

ENCONTRO

DESAFIOS DA ÁGUA





QUALIDADE e SEGURANÇA DA ÁGUA
WATER SAFETY PLAN for BUILDING and INDUSTRY
& LEGIONELLA

Marcos Bensoussan

Our Mission



NSF International is dedicated to being the leading global provider of public health and safety-based risk management solutions while serving the interests of all stakeholders, namely the public, the business community and government agencies.

NSF International is a global, independent, public health and safety organization.

Our mission and focus has always been protecting and improving human health.

Today, NSF is a Global Leader in Public Health and Safety



STANDARDS

Writing standards to promote environmental safety



TESTING

Testing products to these and other standards

ISO 17025



CERTIFICATION

Certifying products to these and other standards



AUDITING

Conducting independent audits

ISO 17020



CONSULTING

Providing strategic and technical consulting



TRAINING

Developing training and education programs

NSF Global Water Services

NSF developed many public health standards adopted by the U.S. EPA to protect drinking water; and standards promoting pool/spa safety.

NSF tests and certifies products to these and other industry standards.

NSF P453 - 2017

Cooling Tower Water Systems - Treatment, Operation, and Maintenance to Prevent Legionellosis

NSF 444 – 20xx

Prevention of Disease and Injury Associated with Building Water Systems



Plumbing Products

NSF/ANSI 14 and 61-Section 9;
NSF/ANSI 372; UPC®; IPC®; ICC;
ASTM; ASSE; ASME

Filtration Products

NSF/ANSI 42, 44, 53, 55, 58, 62, 177,
401 and 419; NSF Protocols P231,
P248 and P477

Municipal Water Products

NSF/ANSI 60, 61 and 419



Onsite Wastewater Treatment and Reuse Devices

NSF/ANSI 40, 41, 46, 245 and 350

Recreational Water Safety

NSF/ANSI 50: *Pumps, drains, pool covers, filters and pool chemicals*

Sustainability

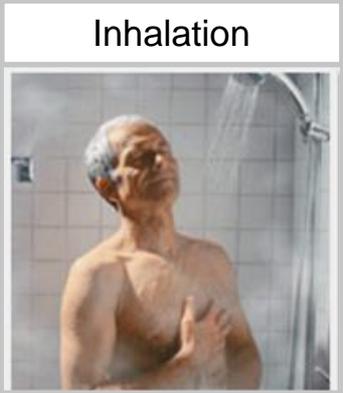
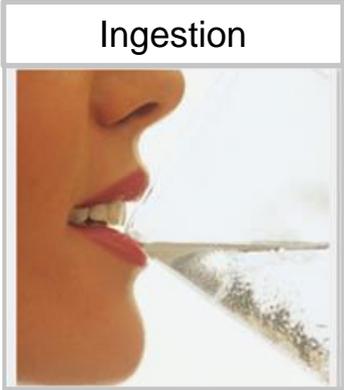
NSF/AWWA/ANSI 416: *Water treatment chemicals*

NSF/ANSI 375: *Water contact products*

Today

IS OUR WATER SAFE?

Aspects



Ingestão



Gastrointestinal



Bactéria

Campylobacter
E. Coli
Salmonella
Shigella
Vibrio cholerae
Yersinia

Vírus

Adenovírus
Astrovírus
Hep A
Hep E
Norovírus
Rotavírus
Sapovírus

**Protozoários e
Vermes**

Cryptosporidiu
m
Dracunulus
Entamoeba
Giardia
Toxoplasma

Aspiração



Respiratório



Legionella

Mycobacteria
Naegleria
Infecções Virais

Contato



Pele, mucosas,
ferimentos



Acanthamoeba
Aeromonas
Bukholderia
Mycobacteria
Leptospira
Pseudomonas
Schistosoma

Modern paradigm: Barrier

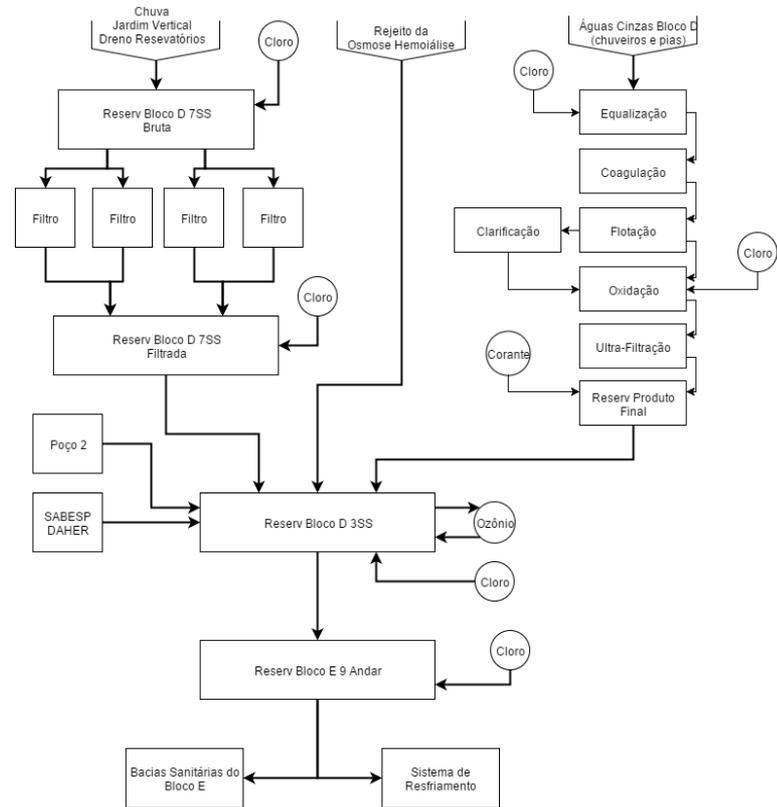
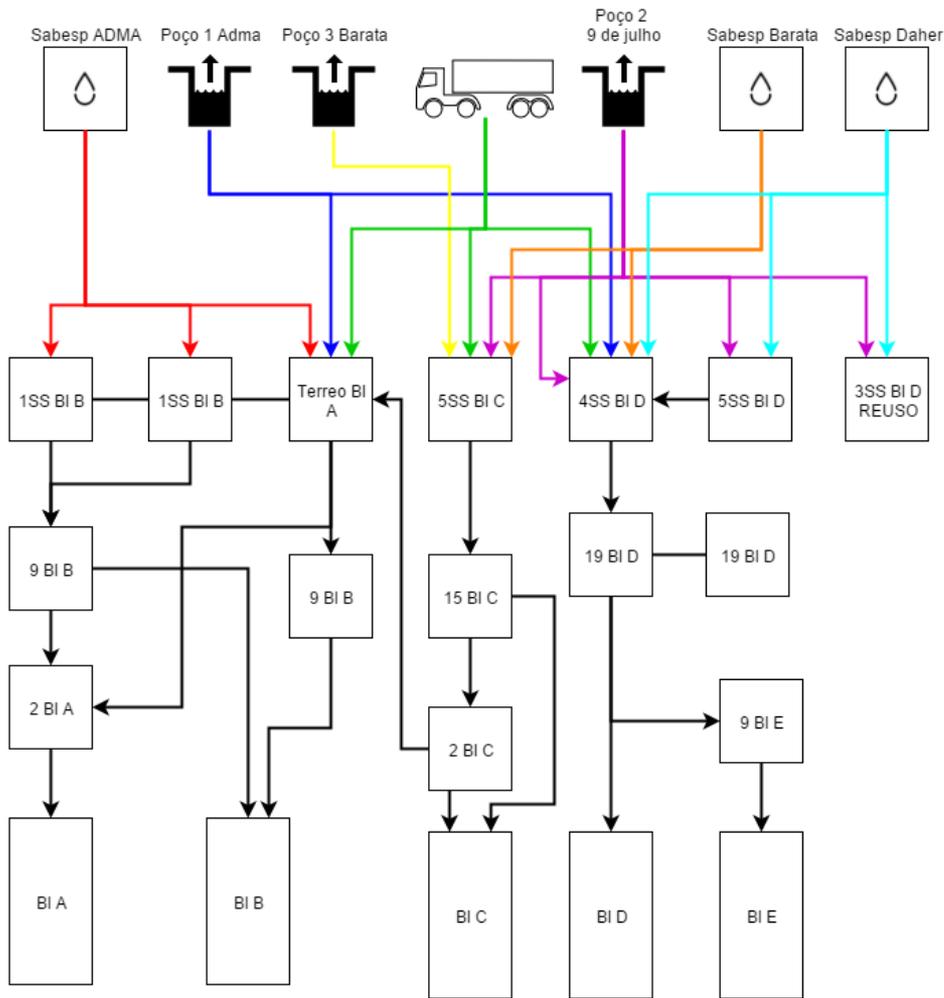


Modern paradigm: Quality Control



What about buildings?





