и профилактики легионеллёзной инфекции?

Да Нет

Укажите, пожалуйста, название/номер национального стандарта/технических норм и правил/методического руководства и ссылку в интернете (если имеется).

3a. Если да, какие требования охватываются стандартом/техническими нормами и правилами? (выбор нескольких вариантов)

Оценка рисков
Минимизация и устранение рисков/управление рисками
Мониторинг окружающей среды
Нормативные величины
Клинический эпиднадзор

3b. Если да, на какие **матрицы рисков** распространяются требования?

	Оценка рисков	Минимизация и устранение рисков	Мониторинг окружающей среды	Оперативный мониторинг	Нормативные величины	Другое
Питьевая вода						
Бытовая горячая вода						
Вода в бассейнах						
Градирня						
Сточные воды						
Генерирующее аэрозоль оборудование (кондиционеры, увлажнители воздуха, стоматологические установки)						
Компосты						
Другое (укажите)						

3c. Если да, на какие **среды рисков** распространяются требования?

	Оценка рисков	Минимизация и устранение рисков	Мониторинг окружающей среды	Оперативный мониторинг	Нормативные величины	Другое
Лечебно-профилактические учреждения						
Школы и другие учреждения образования						
Гостиницы и другие объекты проживания						
Бытовая обстановка						
Промышленные объекты						
Градирни						
Бассейны и спа						
Водопроводные сооружения						
Станции очистки канализаицонных стоков						
Другое (укажите)						

Часть B. Оценка и минимизация и устранение рисков/управление рисками

4. Кто уполномочен проводить оценку риска легионеллёзной инфекции?

Не оговаривается
Собственник или оператор объекта, создающего риск легионеллёзной инфекции
Сторонний эксперт без официально подтвержденной подготовки
Сторонний эксперт с официально подтвержденной подготовкой (например, имеющий определенную степень или диплом)
Орган общественного здравоохранения
Другое *(укажите, пожалуйста)*
Информации нет

5. Оговаривается ли содержание оценки рисков?

Оговаривается в законодательстве
Оговаривается в стандарте/технических нормах и правилах/методических указаниях
Не оговаривается
Информации нет

6. Проводится ли проверка результатов оценки рисков?

Да Нет

6а. Если да, кто проводит проверку?

Не оговаривается
Сторонний эксперт без официально подтвержденной подготовки
Сторонний эксперт с официально подтвержденной подготовкой
Орган общественного здравоохранения
Другое (укажите, пожалуйста)
Информации нет

7. Подлежит ли оценка рисков регулярному пересмотру?

Да Нет

7а. Если да, как часто?

Каждый год
Каждые 2-3 года
Реже, чем раз в 2-3 года
В случае изменений в системе
В случае инцидентов легионеллёза
Не оговаривается
Информации нет

8. Оговариваются ли конкретные меры по минимизации и устранению рисков для следующих видов среды риска?

	Оговаривается в законодательстве	Оговаривается в стандарте, технических нормах и правилах, методических указаниях	Определяется результатом оценки рисков	Не оговаривается
Лечебно-профилактические учреждения				
Школы и другие учреждения образования				
Гостиницы и другие объекты проживания				
Бытовая обстановка				

Промышленные объекты				
Градирни				
Бассейны и спа				
Водопроводные сооружения				
Станции очистки канализаицонных стоков				
Другое (укажите)				

Приведите, пожалуйста, дополнительные подробности в отдельной вставке (не более 200 слов).

9. Что заставляет принимать меры по минимизации/устранению рисков?

Постоянные/регулярные меры требуются законодательством/методическими указаниями

Меры требуются в том случае, если в результате оценки рисков выявляется риск (не являющийся пренебрежимо малым)

Меры требуются в том случае, если обнаружены высокие уровни легионелл

Меры требуются в ситуации, когда с данным объектом связан случай легионеллёза

Меры требуются в том случае, если с данным объектом связана вспышка легионеллёза

Информации нет

Часть С. Мониторинг окружающей среды

10. Когда требуется проводить мониторинг легионелл в указанных ниже средах риска (отметьте галочкой все, что относится к вашему случаю)

	Требуется регулярный мониторинг	Если признано необходимым в результате оценки рисков	Если не соблюдается другой параметр (например, температура, уровень дезинфицирующего средства, другой микробный параметр)	Если с объектом связан случай легионелёза	Если с объектом связана вспышка легионелёза	Требований нет
Лечебно-профилактические учреждения						
Школы и другие учреждения образования						
Гостиницы и другие объекты проживания						
Бытовая обстановка						
Промышленные объекты						
Градирни						
Бассейны и спа						
Водопроводные сооружения						
Станции очистки канализаицонных стоков						
Другое (укажите)						

11. Если требуется регулярный мониторинг, как часто он должен проводиться?

