How to ensure your building water system is safe during and post COVID-19

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Duty of care to prevent infections from water

- Poor management of water within buildings has resulted in waterborne illness and deaths amongst staff, visitors (including patients in hospitals) and members of the public.
- Prosecutions are usually based on H&SAW legislation
- The management of all workplace premises have an overriding general duty of care to supply, store, distribute and manage water services safely under their control.
- This duty remains during the COVID-19 pandemic

Waterborne opportunistic pathogens:-

- In poorly managed building water systems and associated equipment, hazards, both of a microbial and chemical nature, can increase to levels which can cause harm
- Water delivered from outlets even when supplied from a regulated drinking water supply is not sterile
- Whilst naturally occurring microorganisms in water do not generally cause harm to healthy people in their natural environment they can cause severe illness and death in susceptible persons
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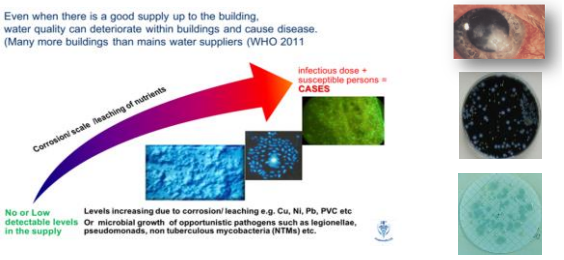
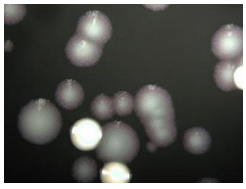


Potential routes of water system contamination include:

- poor backflow prevention (consider also drains);
- poor design and construction including of piping system & components;
- existence of deadlegs/ blind ends in the distribution system;
- inadvertent cross connection
- damaged pipes / connections;
- chemical contamination from construction materials;
- ingress during maintenance or repair ;
- nutrients, scale and corrosion supporting growth in pipe work and fittings
- stagnant water for example in infrequently used storage tanks, outlets or other part of the water system where water remains stagnant for more than 7 days.
- poor hygiene when bunkering allowing microbial contamination to enter the system.
- deliberate attempts of water contamination.

Legionella is still the primary concern in most building water systems

- Overall mortality rate ≈8-10%
- Hospital acquired mortality rate can be up to 40%



Legionellosis:

an infection caused by *Legionella*

- Severest - Legionnaires' disease
  - Pneumonia
  - Symptoms: cough - usually dry, 75%; fevers, 70%; confusion, 45%; new sputum, 45%; bad headache, 32%; diarrhoea & vomiting, 30%
  - Incubation 2-10 days (average 2-5 but can be extended to ≃ 21days)
  - Low attack rate ≤ 1%
- Mild self limiting Pontiac Fever (flu like)
  - Short incubation period
  - High attack rate ≃ 95%

Who is most at risk?

In the 'general population'

- Men more than women (3:1)
- Smokers
- Elderly people
- People with poor immune respo
- People with underlying conditio
  - Heart conditions
  - Diabetics
  - Existing respiratory problems

Risk factors

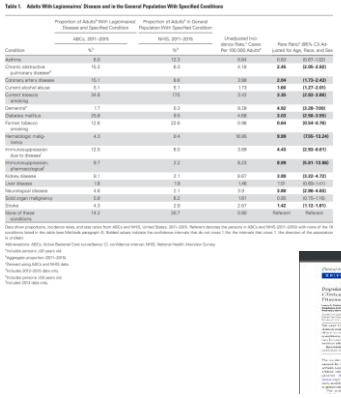
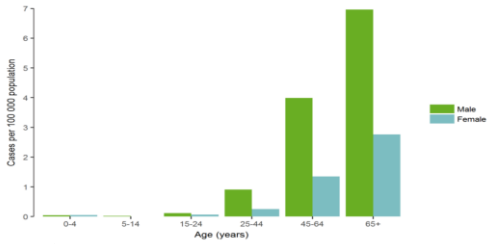


Table 1. Adults With Legionnaires' Disease and in the General Population With Specified Conditions

Cases of Legionnaires' disease with underlying conditions/risk factors, England and Wales 2012 to 2016

Risk factors :Age and sex (ECDC report 2019)

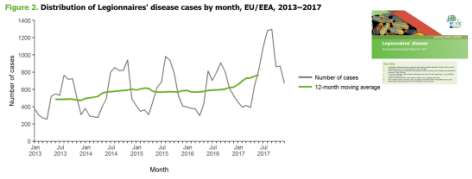
Figure 4. Distribution of Legionnaires' disease cases per 100 000 population by age and gender, EU/EEA, 2017



The notification rate increased with age,
from ≤0.1 per 100 000 in those under 25 years of age to 4.6 in persons aged ≥ 65
7.0 / 100 000 in males and 2.8 / 100 000 in females
The overall male-to-female ratio was 2.4:1

Incidence of Legionnaires' disease is rising worldwide

Figure 2. Distribution of Legionnaires' disease cases by month, EU/EEA, 2013–2017



Source: Country reports from Austria, Belgium, Bulgaria, the Czech Republic, Cyprus, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, the Netherlands, Norway, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden and the United Kingdom.