Waterborne diseases

Agent	Europe	USA
Legionella	5,829	~22,000
Cryptosporidium	9,595	~8,000



Sanitation coverage	Europe	USA
	more than 91%	More than 91%



**World Health
Organization**

Our environment has risks



Modern “Incident”

Baixas na Legião

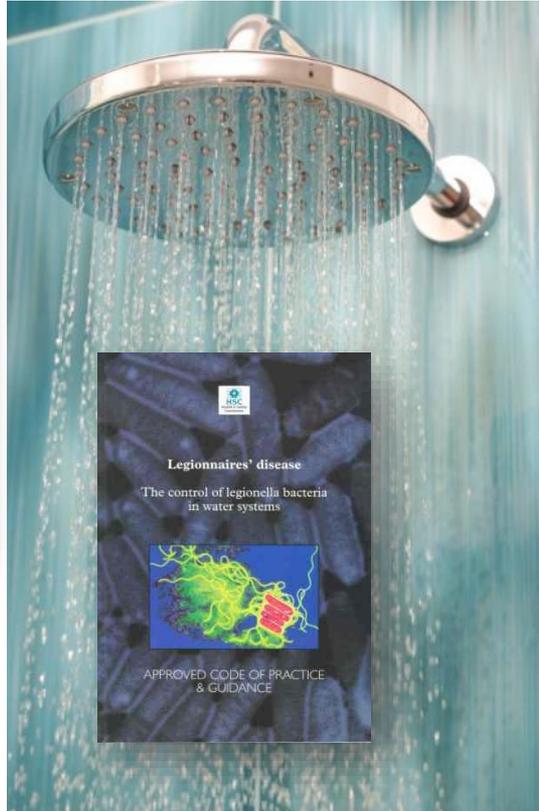
Como tantas outras convenções promovidas periodicamente pela ultraconservadora Legião Americana, a que se realizou de 21 a 24 de julho na cidade de Filadélfia transcorreu em meio a eloquentes discursos sobre as glórias passadas e o futuro dos Estados Unidos, festivais desfilas pelas ruas e alguns coquetéis. Os 10.000 participantes, quase todos veteranos de guerra, despediram-se na apoteótica reunião de encerramento, num sábado, e começaram a retornar para suas cidades. Dois dias depois, na segunda-feira, dezenas de legionários, em cidades diferentes, queixavam-se de males surpreendentemente semelhantes — dores de cabeça, tosse, febre alta, problemas respiratórios, cansaço.

Na terça, morreu a primeira vítima. E, até o fim da semana passada, 25 legionários já haviam morrido enquanto outros 140, também atingidos pelo mal, permanecem hospitalizados sob rigorosa observação médica. Quanto às causas do misterioso surto, fazem-se por enquanto não mais que vagas conjecturas — segundo autoridades sanitárias americanas, seria fruto da ação de um vírus, ainda indeterminado, ou talvez mesmo de um fungo. Até

agente causador da doença, os cientistas ainda se debruçam com o intrigante comportamento da moléstia. De acordo com todas as aparências, ela seria transmissível, já que provavelmente se teria alastrado dessa forma entre os convenções. Mas, por outro lado, não tem vitimado as pessoas que mais tarde entraram em contato com os doentes. A inexistência de vítimas entre amigos e parentes dos legionários não anula, entretanto, a possibilidade de que a moléstia seja de algum modo contagiosa.

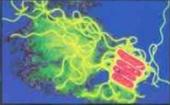


Um dos 25 funerais: sem explicações

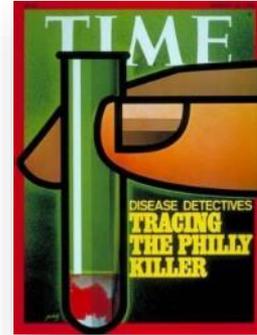


Legionnaires' disease

The control of legionella bacteria in water systems



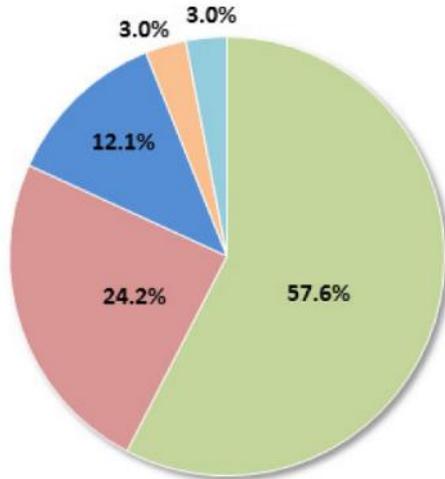
APPROVED CODE OF PRACTICE & GUIDANCE



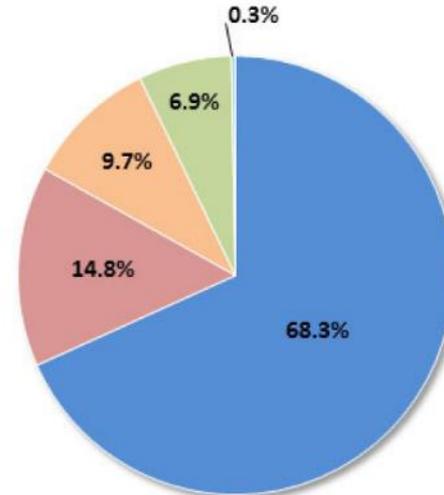
Post-sanitation

Study of waterborne diseases (USA, 2009-2010)

Outbreaks (N = 33)



Cases (N = 1,040)



- Legionella spp. in Premise Plumbing System
- Untreated Ground Water
- Distribution System
- Untreated Ground Water & Distribution System
- Point of Use — Bottled



Legionella
Bacteria, Non-Legionella
Parasites
Multiple
Viruses
Chemical

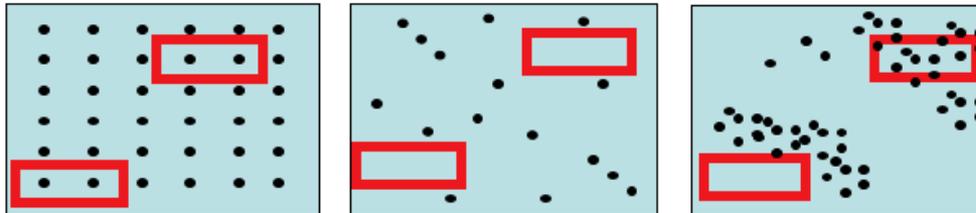
Lab Analysis approach

Traditional Approach Limitations

- Does not represent whole system
- Sampling basis
- Action when water had already been consumed
 - About 35 days from sampling to corrective action



Controle de qualidade da água ⇒ Princípio amostral





Legionnaire's Disease

Legionella

Legionella: OMS considera surto em Portugal como "grande emergência de saúde pública"



What is Legionella?



The 9th International Conference on
Legionella

Rome, 26th - 30th September 2017

Disease at Disney

Elevated levels of legionella bacteria causes
Disneyland to shut down cooling towers.