	Регулярно, ежемесячно	Регулярно, более одного раза в год	Регулярно, каждый год	Регулярно, менее одного раза в год	Иногда	В зависимости от риска/ уровня	Никогда

						колонизации	
Лечебно-профилактические учреждения							
Школы и другие учреждения образования							
Гостиницы и другие объекты проживания							
Бытовая обстановка							
Промышленные объекты							
Градирни							
Бассейны и спа							
Водопроводные сооружения							
Станции очистки канализаицонных стоков							
Другое (укажите)							

12. Кто отвечает за мониторинг? (выбор нескольких вариантов)

Собственник или оператор объекта
Орган общественного здравоохранения
Другое (пожалуйста, укажите)
Информации нет

13. Оговаривается ли метод выявления легионелл в образце, взятом в окружающей среде?

Оговаривается в законодательстве
Оговаривается в стандарте/технических нормах и правилах/методических указаниях
Не оговаривается
Информации нет

14. Какие из указанных ниже методов приняты в стране? (выбор нескольких вариантов)

ISO 11731:1998
ISO 11731-2:2004
ISO 11731:2017
ISO/TS 12869:2019 (qPCR)
Legiolert
Другое (укажите)
Не оговаривается
Информации нет

15. Существуют ли требования в отношении лабораторий, выполняющих тесты на легионеллу в образцах, взятых в окружающей среде?

Лаборатории должны быть сертифицированы (например, аккредитованы) и иметь соответствующее разрешение
Лаборатории должны быть сертифицированы

Другие требования (укажите)
Не оговаривается
Информации нет

16. Сколько лабораторий выполняют тесты на легионеллу в образцах, взятых в окружающей среде?

Примерно X лабораторий
Информации нет

17. Существует ли программа гарантии качества (round robin, межлабораторное сравнительное испытание) для лабораторий, выполняющих тесты?

Да Нет

18. Представляется ли отчетность о результатах мониторинга легионелл?

Да, на центральном уровне
Да, на местном уровне
Нет, но результаты представляются руководству при проведении санитарных проверок
Отчетность не представляется
Информации нет

19. Как используются результаты мониторинга окружающей среды и эпиднадзора? (выбор нескольких вариантов)

Для разработки/совершенствования национальной нормативной базы
Для получения общей картины легионеллёзной инфекции на уровне страны или на местном уровне
Для выявления главных источников и разработки стратегий минимизации и устранения рисков легионеллёзной инфекции
Для информирования заинтересованных партнеров и населения о рисках для общественного здоровья, связанных с легионеллой
Для осуществления программ укрепления организационно-кадрового потенциала
Другое (укажите)

Часть D. Клинический эпиднадзор

20. Является ли легионеллёз заболеванием, подлежащим обязательному уведомлению?

Да Нет

Если ответ "нет", переходите к вопросу 21.

20a. Какие случаи подлежат уведомлению?

Единичный случае лихорадки Понтиак
Единичный случай болезни легионеров
Кластер случаев лихорадки Понтиак
Кластер случаев болезни легионеров
Случаи лихорадки Понтиак, связанные с путешествиями
Случаи болезни легионеров, связанные с путешествиями
Случаи нозокомиальной лихорадки Понтиак
Случаи нозокомиальной болезни легионеров
Информации нет

20b. Сколько случаев было указано в уведомлениях за последние 5 лет?

2020 г.
2019 г.
2018 г.
2017 г.
2016 г.
Информации нет

21. Если нет, планируется ли включить легионеллёз в список заболеваний, подлежащих уведомлению?

Да Нет

22. Какие случаи тестируются на легионеллёзную инфекцию?

Каждый случай пневмонии
Каждый случай атипичной пневмонии
Каждый случай пневмонии, требующий госпитализации
Каждый случай атипичной пневмонии, требующий госпитализации
Случаи подозрения на лихорадку Понтиак
Только в особых случаях
Тестирование не проводится
Информации нет

23. Какие методы используются в клиническом эпиднадзоре для лабораторной диагностики? (выбор нескольких вариантов)

Культуральный метод
ПЦР
Тестирование на антиген в моче
Тест методом прямой иммунофлуоресценции
Серологический тест
Другое (укажите)
Информации нет

24. Сколько лабораторий выполняют клинические тесты на легионеллёзную инфекцию?