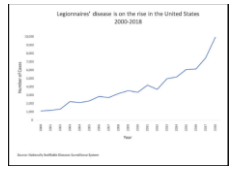
WHO has identified *Legionella* as causing the highest health burden of all waterborne pathogens within the EU
based on the ECDC 2015 surveillance report

WHO Guidelines for drinking water quality 2017:-

Key Legionella Facts (ECDC 2017 data published in 2019)

- **Rates of notification are increasing worldwide**
  - The annual notification rate increased continuously over the 2013–2017 period from **1.2 per 100 000 in 2013 to 1.8 in 2017**.
  - **With a 30% increase in the number of cases in 2017 cf to 2016**.
- Of 6976 cases with known outcome,
  574 (8%) were reported to have a fatal outcome.
- **Males aged 65 years and above were most affected (7.0 per 100 000).**

Increasing in the USA



https://www.cdc.gov/legionella/images/national-incidence.jpg

The incidence rate of Legionnaires' disease reported cases increased 5.5-fold during 2000–2017 in the USA, from 0.42 to 2.29 per 100,000 persons

Laura A Cooley, Tracy Pondo, Louise K Francois Watkins, Priti Shah, Stephanie Schrag, Active Bacterial Core Surveillance Program of the Emerging Infections Program Network, Population-Based Assessment of Clinical Risk Factors for Legionnaires' Disease, Clinical Infectious Diseases, , ciz771, https://doi.org/10.1093/cid/ciz771

RISES IN JAPAN TOO

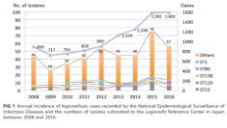


FIG 1 Annual incidence of legionellosis cases recorded by the National Epidemiological Surveillance of Infectious Diseases and the numbers of isolates submitted to the Legionella Reference Center in Japan between 2008 and 2016.

What are the reasons?

Possible causes for the increase in Legionnaires' disease include:

- Better surveillance and ascertainment
- Economic challenges for building owners?
- An aging population,
- Old plumbing and materials which support growth
- Increased use of TMVs
- Poor design and commissioning of new builds and refurbishments
- Weather patterns / climate change?
- **More people with underlying conditions and compromised immune systems in the community and travelling**

For example:-
In the USA 0.85% in 2000
3.6% in 2016

This is number is likely to increase following COVID -19

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Infection from Aerosols

- An infectious aerosol is not a spray although it can be formed from a spray
- When aerosols are small enough to get deep into the lungs the particles are not visible – most of the water has evaporated and just contains the droplet nuclei
- These small particles <5µm can remain in suspension in air for prolonged periods (hours) and can be inhaled deep into the lungs

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From Inhalation of contaminated aerosols

- cooling towers, evaporative condensers, humidifiers
- hot and cold water outlets e.g.
  - showers, taps, toilets
- spa pools and hot tubs
- decorative fountains,
- irrigation systems
- misting devices
- medical equipment: nebulizers, foot spas etc.
- specialist equipment: jet washers etc.
- fire hoses and sprinklers

09/10/2020

MAJOR ARTICLE

First Outbreak of Nosocomial *Legionella* Infection in Term Neonates Caused by a Cold Mist Ultrasonic Humidifier

- 50% fatality rate
- Legionella pneumophila sg-3
- Manufacturer said tap water could be used – so it was. NO RISK ASSESSMENT!
- Large-volume, room-air humidifiers that create aerosols should not be used in hospitals unless they can be sterilized or subjected to high-level disinfection on a daily basis and filled only with sterile water

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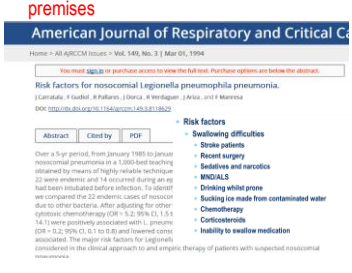
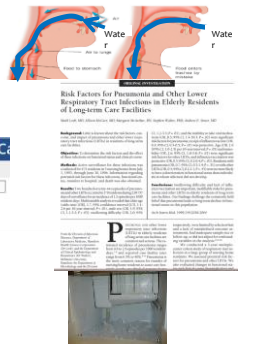
Aspiration an underestimated risk for HAI pneumonia including from LD

* Aspiration should not be overlooked as a potential source in hospitals and healthcare premises





A. Bencini MDa, *et al.* A Case of Legionnaires' Disease Caused by Aspiration of Ice Water Archives of Environmental & Occupational Health Volume 60, Issue 6, 200 pages 302-306

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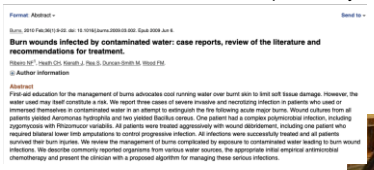
Direct and indirect Contact with contaminated water

- Washing / irrigating wounds, cooling burns
- Contact during bathing: especially for *Pseudomonas aeruginosa*
  - From using swimming pools, spa pools, whirlpool baths, hydrotherapy pools
- Foot spas, burns cooling, debridement bath
- Contact with inflatables and plastic toys in



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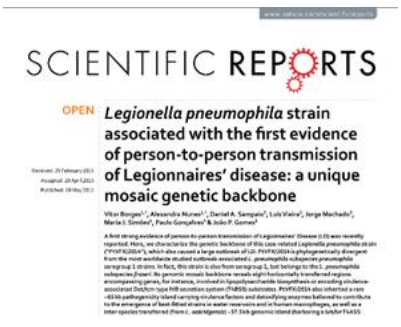
Only one possible case of person to person transmission*



Long term outcomes

- Long periods in intensive care
  - Multi organ failure
  - Renal failure
  - Breathing problems
  - Weakness and fatigue
  - Loss of extremities
- Neurological problems
  - Depression
  - Poor memory and concentration
  - Retrograde amnesia
  - Cerebellar dysfunction – causing problems with balance, motor control
- Many never work again

Evidence that Outbreaks can last years

- University Hospital and Regional Transplant Centre – outbreak lasting 17 years interrupted in 1996[1].
- Veterans Administration Hospital in California – 250 cases over 8 years[2].
- Hospital with an outbreak in 1980-82 had a cluster identified in 1994 when urinary antigen testing introduced – probable continuing outbreak for 12 years[3].
- Nottingham – Teaching Hospital. 12 patients infected over 12 months from a low temperature hot water system [4].