J. Aaron Delgado

Legionella: lessons to be learned



x

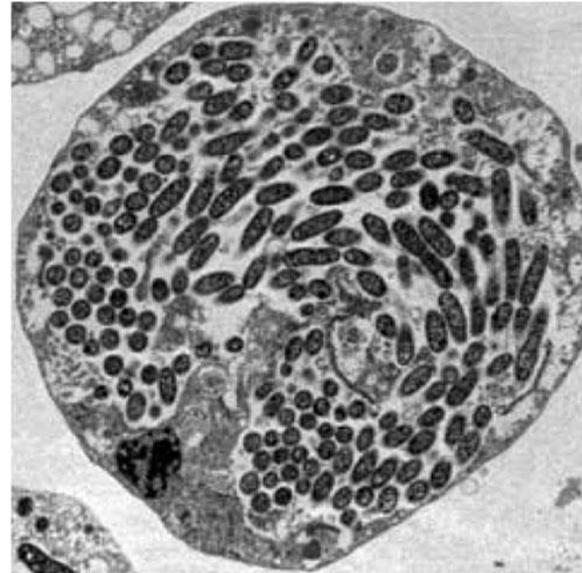
Bellevue-Stratford Hotel, Philadelphia



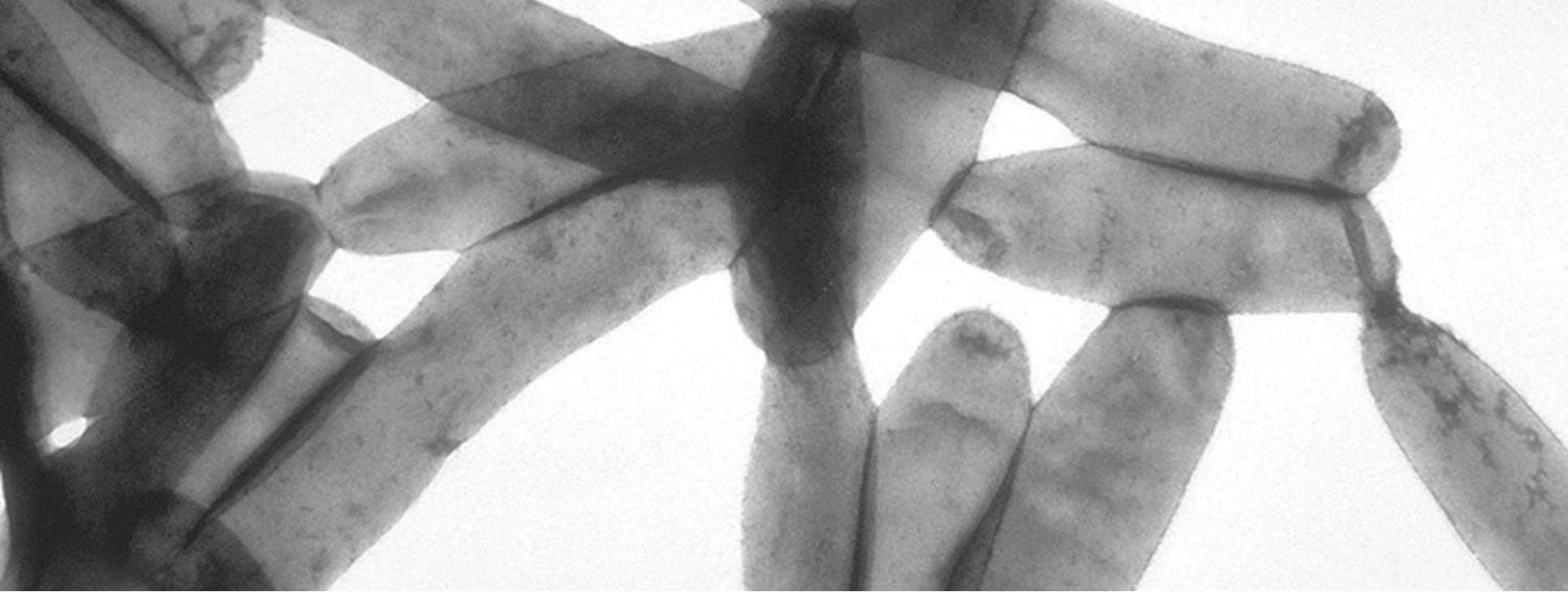
Amoeba relation



Macrophage and *Legionella*
(glóbulo branco)



Amoeba and *Legionella*



The Bacteria

Know your enemy

Natural habitat



Within human premises



**IT IS HUMAN ACTIVITY THAT
MAKES LEGIONELLA A RISK**



Amplification

Bacteria growth and concentration



Dissemination

From water system to environment

Route of infection

- Inhalation of aerosols most likely
- $<5\mu$ aerosols can enter alveoli
- Legionella survive 3-4 hrs in aerosols at relative humidity of 65%
- Aerosols created by water impacting surfaces
- No evidence of person to person spread (New Probable 2016)