Примерно X лабораторий
Информации нет

25. Подлежат ли случаи легионеллёза эпидемиологическому расследованию?

Да, каждый случай
Да, при кластерах случаев
Да, случаи, связанные с путешествием
Да, при кластерах случаев, связанных с путешествием
Да, нозокомиальные случаи
Да, при кластере нозокомиальных случаев
Только в особых обстоятельствах (укажите)
Нет
Информации нет

26. Существуют ли стандартные протоколы /контрольные перечни вопросов для проведения эпидемиологического расследования?

Да Нет

27. Являются ли частью эпидемиологического расследования отбор образцов с объектов окружающей среды и их анализ?

Да, в каждом случае
Да, при кластерах случаев
Да, в случаях, связанных с путешествием
Да, при кластерах случаев, связанных с путешествием
Да, при нозокомиальных случаях
Да, при кластере нозокомиальных случаев
Только в особых обстоятельствах (укажите)
Нет
Информации нет

28. Выполняете ли вы в рамках эпидемиологического расследования типирование изолятов (любым методом типирования) для сравнения образцов, взятых из окружающей среды, и клинических образцов?

Да, всегда
Да, в некоторых случаях
Нет
Информации нет

29. Как анализируются и используются данные клинического эпиднадзора? (выбор нескольких вариантов)

Отслеживание бремени легионеллёза
Улучшение клинического эпиднадзора на уровне страны и на местном уровне
Разработка и осуществление программ повышения квалификации специалистов (например, в области лечебной работы, эпидемиологии, гигиены окружающей среды)
Выявление сильных сторон и недостатков и совершенствование стратегий/практических мер

Часть E. Практическое осуществление

Оцените, пожалуйста, баллами от 1 до 5, насколько справедливы для вашей страны приведенные ниже утверждения:

Население информировано о риске легионеллёзной инфекции и мерах по ее профилактике.

Органы общественного здравоохранения считают серьезным риск легионеллёзной инфекции.

Законодательство/методические указания охватывают каждый необходимый аспект.

Законодательство/методические указания реализуются на практике.

Операторы объектов, создающих риски, знают о риске легионеллёзной инфекции.

Органы власти принимают меры к обязательному исполнению нормативных требований.

Лабораторные мощности для мониторинга окружающей среды достаточны.

Лабораторные мощности для клинического эпиднадзора достаточны.

Кадровые возможности для оценки рисков и для минимизации и устранения рисков достаточны.

Финансирование работ по оценке рисков и минимизации и устранению рисков достаточное.

Кадровые возможности органа общественного здравоохранения для контроля легионеллёзной инфекции достаточны.

Финансирование органа общественного здравоохранения для контроля легионеллёзной инфекции достаточное.

Часть F

В этой части добавьте, пожалуйста, другие важные аспекты, которые, по вашему мнению, имеют значение для профилактики и контроля легионеллёзной инфекции в вашей стране (не более 150 слов).

Сможете ли вы или кто-либо из ваших коллег, участвовавших в заполнении вопросника, присутствовать на собеседовании для уточнения ответов? Если да, укажите, пожалуйста, ниже ваши имя и фамилию и сведения для контакта (адрес электронной почты).