1. *Kool JL et al. Infect Control Hosp Epidemiol 1998:19(12):898-904*
2. *Haley et al. Ann Intern Med 1979;90:583-586*
3. *Lepine et al. Infect Control Hosp Epidemiol 1998;19(12):905-10*
4. Coville A et al. Epidemiol Infect 1993;110:105-16

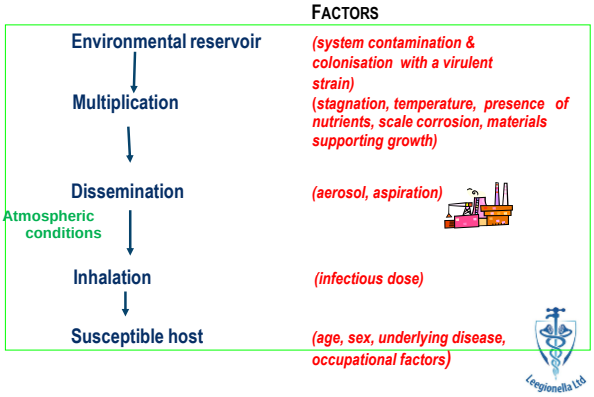
44 years after Philadelphia

- we know that all systems which contain non- sterile water,
- operate within the range of 20-45 ºC (68-113ºF) in any part of that system
- and have the potential for aerosol production are HIGH RISK SYSTEMS.

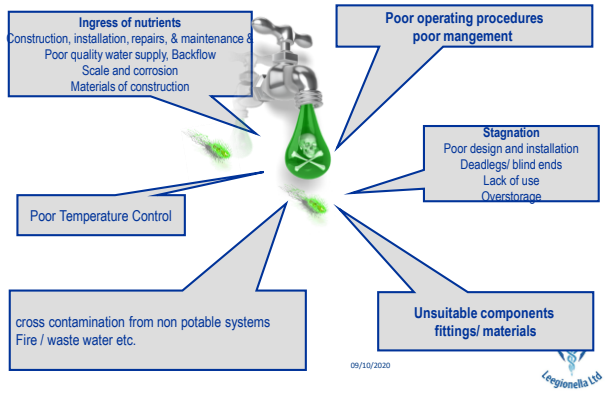
We know that in addition

- Stagnation /low flow/ lack of use
- The presence of nutrients
  (for legionellae : background microorganisms)
- **A lack of controls e.g.**
  - Low hot water temp <45ºC (122 ºF)
  - Warm cold water > 20 ºC or 68 ºF
  - Lack of appropriate biocide concentrations
- **And a susceptible population**
- **Result in an increased risk of Legionnaires' disease**

Chain of events leading to legionellosis

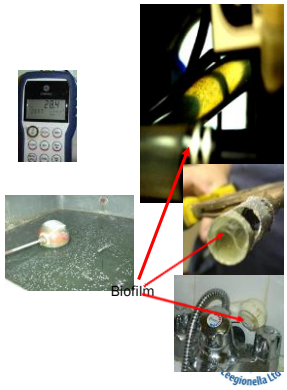


Sources and causes of contamination & biofilm formation



Stagnation increases the risk of hazards rising to levels which may cause harm :

- Many buildings will have just been vacated without any water system precautions put in place resulting in:
  - Increased temperatures in both the incoming supply, building water systems and associated equipment
  - Decreasing biocide levels throughout the system allowing increased colonisation and growth of biofilms
  - Warm stagnant water increasing the risk of growth of biofilms containing *Legionella*, *P. aeruginosa* nontuberculous mycobacteria, and other related opportunistic pathogens



Stagnation in the Presence of scale & corrosion increases the risk of biofilm formation

- Rougher materials and those with corrosion and scale are preferentially colonised.
- Form micro-niches which give protection from biocides and flow factors.
- Corrosion also releases iron which is a legionellae growth factor.
- Biofilms can grow in all parts of the system including:-
  - Outlets, washers, seals, flexible hoses, plastic shower heads, thermostatic mixer valves
  - Areas of stagnation
  - Dead legs / blind ends

Intracellular growth can be protective

- Growth within protozoa; especially cysts is protective
- *L. pneumophila* have been shown to survive inside amoebal cysts treated with 50ppm chlorine overnight (Kilvington).
- Intra-amoebal growth patterns vary compared to those grown *in vitro*
  - modifications of lipopolysaccharide and fatty acid content of the cell envelope.
- Legionellae within cysts are also protected against dessication and heat

Not just biological

Chemical hazards

Stagnation causes:
- increases in heavy metals (lead pipes),
- & nitrites Formed by Nitrosomas bacteria in galvanised pipes

Chemical
Disinfectants and their by products
Corrosion products
Hydrotherapy pool chemicals
Laboratory chemical contamination
Cleaning chemicals
Hydrocarbons

Physical
Scalding
Slips
Drowning

Radiological
Natural radon gas
Radiotherapy and research with radionuclides

COVID-19
Brings extra challenges for managing buildings water systems

- Stagnation increase the likelihood of opportunistic pathogens to grow to levels which can cause infections
- Aso have specialist equipment where other waterborne pathogens may pose a risk including in the leisure and beauty industry, education, building, commercial, industrial as well as healthcare premises e.g. dental practices, podiatry etc.
- Legionnaires disease is of primary concern in non healthcare buildings but the risk from chemical contamination (e.g. lead) should also be assessed.