<http://www.nejm.org/doi/full/10.1056/NEJMc1505356#t=article>

Cooling towers

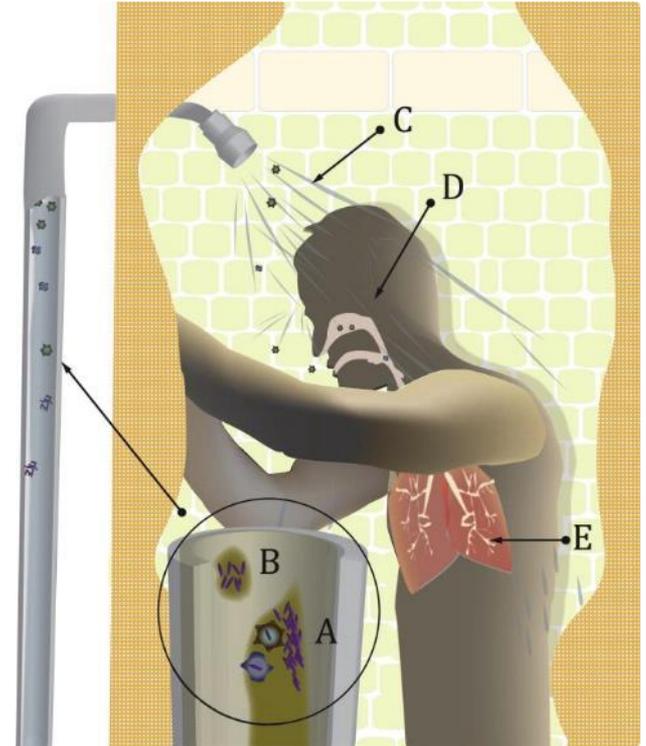


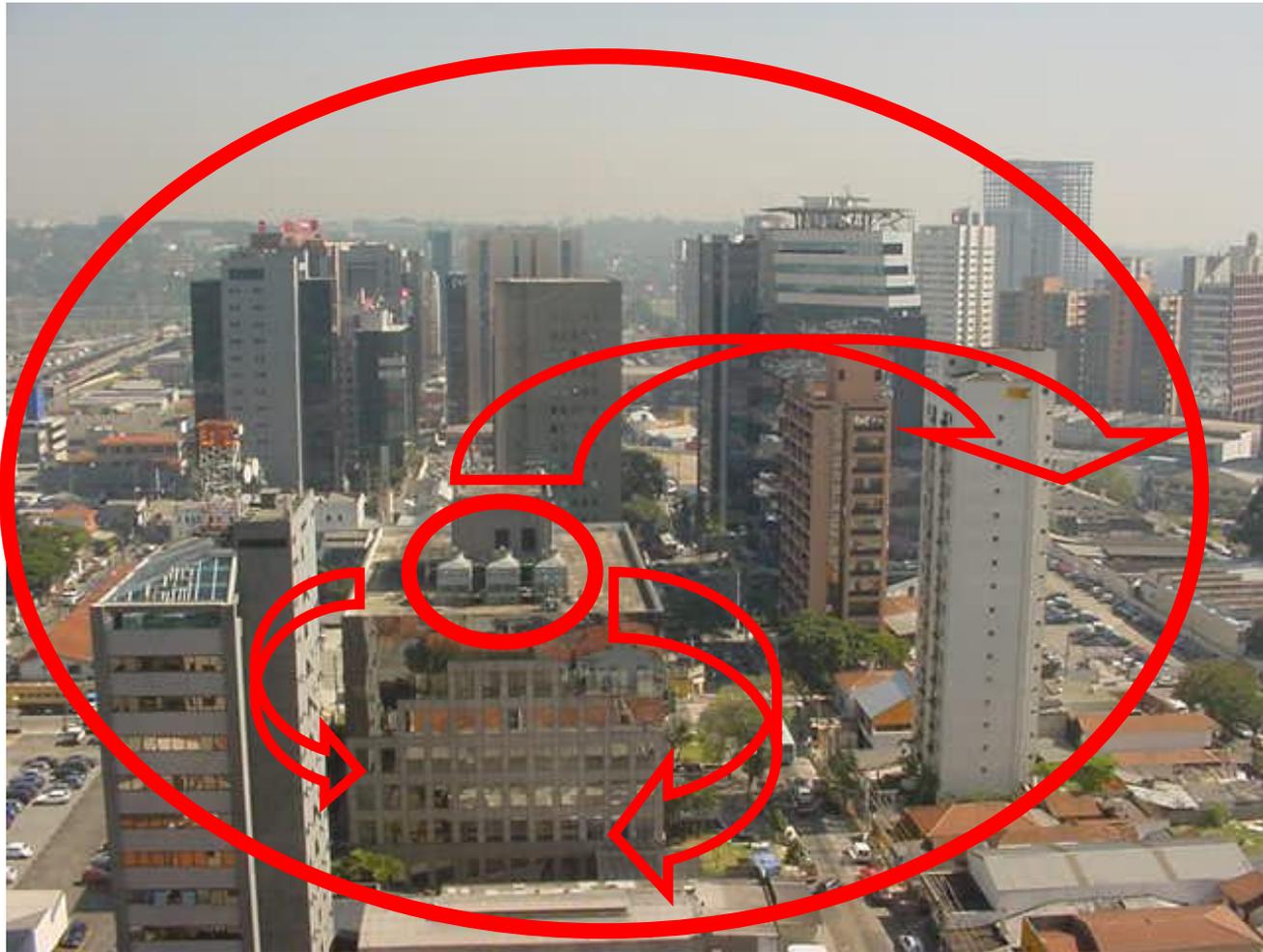
Shower



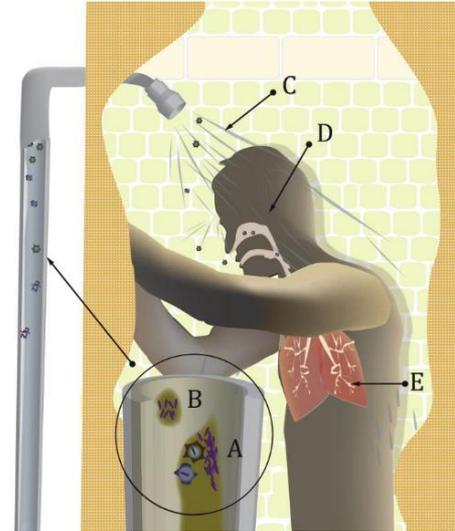
Shower

- Stagnant water
- Flexible hose
- Biofilm
- Hot water temperature
- Aerosols
- Most likely to cause sporadic cases





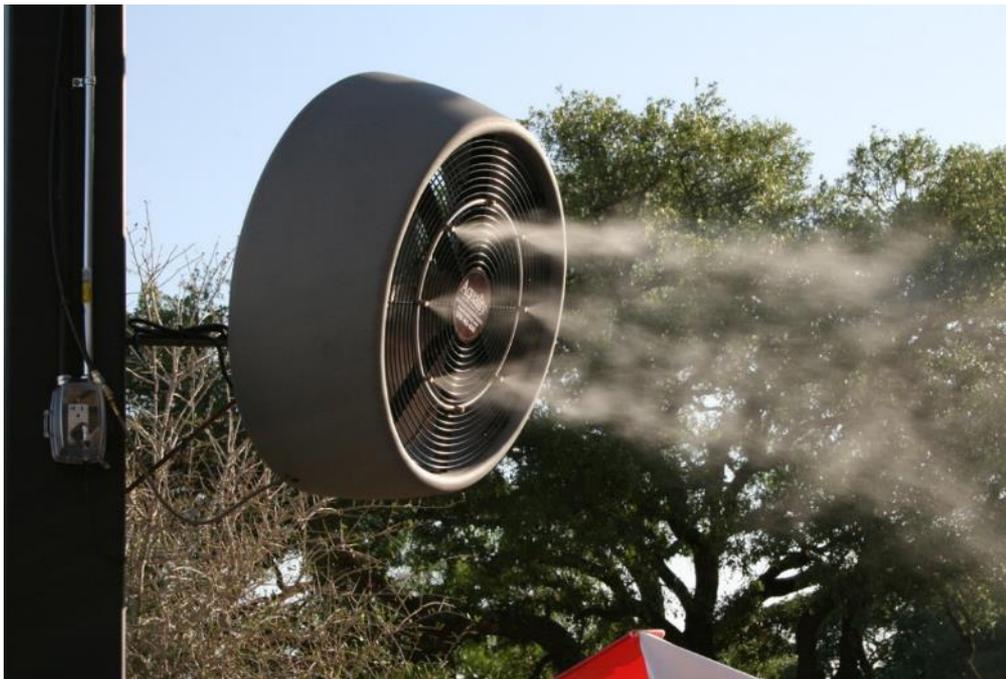
X



Dentist equipment



Misting fans



Irrigation



Car Washes



Decorative Fountains



Spas and hot tubs



Cruise Ship



Outbreaks are commonly associated with buildings or structures that have complex water systems, like cruise ships.



Natural habitat

Legionella can be present in any natural water source



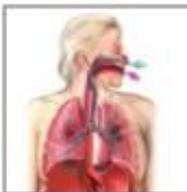
Contact with aerosol

The risk is also related to how people have contact with contaminated aerosol



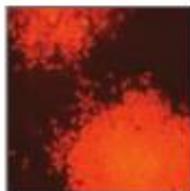
System contamination

Occurs by contaminated water



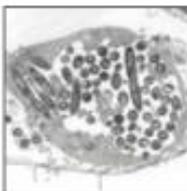
Host susceptibility

Gender, age, disease, respiratory disease, immunodeficiency, smokers and diabetics



Amplification system

There are several elements that promote the growth of *Legionella* (temperature, contamination process, water stagnation)



Virulence

Bacterium very aggressive to the host, and *Legionella pneumophila* sg1 requires more care



Spreading out of the system

There are many parts of the system or equipment that produce aerosols / sprays as cooling towers, showers, etc. (temperature, humidity, amount of aerosol)



Diagnosis of the disease

Identified by symptoms, laboratory testing and surveillance of locations affected by outbreaks of *legionella*



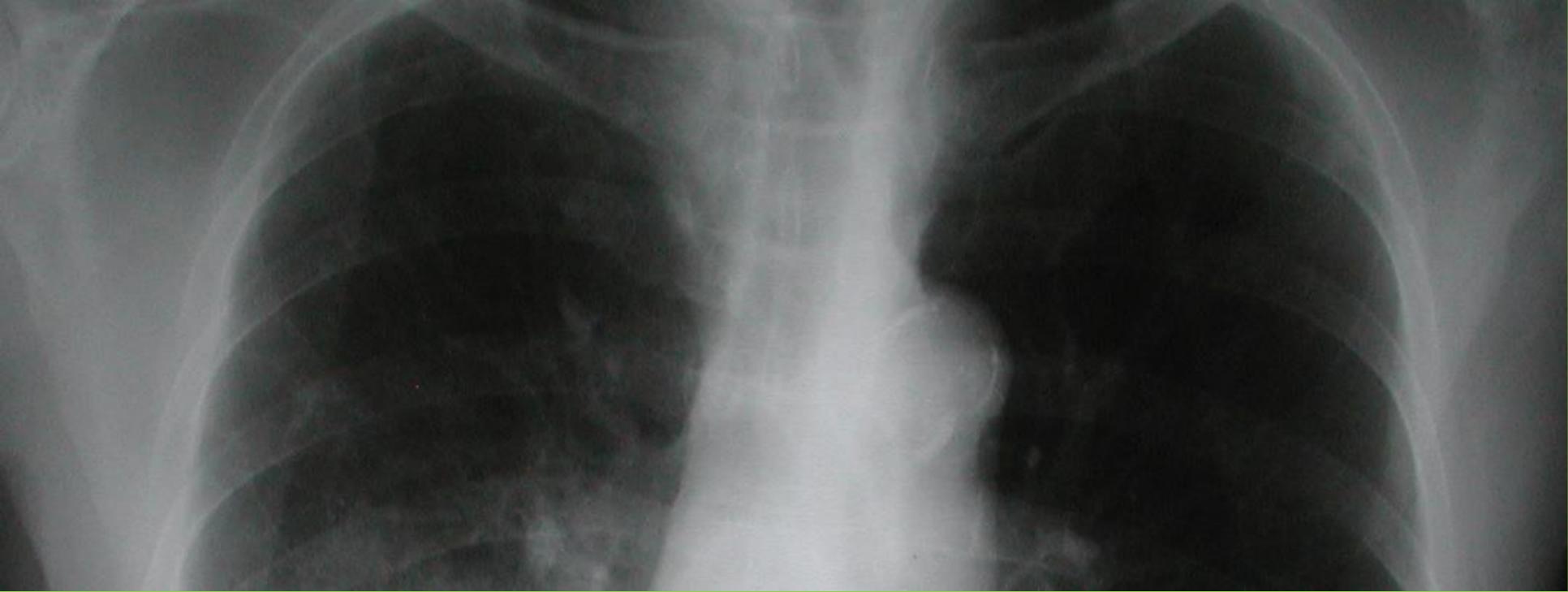
Lab analysis

Identifying *Legionella*

Methods

- ISO
- Dipslide
- PCR
- Others





The Disease

A hazard to prevent

Legionellosis

Legionellosis is the term used to describe diseases caused by Legionella bacteria.