Appendix C – Contacted persons

Country	Title	Last name	First name	Email
Albania	Ms	Miska	Zhaneta	Zhaneta.Miska@shendetesia.gov.al
Andorra	Ms	Vendrell	Celia	min.sanitat@andorra.ad
Andorra	Mr	Romagosa Massana	Josep	josep_romagosa@govern.ad
Andorra	Mr	Galindo Ortego	Jesús	Jesus_Galindo@govern.ad
Armenia	Ms	Bakunts	Nune	n.bakunts@gmail.com; nune.bakunts@ncdc.am
Austria	Ms	Spiegel	Sonja	sonja.spiegel@bmg.gv.at
Austria	Ms	Sommer	Regina	regina.sommer@meduniwien.ac.at
Azerbaijan	Ms	Gurbanova	Gunel	gunel.gurbanova@eco.gov.az; gunel-qurbanova-90@mail.ru
Azerbaijan	Ms	Taghizade	Leylakhanim	leylatagizadeh@yahoo.com
Belarus	Ms	Drazdova	Alena	drozdovaev@mail.ru
Belgium	Mr	Van Den Belt	Kris	k.vandenbelt@vmm.be
Bosnia and Herzegovina	Ms	Vicanovic	Jelena	jvicanovic@voders.org; jelenavicanovic@gmail.com;
Bosnia and Herzegovina	Ms	Rudić Grujić	Vesna	vesna.rudicg@gmail.com
Bulgaria	Ms	Staykova Nenova	Rumiana	rnenova62@gmail.com
Bulgaria	Ms	Angelova Tomova	Iskra	iskra.tomova@gmail.com
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Croatia	Ms	Janev Holcer	Natasa	natasa.janev@hzjz.hr
Cyprus	Mr	Pissarides	Nikolas	npissarides@sgl.moh.gov.cy
Czech Republic	Mr	Kozisek	Frantisek	water@szu.cz; frantisek.kozisek@szu.cz
Denmark	Ms	Duer	Anne Christine	ancdu@mst.dk
Estonia	Ms	Albreht	Leena	leena.albreht@terviseamet.ee
Estonia	Mr	Nahkur	Ramon	ramon.nahkur@sm.ee
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Finland	Ms	Zacheus	Outi	outi.zacheus@thl.fi

France	Mr	Pavageau	Yannick	yannick.pavageau@sante.gouv.fr;
France	Ms	Jedor	Beatrice	Beatrice.JEDOR@sante.gouv.fr
Georgia	Ms	Gabriadze	Nana	gabriadzenana79@gmail.com
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Germany	Ms	Mendel	Birgit	birgit.mendel@bmg.bund.de
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Hungary	Ms	Vargha	Marta	vargha.marta@nnk.gov.hu
Iceland	Ms	Matthíasdóttir	Dagmar Huld	dagmar.matthiasdottir@vel.is
Ireland	Mr	Page	Darragh	d.page@epa.ie
Ireland	Ms	Byrne	Noah	n.byrne@epa.ie
Israel	Ms	Karakis	Isabella	isabella.karakis@moh.health.gov.il;
Israel	Ms	Eichen	Dganit	dganit.eichen@moh.gov.il
Italy	Mr	Lucentini	Luca	lucaluce@iss.it
Kazakhstan	Ms	Rahimzhanova	Maral	m.rakhimzhanova@mz.gov.kz
Kazakhstan	Ms	Utemisova	Laura	
Kyrgyzstan	Ms	Arykbaeva	Bubuzhan	abk_cgsn@mail.ru;
Kyrgyzstan	Ms	Saryeva	Gulnara	g.sarieva@mail.ru
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Latvia	Mr	Kadikis	Normunds	normunds.kadikis@vi.gov.lv
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Lithuania	Mr	Sabaliauskas	Romualdas	sabal@smlpc.lt; smlpc@smlpc.lt;
Lithuania	Ms	Sketerskiene	Rita	rita.sketerskiene@sam.lt
Luxembourg	Mr	Alves	Bruno	bruno.alves@mev.etat.lu;
Luxembourg	Ms	Diescbourg	Carole	carole.dieschbourg@gouv.etat.lu;
Luxembourg	Mr	Zwank	Luc	luc.zwank@eau.etat.lu;
Luxembourg	Ms	Lambert	Brigitte	brigitte.lambert@eau.etat.lu
Malta	Ms	Pace	Claire	claire.a.pace@gov.mt