Many factors which increase the risk of waterborne infections as a result of the COVID-19 response including: -

- A rapid increase in the number of patients with increased susceptibility to secondary infections requiring special precautions to prevent waterborne infections (augmented care)
- Rushed planning, specification, installation, commissioning etc. of changes to water systems or, installing equipment with the potential to increase the risk of introducing contamination including :
  - -additional point of use fittings, ventilators, humidification equipment, additional showers and clinical wash hand basins, mobile handwash stations etc.
- Conversion of public buildings including hotels and conference centers to healthcare facilities (e.g. as isolation or recovery facilities).
  - Increased patient and staff occupancy putting a strain on the ability to provide sufficient hot and cold water with adequate temperature recovery times
- Interruption or disruption to routine water maintenance due to staff shortages due to self-isolation, illness, site closures / shutdowns etc.,
- Temporary closure of buildings, parts of buildings or their restricted use leading to stagnation with water systems and associated equipment,
- **Reduction in testing for *Legionella* of patients and water leading to under-recognition of contaminated sources, outbreaks, cases and clusters.**

Management of water within complex buildings poses many challenges

- Within large buildings with multiple distribution loops
- Buildings with additional uses of water e.g. :
  - Hospitals
    - Additional water uses for diagnosis and treatment
  - Hotels and Recreational complexes
    - Swimming pools; spa pools etc., water features, evaporative cooling
  - Health spas
    - Pools / balneotherapy, hairdressing, footbaths, etc/
  - Industry
    - Processes such as cooling; panel spraying etc.

New hospitals may not be safe!

- New healthcare building water systems are adversely affecting the health of vulnerable users and in some cases causing their death.

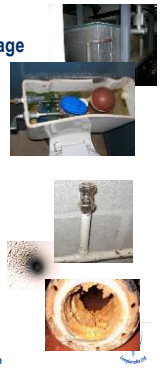
TAP WATER LINK TO BABY DEATH IN £1BN HOSPITAL

Urgent probe as infant dies and 12 are infected by superbug

Infections: The Royal Hospital for Children, Glasgow, where the premature baby died

Common Risk Factors in Hot & Cold Water Distribution Pipework

- Risk factors include:-
  - **Lack of input from specialist users at the design stage**
  - **Poor specification and design**
  - **Poor choice of components and materials**
  - **Poor installation**
  - **Poor commissioning**
  - **Poor operation**
  - **Areas of stagnation / low flow**
    - Lack of use
    - Deadlegs and blind ends
    - Occluded pipework e.g. by scale and corrosion
    - Overstorage of water etc.



In 2011 WHO published Water Safety in Buildings :-

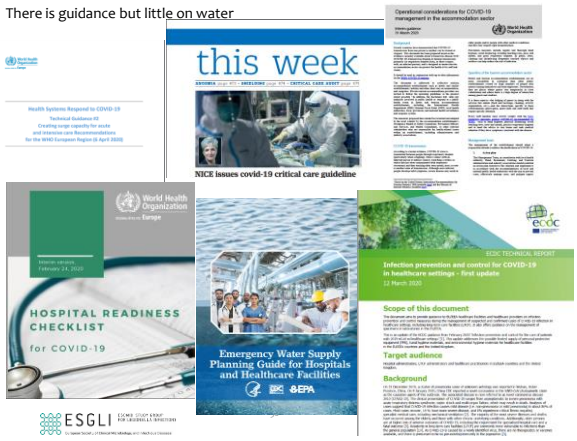
- "A common theme associated with waterborne outbreaks has been poor management of water systems in buildings.
- These can be prevented through good design and the application of WSPs."

http://apps.who.int/iris/handle/10665/76145
ISBN 978 92 4 154810 6

Proportionality

- The scope and complexity of the WSP **should be proportional to the type of water-related activities carried out and the scale and complexity of the business/organization**.