Legionnaires' Disease is a pneumonia induced by a particular bacterium *Legionella pneumophila* (90% of all cases)

There are several types of illness that Legionella bacteria can cause:

- Legionnaires' Disease
- Pontiac Fever
- Lochgoilhead fever
caused by *Legionella micdadei*

• Legionnaires' Disease

- Most commonly caused by *L. pneumophila* sero group 1
- 5 % attack rate
- incubation period 2 to 10 days
- acute bacterial pneumonia
- being delirious with diarrhea & vomiting are common
- treated with antibiotics / slow recovery
- 12 % fatality

• Pontiac Fever

- Short fevers without pneumonia
- Incubation period, Pontiac 2-3 days, Lochgoilhead up to 9 days
- zero fatality

Pontiac fever

- The illness is self-limiting and symptoms can include:
 - fever
 - shivers
 - headache
 - muscle aches
 - tiredness
 - dry cough



- It is not clear why some people get Legionnaires' disease (with pneumonia) and some people get the milder Pontiac fever when infected with *Legionella* bacteria. It is also thought that some people who are infected with *Legionella* bacteria do not become ill at all.
- The incubation period is short and varies from a few hours to 12 to 48 hours.

Most affected people

Epidemiologic risk factors for legionellosis include:

- Recent travel with an overnight stay outside of the home, including stay in a healthcare facility
- Renal or hepatic failure
- Diabetes
- Chronic lung disease
- Systemic malignancy
- Smoking (current or historical)
- Immune system disorders
- Age ≥ 50 years



Infants born in water births at risk of Legionnaires' disease, CDC says



Babies born during water births are at risk of contracting [Legionnaires' disease](#), a severe and potentially life-threatening form of pneumonia that infected two infants in Arizona last year.

Sensitivity and Specificity of Diagnostic Tests

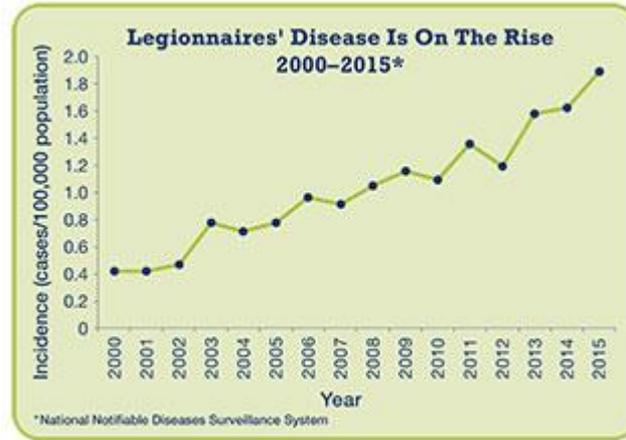
Sensitivity varies depending on the quality and timing of clinical specimen collection, as well as technical skill of the laboratory worker performing the test. The table below provides general ranges for the sensitivity and specificity of each diagnostic test.

Test	Sensitivity (%)	Specificity (%)
Culture	20-80	100
Urinary antigen for <i>L. pneumophila</i> serogroup 1* (Lp1)	70-100	95-100
Paired serology**	80-90	>99
Direct Fluorescent Antibody (DFA) Stain	25-75	≥95
Polymerase Chain Reaction (PCR)	unknown	unknown

*Cross reactions with other species and serogroups have been documented.

**CDC labs do not perform serology testing for legionellosis diagnosis due to inherent limitations of this approach.

Incidence – CDC (USA)



Continuous increase for the last 15 years

Flint/USA

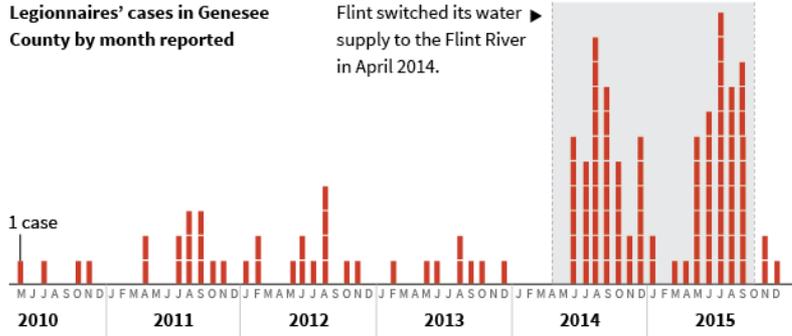
Legionnaires' Cases Rose Sharply In Flint After Water Switch

No official link has yet been detected between the city's water supply switching to the Flint River and the uptick in cases, but dozens have been sickened since April 2014.

Legionnaires' cases in Genesee County by month reported

Flint switched its water supply to the Flint River in April 2014.

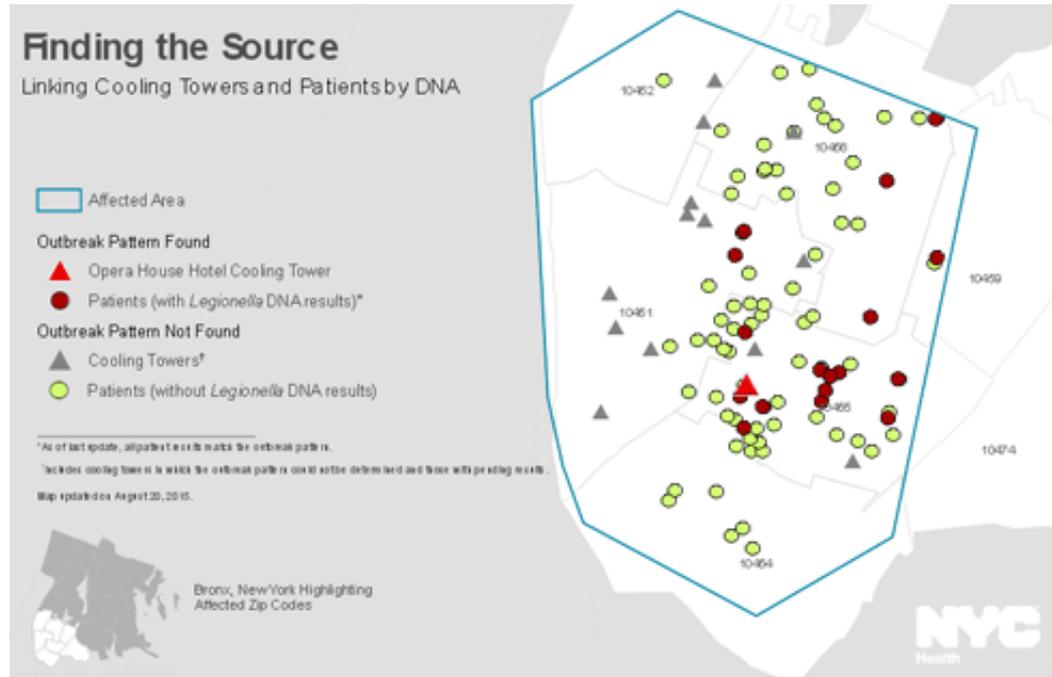
City's water supply was switched back to Lake Huron.