Monaco	Ms	Donati	Julie	jdonatii@gouv.mc
Monaco	Ms	Donati	Julia	jdonati@gouv.mc;
Montenegro	Ms	Djurovic	Dijana	dijana.djurovic@ijzcg.me
Netherlands	Ms	Appelman	Jelka	jelka.appelman@minienw.nl;
Netherlands	Mr	Lock	Jerome	jerome.lock-wah-hoon@rivm.nl;
Netherlands	Mr	Van den Berg	Harold	harold.van.den.berg@rivm.nl;
Netherlands	Ms	De Roda Husman	Ana Maria	ana.maria.de.roda.husman@rivm.nl
North Macedonia	Mr	Kochubovski	Mihail	kocubov58@gmail.com
Norway	Mr	Tveitan	Kjetil	kjetil.tveitan@hod.dep.no; kjt@hod.dep.no;
Norway	Ms	Eik Helle	Solveig	solveig-eik.helle@hod.dep.no;
Norway	Ms	Nygård	Karin	karin.nygard@fhi.no;
Norway	Ms	Hyllestad	Susanne	susanne.hyllestad@fhi.no
Poland	Ms	Parafińska	Katarzyna	k.parafinska@gis.gov.pl
Portugal	Ms	Helena	Costa	helena.costa@ersar.pt;
Portugal	Mr	Brandão	João	joao.brandao@insa.min-saude.pt
Republic of Moldova	Mr	Salaru	Ion	ishalaru@yahoo.com
Romania	Ms	Neagu	Carmen	carmen.neagu@mmediu.ro; neagu_carmen2003@yahoo.co.uk;
Romania	Mr	Chirila	Ioan	ioan.chirila@insp.gov.ro;
Russian Federation	Ms	Sereda	Zoya	SeredaZS@rosminzdrav.ru
San Marino	Ms	Masi	Francesca	francesca.masi@iss.sm;
Serbia	Ms	Jovanovic	Dragana	dragana_jovanovic@batut.org.rs
Slovakia	Ms	Gubkova	Dasa	dasa.gubkova@uvzsr.sk
Slovenia	Ms	Kralj	Breda	breda.vatovec@gmail.com;
Slovenia	Ms	Rupel	Tatiana	tatjana.rupel@nlzoh.si
Spain	Ms	Palau	Margarita	mpalau@msssi.es
Sweden	Ms	Schönning	Caroline	caroline.schonning @folkhalsomyndigheten.se;
Sweden	Ms	Hansen	Anette	anette.hansen@folkhalsomyndigheten.se

Sweden	Mr	Slapokas	Tommy	tommy.slapokas@slv.se
Switzerland	Ms	Ochieng Pernet	Awilo	awilo.ochieng@blv.admin.ch
Tajikistan	Mr	Kalandarov	Safo	kalandarovs@who.int
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Turkmenistan	Mr	Myradov	Bashim	Sei@online.tm; gazizowa.ses@mail.ru
Ukraine	Ms	Rudenko	Iryna	dok7tor@ukr.net; irynarudenko4@gmail.com
United Kingdom	Ms	Moss	Laura	laura.moss@defra.gov.uk;
United Kingdom	Mr	Rink	Marcus	marcus.rink@defra.gsi.gov.uk
Uzbekistan	Ms	Mirshina	Olga	mop-61@mail.ru; olga.mirshina@minzdrav.uz

Appendix D - Legionella interview questions

A. Development of the regulation
1. When was the first regulation on Legionella issued?
2. What lead to the development of a regulation?
3. What was the scope of the regulation? Was it extended since?
4. If there are also guidelines, how are the requirements separated in the legislative and the guidance document?

B. Implementation
4. How is the implementation of the regulation is enforced?
5. What are the key challenges and success areas?

C. Training
6. Are there regular trainings organized for the operators of the risk facilities/public health authorities/plumbers and engineers on Legionella?
7. Who conducts such trainings?

D. Environmental surveillance
8. Please elaborate on the system of monitoring and reporting
9. What are the compliance rate with the monitoring requirements? (Frequency, reporting)
10. What are the compliance rates with the parametric values?

E. Clinical surveillance
11. Do you think legionellosis is underreported in your country?
12. If yes, what are the major reasons for it?
13. How do you rate the importance of legionellosis in relation to other waterborne disease in your country?

Outline of the evidence review methodology

Scientific and grey literature and relevant databases were screened to obtain information on the incidences and outbreaks of legionellosis in the WHO European Region, considering but not limiting to the following sources:

a. Relevant scientific and grey literature from the past 5-7 years
b. National summary reports (2019) submitted by the Parties to the fifth session Meeting of the Parties of the Protocol on Water and Health
c. Reports by national or supranational authorities concerned with reporting infectious diseases
d. National and regional infectious disease information systems
e. European Legionnaires' Disease Surveillance Network (ELDSNet), coordinated by the European Centre for Disease Prevention and Control
f. Global Infectious Disease and Epidemiology Network (GIDEON)

The data were analysed and datasheets on water-related incidents and outbreaks of legionellosis prepared for the last 5-7 years by countries of the WHO European Region, including additional information such as description of pathways. Additionally, complementary information on national regulations and surveillance system capacities on *Legionella* monitoring was collected when found.

Aim

The aim is to provide a review of scientific and grey literature and relevant regional information data bases to obtain systematic data on the incidences and outbreaks of legionellosis in the WHO European Region with particular focus to Eastern Europe, the Caucasus and Central Asia (EECCA). The outcomes of the review will serve as a scientific basis for the preparation of a regional report on the state of *Legionella.*

Preliminary results were presented during the regional meeting on *Legionella* which took place virtually from 30 November – 2 December 2021.