There is guidance but little on water



The ESCMID Study Group for *Legionella* Infections

The ESCMID Study Group for Legionella infections (ESGLI) is a group of like minded scientists and professionals who aim to study and improve the diagnosis, treatment, control and prevention of Legionellosis.
This is achieved by promoting and supporting research, education, training, and good medical practice
This international multidisciplinary group includes members from national reference laboratories, academia, public health consultants, water treatment specialists, etc. has put their heads together to provide guidance for managing build water systems both during the construction of new and altered water stems to accommodate COVId – 19 patients or patients at increased risk of infection who have been moved from hospitals to make way for COVID 19 patients.
One of our greatest concerns is that during lockdown there are thousands of buildings which have been temporarily closed

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https://www.escmid.org/research_projects/study_groups/legionella_infections/

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Secondary infections in COVID-19 patients

Clinical course and risk factors for mortality of adult inpatients with COVID-19 in Wuhan, China: a retrospective cohort study

Half of non-survivors experienced a secondary infection,

medRxiv

24/30 (80.00%) from Qingdao had IgM antibodies against at least one respiratory pathogen, 20% *L. pneumophila*

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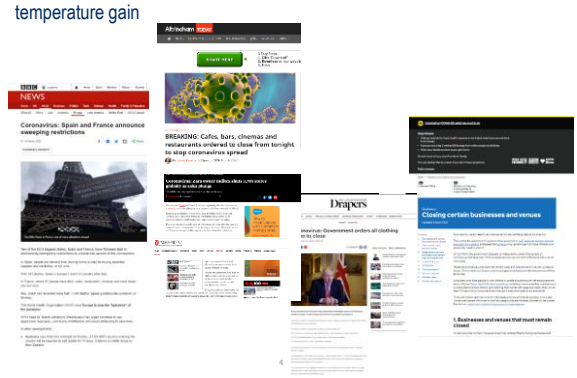
* Many buildings have been closed for weeks-leading to stagnation and temperature gain



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Temporary or partial closure of buildings

- If a building or part of a building is to be 'closed temporarily until the current pandemic is over, precautions need to be taken to ensure that the water systems can be re-instated without presenting increased risks of harm from increases in hazards both biological and chemical
- Seasonal hotels have processes to protect their premises and have de-commissioning and re-commissioning protocols in place
-

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Many buildings will have just been vacated without any precautions put in place resulting in:

- Increasing temperatures in both the incoming supply, building water systems and associated equipment
- Microbiological
  - This rise in temperature increases the risk of growth of legionellae, nontuberculous mycobacteria, *P. aeruginosa* and other related opportunistic pathogens
- Chemical,
  - Increases in heavy metals (lead pipes),
  - Nitrites Formed by Nitrosomas bacteria in galvanised pipes

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CONTAMINATION

- Contamination includes any reduction in aesthetic, chemical or biological quality of the water due to raising its temperature or the introduction of polluting substances – whether it is harmful to health or not.
- Will water which has been stagnating for several weeks still meet the definition of a potable water supply?

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High risk systems

1.4 A reasonably foreseeable risk of exposure to *Legionella* exists in buildings with:

- water systems incorporating an evaporative cooling tower and/or evaporative condenser;
- hot and cold water distribution systems;
- natural thermal springs and their distribution systems;
- spa pools (also known as hot tubs), whirlpool spas (they are also often referred to as Jacuzzis; however, this is a trade name and should not be used generically), water used in health and beauty treatments, etc.;
- other systems including humidifiers, fountains and water features, and industrial water systems (e.g. air washers, wet scrubbers, vehicle washers, wastewater treatment plants/systems, misting devices and horticultural sprinkler systems);
- any other plant, systems or equipment containing water that is likely to be between 20°C and 45°C which may release a spray or aerosol (i.e. a cloud of droplets and/or droplet nuclei) during operation or demonstration, or when being maintained;
- any plant or system which uses water from a non-potable source (e.g. river water for evaporative cooling systems).

Industrial and workplace premises:

- Shops, shopping malls,
- Offices etc.
- Industrial process plants and equipment
- Educational facilities; schools, universities, nurseries
- Government buildings
- Construction sites
- Prisons, military buildings

Preliminary report: outbreak of Legionnaires' disease in the cities of Ulm and Neu-Ulm in Germany, December 2009 - January 2010
H von Baum (), G Härter2, A Essig1, C Lück3, T Gonser4, A Embacher4, S Brockmann5

Asphalt paving machine, Spain, 2009
Eurosurveillance, Volume ... ue 4, 28 January 2010

Also within Leisure & Travel related premises e.g. :

- Sports & leisure complexes
- Health spas
- Hotels, bed and breakfast, self catering, and camp sites; etc.
- Conference centres
- Restaurants
- Trains; planes and cruise ships
- Garden centres; glasshouses
- Museums, art galleries etc.
- Aquaria and Zoos

Ritz-Carlton Berlin
"Das wollen wir unseren Gästen ersparen"
02.08.2004, 09:27
Gut zwei Wochen nach der Entdeckung von **Legionellen** stehen im Berliner Luxushotel Ritz-Carlton alle Zimmer leer. Das Fünf-Sterne-Haus am Potsdamer Platz hat vor wenigen Tagen alle Zimmer und Suiten für Gäste gesperrt. mehr...

ESGLI Building System Guidance

this guidance is aimed at hotels, other accommodation sites including campsites, cruise ships etc. it is relevant to all public, residential and office buildings with similar water systems.
It is very important that, during this pandemic, you manage and keep all water systems safe whilst closed or during partial shutdowns for the future health and safety of guests, visitors and staff.
The procedures you follow now will have an impact on how soon you can open your facilities without causing harm to health.

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Where should I start?Step 1

- **Landlord / leaseholder/ owner/ manager/ CEO?**
- Is there a risk assessment and management plan (WSP)?
  - develop or update it to reflect your current water system risks and a plan for re-instating safely include all systems or equipment which have had reduced use or are shut down.
- If these have not been cleaned, drained and ideally disinfected before abandoning they pose a high risk of causing harm to health once restarting
- The ESGLI guidance has options for de-commissioning systems safely
- Document how you will protect staff, visitors and others from harm including potential chemical contamiantion and *Legionella* growth
- If required, get help from an experienced and competent water treatment advisor, public health or environmental health authorities especially for high risk systems such as evaporative cooling towers, spa pools etc.