Note: Monthly case values are approximated for May/June 2015 and August/September 2015.



New York/USA



New York (2015)

ILLINOIS/USA

HEALTH

Legionella Detected in Illinois Statehouse Complex

Amanda Vinicky | January 22, 2018 7:51 pm



The capitol complex is comprised of 14 buildings, including the statehouse, the Secretary of State Driver's Facilities, the Illinois State Archives, and other several buildings in downtown Springfield that house the offices for state legislators and employees:

- Illinois Capitol
- Michael J. Howlett Building
- Illinois State Library
- Illinois State Archives
- William G. Stratton Building
- Illinois State Museum
- Willard Ice Building
- Index Building
- Illinois Attorney General Office
- Appellate Court Building
- Central Management Services Computer Center
- Secretary of State Warehouse
- Secretary of State Driver's Facilities
- Secretary of State Power Plant

Incidence – ECDC (Europe)

Other sites: [ECDC](#) [European Antibiotic Awareness Day](#) [ESCAIDE - Scientific conference](#) [Eurosurveillance journal](#)

 **European Centre for Disease Prevention and Control**
An agency of the European Union

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Legionnaires' disease

Leaflet for hotel managers

Leaflet for managers of tourist accommodation on how to reduce the risk of Legionnaires' disease

[Read the leaflet](#) ▶



<https://ecdc.europa.eu/en/legionnaires-disease>

Disease data from ECDC Surveillance Atlas - Legionnaires disease



Surveillance Atlas of Infectious Diseases

← → Legionnaires' disease ▾ All cases ▾ Reported cases ▾ : [Print] [Download] [Comment] [Share] [Alert]

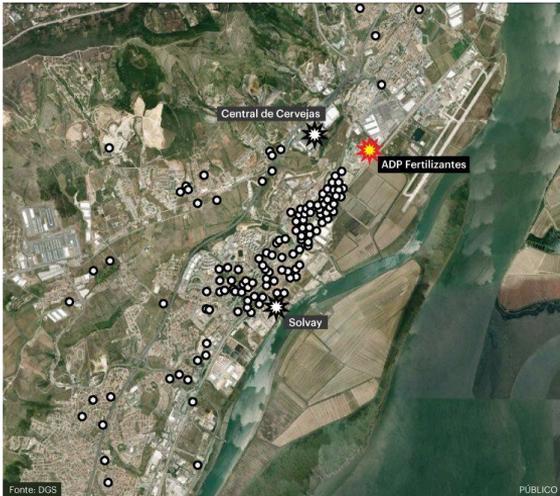
▶ ◀◀ 2015 ▾ ▶▶



PORTUGAL

Surto de Legionela em Lisboa faz dois mortos.
Há 29 casos identificados

Surto de Legionella em Vila Franca de Xira provocou 12 mortos em 2014



A Legionella infectou, entre 2005 e 2015, um total de 1.300 pessoas em Portugal, e causou a morte a uma centena desses doentes.

Casos de DL notificados por distrito em Portugal no período de 2004 - 2013

Fonte: Direção-Geral da Saúde



Quatro casos de "legionella" no hospital CUF Descobertas

Hospitais do Oeste vão ter sistema de desinfecção para evitar contaminações de 'legionella'

Os hospitais das Caldas da Rainha, Peniche e Torres Vedras vão ser equipados com um sistema de desinfecção do circuito de água para evitar futuras contaminações de 'legionella', divulgou o Centro Hospitalar do Oeste.

A instalação do novo sistema de desinfecção para as três unidades tem por "finalidade a obtenção de resultados negativos para 'legionella' em todos os pontos em que a mesma foi detetada", bem como a prevenção de "possíveis situações futuras", explicou o CHO, num comunicado.

Segunda, 29 Janeiro, 2018 - 09:54

Detetados dois casos de Legionella... na Acuinova

Esta semana foi detetada a presença da bactéria Legionella na Acuinova, empresa sediada na região da Praia de Mira. A bactéria terá sido encontrada nos chuveiros dos balneários masculinos, durante uma inspeção.



Amostras de água de hospitais nas cinco regiões de saúde foram colhidas e estão a ser analisadas no âmbito do Programa de Intervenção Operacional de Prevenção Ambiental da Legionella (PIOPAL), revelou o presidente do Instituto Nacional de Saúde Ricardo Jorge.

LEGIONELLA = WATER RISK



Probable Person-to-Person Transmission of Legionnaires' Disease

Legionnaires' disease is an often severe form of pneumonia that is typically acquired by susceptible persons (e.g., elderly persons and smokers) through inhalation of aerosols that contain legionella species.¹⁻⁴ A cluster of cases of this disease occurred in Vila Franca de Xira, Portugal, in 2014.⁵



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CME ▶

CORRESPONDENCE

Probable Person-to-Person Transmission of Legionnaires' Disease

N Engl J Med 2016; 374:497-498 | February 4, 2016 | DOI: 10.1056/NEJMc1505356

NSF International™

Risk Management

WATER SAFETY

RISK ASSESSMENT VS RISK MANAGEMENT

World Health Organization



“The most effective means of consistently ensuring the safety of a drinking water supply is through the use of a **comprehensive risk assessment** and **risk management** approach that encompasses all steps in water supply”

Chapter 4 of the Third Edition of the WHO Guidelines for Drinking-water Quality (2004)

The importance of Legionella risk assessment

The bacteria can cause the potentially deadly Legionnaires' diseases which is a severe form of pneumonia. Many health and safety experts have focused on the carrying out of a [Legionella Risk Assessment](#) as an essential first step in the risk management process in order to identify and then eliminate, or at least control the conditions associated with this bacteria. Legionella bacteria exist in small quantities in many water systems, both natural and man-made. Any property that contains a water system is at risk of developing this bacterium. This is why it is important for building owners and operators to conduct a thorough risk assessment to protect people from potential harm.

Our Approach - Two Steps

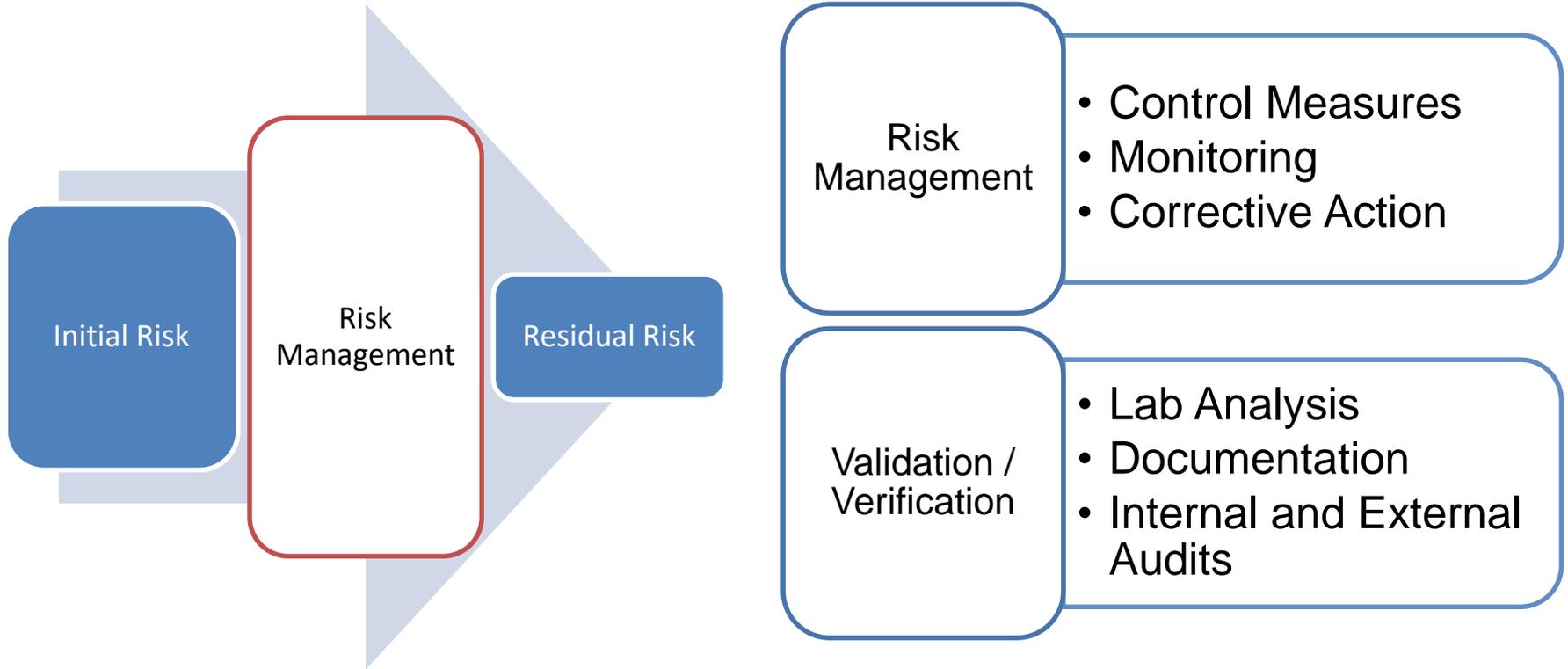
Risk Assessment (NSF)