Search strategy using electronic sources

PubMed and Web of Science were searched for academic peer-reviewed literature in English. For Russian language articles the databases elibrary.ru and cyberleninka.ru were used as the search engine. Articles from the time range 2011 to 2021 were included. Additional documents identified through expert contributors and snowballing techniques complemented the academic peer-reviewed literature.

The Russian language search results were analysed by the Team of the Republican Scientifical-Practical Centre of Hygiene, Minsk, Belarus and the English language search results were analysed by the WHO Collaboration Centre Bonn, Germany.

Search terms

The following terms were used for the search strategy:

- Legionellosis
- Legionnaire*
- Legionella AND outbreak
- legionell* AND outbreak
- Legionella AND case study
- legionell* AND case study
- legionell* AND incident
- legionell* AND hospital acquired

In Table 1 and Table 2 the results for each search term are provided.

Table 1- Search results for the English language literature

№	Search term	**Search results; time range 2011 to 2021**				
		Pubmed 05/07/2021		Web of Science 06/07/2021		**Combined, dublicates removed**
		Direct search results	After dublicate removal	Direct search results	After dublicate removal	
1.	Legionellosis	1,384	1,384	457	457	929
2.	Legionella AND outbreak	728	262	596	445	526
3.	legionell* AND outbreak	764	10	622	2	10
4.	Legionella AND case study	280	71	434	247	292
5.	Legionell* AND case study	291	0	448	2	2
6.	legionnaire	1,404	290	1,705	1,038	1,082
7.	legionell AND incident	633	14	15	2	13
8.	legionell AND hospital acquired	273	53	364	109	121
	SUM	5,757	2,084	4,641	2,302	2,975

Table 2**- Search results for the Russian language literature**

	Search term	**Search results; time range 2011 to 2021**				
		Elibrary.ru 05/07/2021		Cyberleninka.ru 06/07/2021		**Combined, dublicates removed**
		Direct search results	After dublicate removal	Direct search results	After dublicate removal	
9.	«легионеллез» (Legionellosis)	55	53	295	79	118
10.	«легионелла и вспышка» «легионелл и вспышка» "Legionella AND outbreak ")	5	3	103	27	27
11.	«Legionella и вспышка» "Legionella AND outbreak")	2	2	134	23	25
12.	«легионелла и внебольничная пневмония» «легионелл* и внебольничная пневмония» (Legionella AND community-acquired pneumonia)	10	9	129	58	64

13.	«болезнь легионеров» (legionnaire*)	24	8	258	44	48
14.	«легионелл* и пациент» **«легионелла и случай»** (legionell* AND patient)	42	31	310	13	30
15.	легионелла	24	24	339	6	16
16.	«легионелла и внутрибольничная инфекция» (legionell* AND hospital acquired)	10	9	55	2	3
	SUM	172	137	1,623	252	331

Study selection

The results of all database searches were downloaded using the export function of the databases and stored in a CITAVI database in a cloud storage system. All results were stored in separate folders for each search term but in one single database. In a second step the results from each search engine were combined in one database and dublicates were removed automatically. After the duplicate removal, the titles and abstracts were screened for eligibility using inclusion and exclusion criteria.
Inclusion criteria: Abstract retrieved through a single or a combination of search term; published after 2011 and WHO European Region country.

Exclusion criteria: Outside of the WHO European Region; articles covering other microorganisms than legionella; cases studies; studies covering detection methods, ecological topics, biological features of legionella and other articles that were non-outbreak related; review articles not covering outbreaks and incidences

The exclusion criteria were defined in advance and adjusted during the review process. The title and abstract were reviewed independently to identify papers for final inclusion. Any areas of disagreement were resolved by discussion. In a final step the full articles were screened for content and extracted information stored in tables.

PRISMA statement

For the review, the flow of information through the different phases of a systematic review as laid out in the PRISMA statement (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) was followed.
The PRISMA diagram for the English language search is provided in Figure 1 and for the Russian language search in Figure 2.