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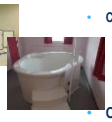
Simple or multiple systems and /or attached equipment

- Step 2
  identify and make a list of everything that uses/ stores / or is attached to water systems- make a list (an asset register)

- Cooling towers, evaporative condensers; humidifiers
- hot and cold water outlets e.g:-
  - showers; taps; toilets;
- spa pools and hot tubs
- decorative fountains,
- irrigation systems
- misting devices
- medical equipment :-nebulizers, foot spas etc.
- specialist equipment: jet washers etc.
- fire hoses and sprinklers

Assess all potential sources of infection water to take into account e.g:-

- **Drinking water**
  - Point of entry treatment
  - Food preparation areas
  - Ice dispensers and uses of ice
  - Plumbed water dispensers
  - Drinks vending machines
  - Bottled water
  - Softeners
- **Domestic hot & cold water**
  - Hand washing
  - Bathing inc. Showers
  - Dish washing
  - Toilet flushing
- **Pools**
  - Hydrotherapy
  - Birthing
  - Footbaths
- **Building services**
  - Cooling towers/Evaporative Condensers
  - Humidifiers
  - Steam towel dryers

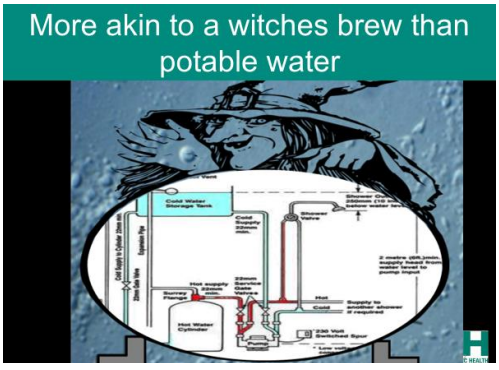


- **Equipment for patients including**
  - RO systems
  - Endoscope washers
  - Sonicator baths
  - Water baths for warming fluids
  - Dialysis machines
  - Heart heater / coolers
  - Burns baths
  - Dental chairs
  - Mobile diagnostic units
  - Bed pan flusher
  - Respiratory devices
  - Chest drains
  - Nebulisers / Clinical humidifiers
- **Cleaning equipment**
  - Carpet washers
  - Steam cleaners
  - Cloths
  - Mops etc.
  - Sanitizers
- **Other**
  - Fountains/ Water features
  - Fire systems
  - Irrigation
  - Misting devices
  - Emergency showers

Step 3 decide what is essential

- when you re-open and what can be left until you can it checked and maintained / disinfected following manufacturers guidance

Step 3 a risk assessment is needed before you turn on a tap /faucet or flush a toilet?



Flushing

- In areas with large industrial sites
- Many multi-storey buildings which have been shut down and require flushing of both the supply and the buildings water systems arrange a phased approach

https://www.elmundo.es/baleares/2016/07/10/578e235fe270

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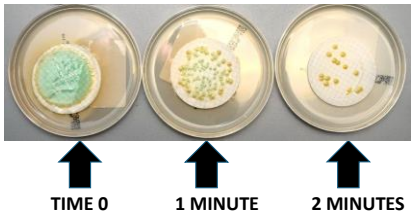
TIMED WATER SAMPLES FROM A CONTAMINATED OUTLET
With thanks to Dr Michael Weinbren



Samples are not a good indicator of risk !!!!
Risk from a single outlet depends on how often it is used; The greater the water turnover per outlet the lower the risk.

American Journal of Infection Control
Volume 33, Issue 10, December 2005, Pages 606-610

Abbreviated duration of superheat-and-flush and disinfection of taps for *Legionella* disinfection: Lessons learned from failure

One medical center in southern Taiwan faced an outbreak of nosocomial Legionnaires' disease; a total of 31 suspected cases were detected during an 8-month period. Baseline environmental surveillance showed that 80% of the distal sites in intensive care units (ICUs) were positive for Legionella pneumophila. Superheat-and-flush was selected for hospital water supply disinfection because it required no special equipment, and it can be initiated expeditiously. We conducted 2 episodes of superheat-and-flush based on the published recommendations from the Department of Health, Taiwan; US Centers for Disease Control and Prevention; and American Society of Heating, Refrigerating, and Air-Conditioning Engineers. Both flushes failed to control colonization of Legionella in the hospital water supply. The rate of distal sites positive for Legionella in wards and ICUs was 34% and 66%, respectively, 10 days after the second flush. The effect of replacement of faucets and showerheads in ICUs appeared to be insignificant in colonization of Legionella. The application of superheat-and-flush for flush duration of 5 minutes was ineffective. Superheat-and-flush may not be economic for a large medical center because it

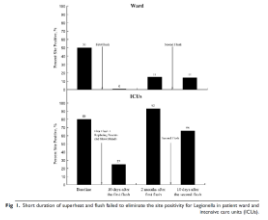
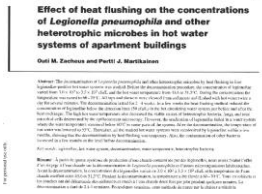


Fig 1. Short duration of superheat-and-flush failed to eliminate the site positivity for Legionella in patient ward and intensive care units (ICUs).