- Water Safety Plan
 - Legionella Risk Assessment
- First Step
- Consultancy
- Hazard Identification
- Planning
- Recommendations

Risk Management (CLIENT)

- Water Management Program
- Created internally
- Day-to-day operation
- Routine actions
- Recordkeeping
- Documentation
- Addresses other topics related to water
 - sustainability

Risk Management



Risk Assessment Flow



In one minute: find the risks



Physical
Chemical
Microbiological

Object

- Any building or any industry
 - Food and beverage industries
 - Pharmaceutical
 - Hospital
 - Hotel / Resorts
 - Mall
 - Corporate buildings
 - Etc.....
- Buildings with collective use, with sensitive users, with sensitive health/food production

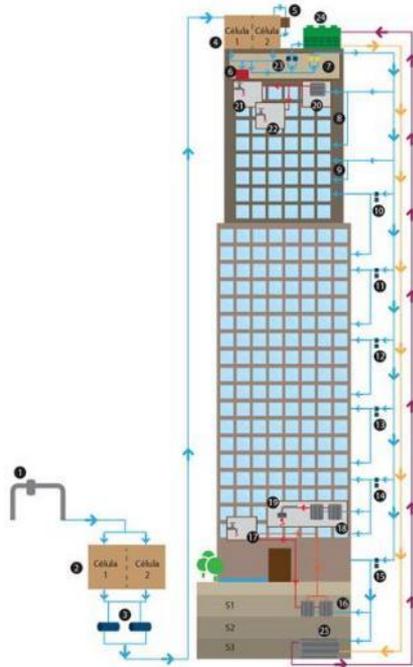


Object

- Any water system that may pose a risk for human health
 - Hot and Cold Potable Water System
 - Cooling Water System
 - Decorative Water System
 - Recreational system
 - Any utilities water system
 - Process water system
 - Industrial water system

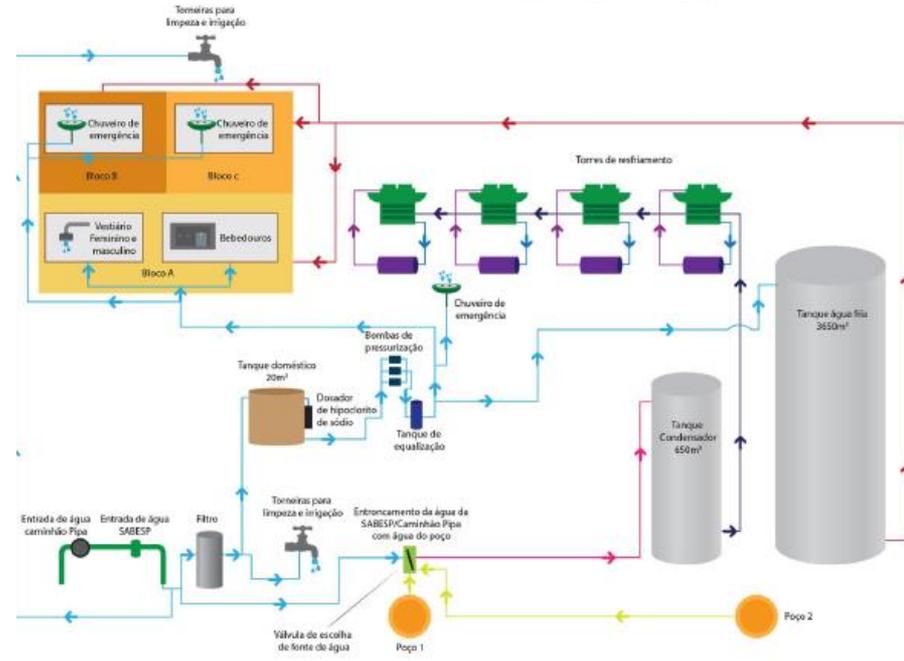


Water Systems



- 1 Entrada água SABESP e Caminhão pipa
- 2 Reservatório superior - Capacidade de cada célula 290m³ Total 596m³
- 3 Bombas de recalque
- 4 Reservatório superior - Capacidade de cada célula 188,5m³ Total 377m³
- 5 Desinfecção secundária
- 6 Água para sistema de incêndio
- 7 Pressurizador
- 8 Água pressurizada dos andares 26 ao 23
- 9 Água por gravidade dos andares 22 ao 21
- 10 Redutor de pressão e água distribuída para os andares 20 ao 17
- 11 Redutor de pressão e água distribuída para os andares 16 ao 13
- 12 Redutor de pressão e água distribuída para os andares 12 ao 9
- 13 Redutor de pressão e água distribuída para os andares 8 ao 5
- 14 Redutor de pressão e água distribuída para os andares 4 ao 1
- 15 Redutor de pressão e água distribuída para os andares T ao S3
- 16 Boiler que abastece o restaurante do 1º andar
- 17 Água quente no restaurante do 1º andar
- 18 Boilers que abastecem o vestiário da academia no 2º andar
- 19 Vestiário da academia do 2º andar com água quente
- 20 Boiler que abastece as cozinhas do 26º e 25º andar
- 21 Água quente no 26º andar
- 22 Água quente no 25º andar
- 23 Bombas de recalque que alimentam o sistema de resfriamento
- 24 Torre de resfriamento
- 25 Chiller do sistema de resfriamento

- Água potável
- Água quente (Boiler)
- Retorno da água quente (Boiler)
- Água para chiller (Sistema de Refrigeração)
- Retorno da água para a torre de resfriamento (Sistema de Refrigeração)



Hazards

Physical

Chemical

Microbiological

Scalding

Debris

Turbidity

Heavy Metals

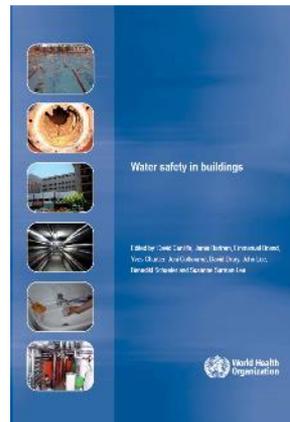
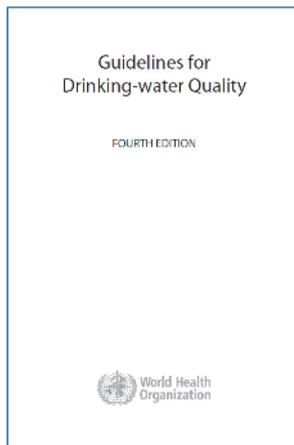
Disinfection by-products

Chemical products

Emerging / Pharmaceuticals

Bacteria

Protozoa



NSF International™

Water Safety Plan for Buildings and Industries & Risk Assessment for Legionella

- Risk-based tool to minimize hazards associated to water with a preventive approach
- Applied to all water systems within a building (domestic hot and cold water, cooling, decorative, leisure, industrial, process, etc)
- Applied to all water systems within an industry (food and beverage, pharmaceutical, utilities, etc)



Water Safety Plan for Buildings and Industries

- Analysis of potential hazards associated with ingestion, inhalation, and skin contact
- Recommendations for control measures, monitoring, and corrective actions
- Basis for a Water Management Program for the whole building
- All water systems are assessed and inspected:
 - Cold Domestic Water
 - Hot Domestic Water
 - Cooling
 - Irrigation
 - Decorative water features
 - Recreation (pools and spas)
 - Recycled water
 - Industrial water systems