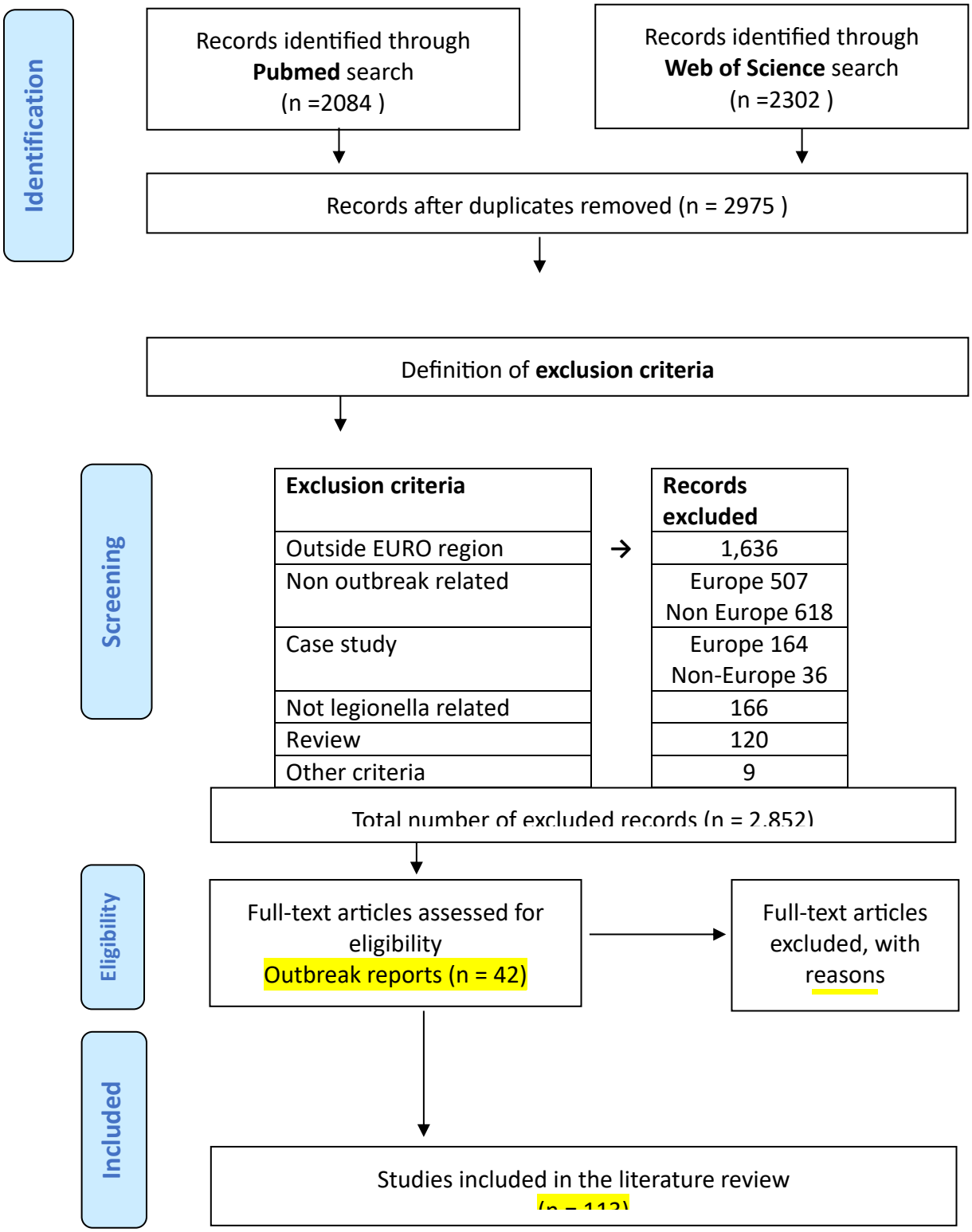

Figure 1 Selection of English language studies based on the PRISMA statement

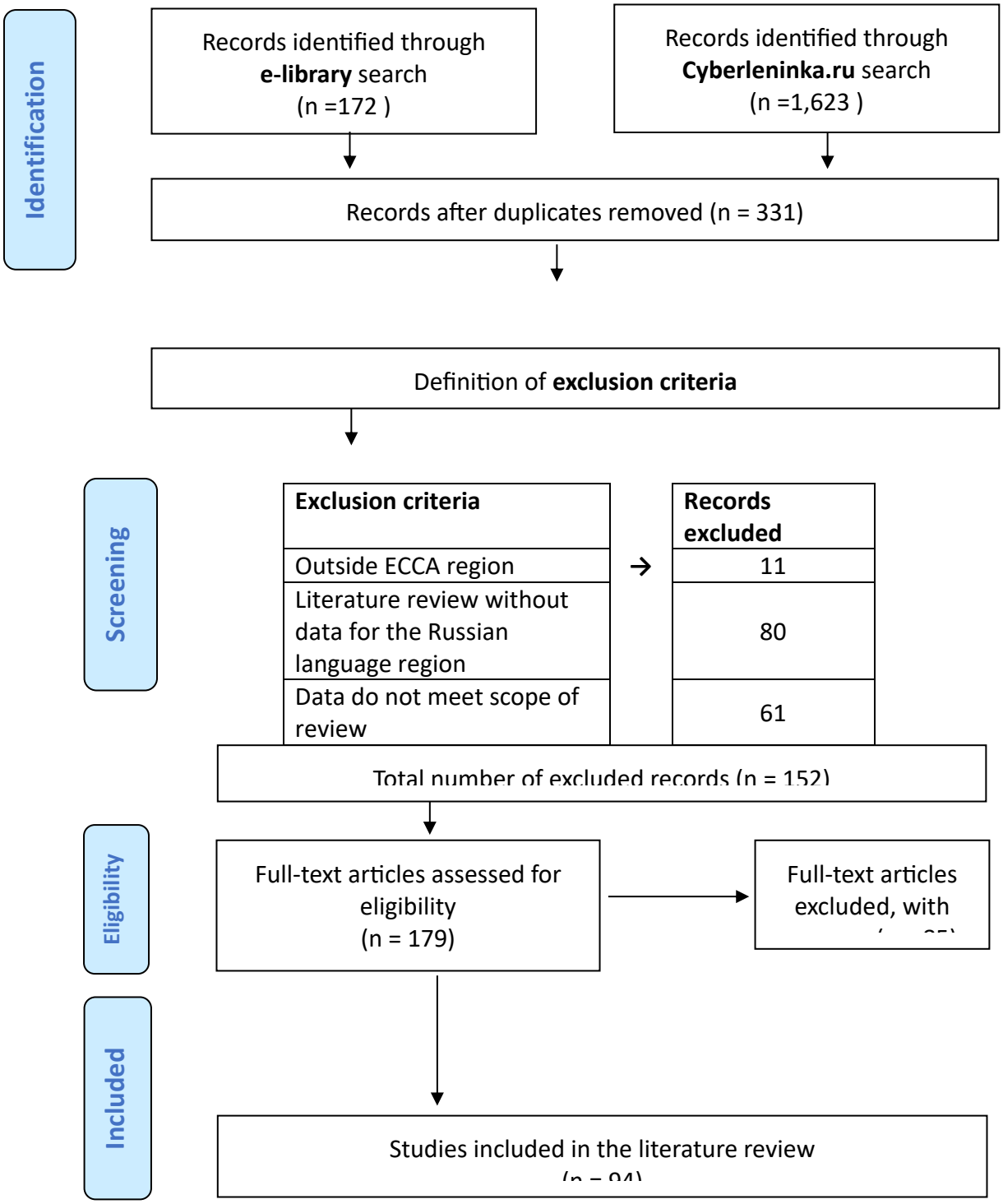

Fig. 2 Selection of Russian language studies based on the PRISMA statement

National summary reports (2019) submitted by the Parties to the fifth session Meeting of the Parties of the Protocol on Water and Health

National summary reports of 2019 were accessed via the Protocol on Water and Health webpage (https://unece.org/environment-policy/water/protocol-on-water-and-health/targets-set-parties).

Each report was checked for any information about Legionella and legionellosis and the extracted information is provided in table 3.

Rows included: cases, incidence, surveillance parameter, number of outbreaks during time range (to be defined based on search results), outbreak source, complementary information on policies, regulations and standards.

European Legionnaires' Disease Surveillance Network (ELDSNet), coordinated by the European Centre for Disease Prevention and Control (ECDC)

Within the EU the ECDC hosts the European Legionnaires' Disease Surveillance Network (ELDSNet). It has been accessed for available information for EURO countries (https://www.ecdc.europa.eu/en/about-us/partnerships-and-networks/disease-and-laboratory-networks/eldsnet).

Reports by national or supranational authorities concerned with reporting infectious diseases

Countries of the EURO region that didn´t provide a national summary report, provided no specific information in their national summary report, and were not covered by the surveillance system of the European Union, were analysed individually for information about legionella incidence.

Global Infectious Disease and Epidemiology Network (GIDEON)

The access to GIDEON was not possible, as it is a paid service.