RESULTS

water systems by pulse-field gel electrophoresis (Chen YS, unpublished data).



Effect of heat flushing on the concentrations of *Legionella pneumophila* and other heterotrophic microbes in hot water systems of apartment buildings

Outi M. Zacheus and Pertti J. Martikainen

All systems recolonised by legionella within a few months and background counts returned to pre flushing levels

Thermal disinfection of hotels, hospitals, and athletic venues hot water distribution systems contaminated by *Legionella* species

Legionella spp. (≥500 cfu liter^{-1}) were detected in 91 of 497 water distribution systems (WDS) examined. Thermal disinfection was applied at 33 WDS. After the first and second application of the disinfection procedure, 15 (45.4%) and 3 (9%) positive for remedial actions WDS were found, respectively. *Legionella pneumophila* was more resistant to thermal disinfection than *Legionella* non-*pneumophila* spp. (relative risk [RR] = 5.4, 95% confidence intervals [CI] = 1–35). WDS of hotels with oil heater were more easily disinfected than those with electrical or solar heater (RR = 0.4 95% CI = 0.2–0.8). Thermal disinfection seems not to be efficient enough to eliminate legionellae, unless repeatedly applied and in combination with extended heat flushing, and faucets chlorine disinfection.

Previous article in issue Next article in issue

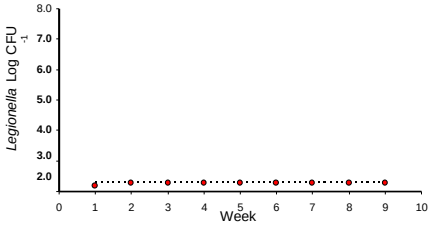
"Biofilm cannot be totally destroyed and can rapidly repopulate serving as a repository for the sustained release of microbes. Moreover, recently developed methods using peptide nucleic acids for Legionella detection, show 90% more viable *Legionella* in biofilm than is culturable."

They suggest biofilm may limit the effectiveness of any intermittent systemic thermal disinfection

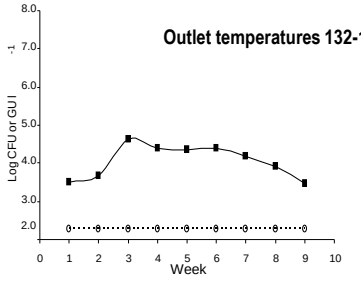
Hospital B HCWS *Legionella* monitoring

***Legionella* culture results over a 10 week period all <100cfu/L**

Temperatures at the sampling points all compliant



L. pneumophila
PCR results from the same outlets

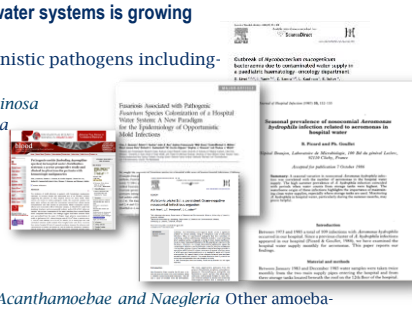


Dental practices

- Dental treatment has the potential to pose an enhanced risk of infection from aerosols which are produced at high speed from powered equipment attached to DUWL close to the nasal cavity increasing the potential for inhalation and also within the oral cavity increasing the potential for aspiration of contaminated water.
- This guidance aims to help minimise the risk of infection from contaminated DUWLs and associated equipment caused by *Legionella* and other waterborne pathogens.

Not just *Legionella*!
The range of recognized opportunistic waterborne pathogens which naturally occur within water systems is growing

Many other opportunistic pathogens including-



- *Pseudomonas aeruginosa*
- *Burkholderia cepacia*
- *Ralstonia pickettii*
- *Serratia* spp.
- *Acinetobacter* spp.
- *Enterobacter* spp.
- *Aspergillus*
- *Fusariium spp.*
- *Rahnella aquatilis*
- *Protozoa including Acanthamoebae and Naegleria* Other amoeba-associated bacteria
- Environmental *Mycobacteria (NTMs)*
- .....

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What are the risks to patients from water

- Patients at high risk of COVID-19 are also those also at high risk of waterborne infections such as those caused by *Legionella* and *P.aeruginosa*
- e.g. the elderly; and those with underlying conditions
- Staff and Cleaners not familiar working in such high risk care settings may not understand the risks from drains, outlets and water splashing leading to cross contamination
- Many interventions, indwelling catheters, central lines etc. also increase the likelihood of access of waterborne pathogens such as *P.aeruginosa*

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Northern Ireland Politics

24 January 2012 Last updated at 18:34

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Sink taps source of infection that killed three babies

Sink taps were the source of an infection which killed three babies at a Belfast hospital, the Northern Ireland health minister has confirmed.

Edwin Poots told the NI Assembly that the Pseudomonas bacteria had been traced to taps at a neo-natal unit in the Royal Jubilee Maternity Hospital.

The unit was deep cleaned at the weekend after six babies were found to be infected.

The neo-natal unit at the Royal under went a de clean

* **We have known of the risk from aerators for 50 years!!!**

The NEW ENGLAND JOURNAL of MEDICINE

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The Faucet Aerator — A Source of Pseudomonas Infection

This article has no abstract; the first 100 words appear below.