Goals

- Give a risk assessment for the team to help create a comprehensive Water Management Plan (or Water Management Program)
- Risk-based tool to identify existing and foreseeable risks within the Building/Industry
- Suggest reasonable control measures
- Suggest an improvement plan
- Suggest a validation plan

Differences

Water Safety Plan

- Based on hazard analysis
- Hazards associated to
 - **Ingestion**
 - **Inhalation**
 - **Skin contact**
- Recommendations for control measures, monitoring and corrective actions
- Base for a Water Management Program

Legionella Risk Assessment

- Based on hazard analysis
- Hazards associated to
 - **Inhalation (Legionella)**
- Recommendations for control measures, monitoring and corrective actions
- Base for a Legionella Management Program

Water Safety Plan for Buildings and Industries

WATER SAFETY PLAN

Aspects

Ingestion



Legionella Risk Assessment

Inhalation



Skin Contact





- 1 Prevenção de legionelose associada a sistemas de distribuição de água em edificações
- 2

Chapter 3 Approaches to risk management

Jamie Barrtram, Richard Bentham, Emmanuel Briand, Phil Callan, Sebastian Crepi, John V Lee, Susanne Surman-Lee

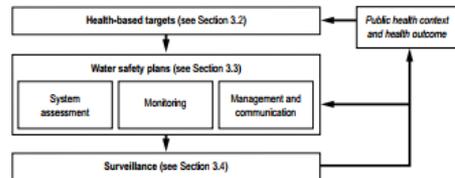
The World Health Organization (WHO) has developed a framework for safe drinking-water that can be applied to assessing and managing the risks posed by *Legionella*. Figure 3.1 illustrates this framework.

This chapter first considers the links between environmental exposure to *Legionella* and outbreaks of disease (Section 3.1), and then describes how the framework can be used to minimise the risk of *Legionella* colonizing a water system. The framework has the following components:

- *health-based targets* (Section 3.2) — these are targets normally set at national or state level by a competent authority, either in the health sector, or in consultation with the health sector
- *water safety plans (WSPs)* (Section 3.3) — these are system specific plans developed and implemented by the operator of the system (in the case of *Legionella*, such plans may be building specific, and may be developed and implemented by the building operator)
- *surveillance* (Section 3.4) — this is a system of independent checking, by a surveillance body or regulatory agency.

The information on health-based targets and surveillance is similar for all types of situation where *Legionella* may be found; however, a WSP is necessary for each particular situation. Therefore, Chapters 4 to 8 discuss the application of WSPs for *Legionella* to particular situations.

Figure 3.1 Framework for safe drinking-water



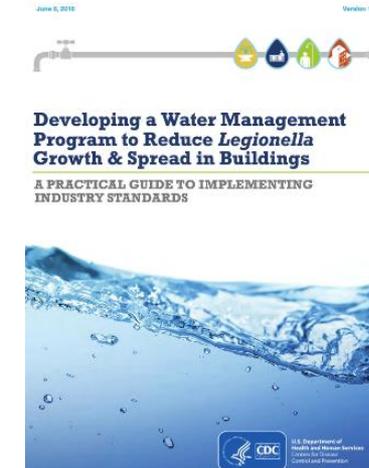
Source: WHO (2004)



Aprobado por el Comité de Estándares de ASHRAE el 27 de mayo del 2015, por el BOO de ASHRAE, el 4 de junio del 2015 y por el Instituto Nacional de Estándares Americanos, el 16 de junio del 2015.

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Governo avança com lei para prevenir surtos de legionella (qualidade do ar)- Portugal

DEPARTMENT OF HEALTH & HUMAN SERVICES
 Centers for Medicare & Medicaid Services
 7500 Security Boulevard, Mail Stop C2-21-16
 Baltimore, Maryland 21244-1850



Center for Clinical Standards and Quality/Survey & Certification Group

Ref: S&C 17-30-*Hospitals/CAHs/NHs*
 REVISED 06.09.2017

DATE: June 02, 2017

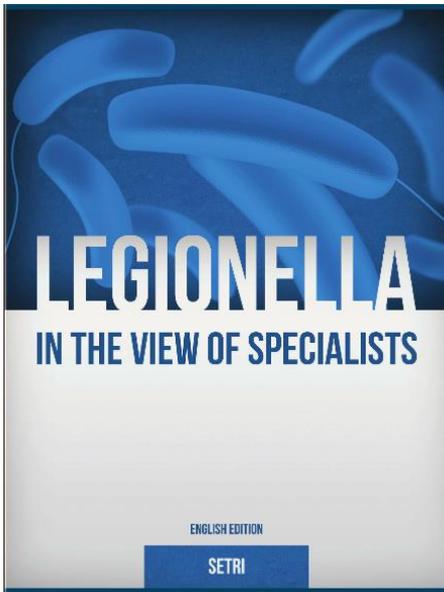
TO: State Survey Agency Directors

FROM: Director
 Survey and Certification Group

SUBJECT: Requirement to Reduce *Legionella* Risk in Healthcare Facility Water Systems to Prevent Cases and Outbreaks of Legionnaires' Disease (LD)
 Revised to Clarify Provider Types Affected

Memorandum Summary

- **Legionella Infections:** The bacterium *Legionella* can cause a serious type of pneumonia called LD in persons at risk. Those at risk include persons who are at least 50 years old, smokers, or those with underlying medical conditions such as chronic lung disease or immunosuppression. Outbreaks have been linked to poorly maintained water systems in buildings with large or complex water systems including hospitals and long-term care facilities. Transmission can occur via aerosols from devices such as showerheads, cooling towers, hot tubs, and decorative fountains.
- **Facility Requirements to Prevent Legionella Infections:** Facilities must develop and adhere to policies and procedures that inhibit microbial growth in building water systems that reduce the risk of growth and spread of *legionella* and other opportunistic pathogens in water.
- **This policy memorandum applies to Hospitals, Critical Access Hospitals (CAHs) and Long-Term Care (LTC). However, this policy memorandum is also intended to provide general awareness for all healthcare organizations.**



LEGIONELLA

IN THE VIEW OF SPECIALISTS

ENGLISH EDITION

SETRI

Legionella in Portugal

CHAPTER 19

By: Raquel Rodrigues Lopes da Silva Esaguy

- Appointed as Technical Officer and Manager of Water Quality at Microbiology Laboratory of INSA, Lisbon
- Department of Environmental Health - Water and Soil Unit - Microbiology Laboratory, National Institute of Health Dr. Ricardo Jorge, Lisbon.
- Water and sprays sampling for microbiological analysis, including pathogenic research;
- Conduct environmental microbiological analysis, Laboratory Accredited by IPAC, according to legislation in force
- Responsible for *Legionella* spp identification and differentiation under community service, health surveillance and epidemiological investigation of cases and outbreaks by applying different techniques from molecular biology to clinical and environmental samples;
- Responsible for maintaining the database and collection of *Legionella* strains from clinical and environmental sources.
- Uses FT-IR (Fourier Transform Infrared Spectroscopy) technique applied to the differentiation of microorganisms.
- 2010-2012, Developed and participated of the Project "Legionella in Water of sport centers in the municipality of Lisbon" funded by the DGS (publication in preparation).
- 2007-2010 Participated in Project Associação Bandeira Azul da Europa (ABAE). Participating agencies: Environment Institute, National Institute of Health Dr. Ricardo Jorge.
- 2007-2008, Developed and participated in the Project "Legionella in Ornamental Lakes and fountains", funded by the DGS.
- 2006 Participated in "First European Quality Control ring trial on *Legionella* Real-Time PCR analysis. Study based on IQ-Check *Legionella* spp and *Legionella pneumophila* quantification by Real-Time PCR", organized by BioRad Company



Plano de Segurança da Água Water Safety Plan Vila Olímpica Rio 2016

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Water Safety Plan for Buildings and Industries



- Increase water systems knowledge and vulnerabilities
- Minimize hazards associated to water (public health)
 - Ingestion, inhalation (Legionella) and skin contact
- Regulations, codes, guidelines compliance
- Preserve reputation in the industry and community
- Internal staff more involved to achieve water safety



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