JCM

Prosthetic Valve Endocarditis and Bloodstream Infection Due to *Mycobacterium chimaera*

Yvonne Achermann,[a] Matthias Rössle,[b] Matt
Guido Bloemberg,[d] Michael Hombach,[d] Barb
Division of Infectious Diseases and Hospital Epidemiolo
University Hospital Zurich, Zurich, Switzerland; Division
of Medical Microbiology, University of Zurich, Zurich, Sw

ecdc

RAPID RISK ASSESSMENT

Invasive cardiovascular infection by *Mycobacterium chimaera* potentially associated with heater-cooler units used during cardiac surgery

30 April 2015

March 2013: Zurich
First case reports of *M. chimaera* infection linked to heater-cooler units used in cardiac surgery

July 2014: Zurich
6 cases of *M. chimaera* infection linked to heater-cooler units used in cardiac surgery

February 2015: Netherlands
Case of *M. chimaera* endocarditis following cardiac surgery. Heater- cooler unit implicated

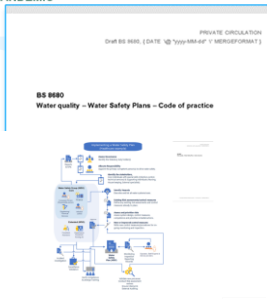
where national guidelines or legislation is in place then you must follow these.

ESGLI ESCMID STUDY GROUP FOR LEGIONELLA INFECTIONS
European Society of Clinical Microbiology and Infectious Diseases

ESGLI GUIDANCE FOR MANAGING *LEGIONELLA* IN HOSPITAL WATER SYSTEMS DURING THE COVID-19 PANDEMIC

1. Where should I start?

Establish and / or consult with the WSG or other person (s) responsible for water safety (often referred to as the Responsible Person or RP) within the organisation, using external expertise where needed. This should be done before plans are put in place to make changes to the water system such as adding temporary wards, wash hand basins, showers etc. and / or where additional equipment needs to be installed or when a decision is taken to close buildings or parts of buildings. Where there are special water quality standards required, such as for dialysis, water used for humidification of incubators, ventilators, oxygen delivery etc. expertise should be sought from the relevant specialist discipline.



Keeping COVID-19 patients safe

- Protect patients by preventing contamination during the build process
- **Competence checks**
- **Training, supervision and WSG review**
- **Risk assessment at each stage -** Apply precautionary principle
  - when connecting supplies to existing or new supply points –
  - Design, specification, storage and installation of materials; components ; fittings, and equipment
  - Commissioning
    - Fill with water as late as possible- only POTABLE WATER – no short cuts
    - All valves open
    - Validation of any control measures
    - Monitoring plans testing for both Legionella and P.aeruginosa
    - Handover –using a soft landings approach

Keeping COVID-19 patients safe

- Protect patients by preventing contamination during on the ward
- WSG input at design and specification stage to ensure only components which minimise growth are chosen
- Have a list of fittings and fixtures that have been assessed as being safe and fit for purpose
- Training, supervision of clinical and cleaning staff
- WSG review of equipment, how it is used and risk management
- Location of outlets to equipment and patient beds, tables, trolleys etc.
- No inserts in outlets
- Limit TMVs assess scalding v Bacteraemia risk
- Demountable / autoclavable components
- Humidification equipment?

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Maintain effective controls

- Keep temperatures <25°C and > 50 °C. so a minimum of 55°C is maintained at all outlets in hot water systems and cold water can be delivered at ≤25 °C within 2 minutes of turning on the outlet (or the feeds into thermostatic mixing valves where these are fitted).
- Effective insulation of hot and cold supply pipework
- Prevent stagnation as a result of poor or no water flow.
- Prevent scale , corrosion and nutrient ingress
- Do not use items leak or pressure tested with water .

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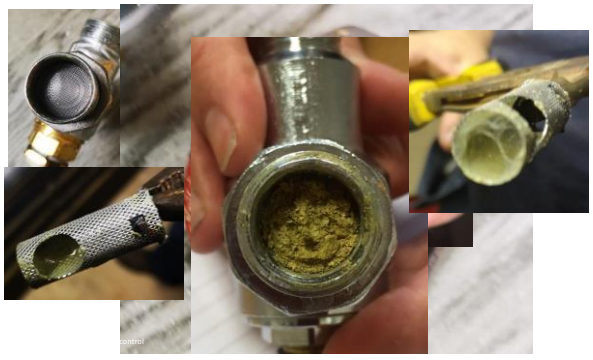
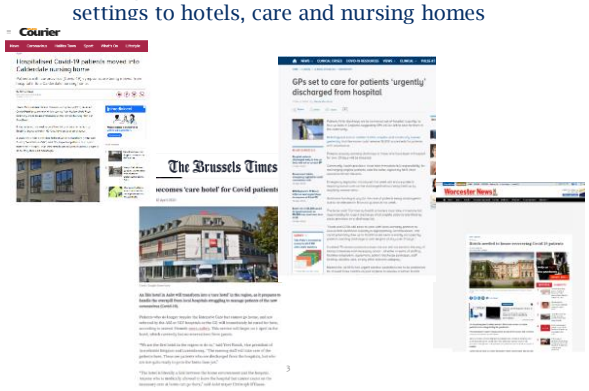
Minimise components which can become colonised



Sinks as a source of infection

- 2004 - 2006, 36 patients in ITU or transplant units of a tertiary care hospital were infected with a multidrug-resistant strain of P. aeruginosa.
- All phenotypically similar isolates were examined for genetic relatedness by means of pulsed-field gel electrophoresis.
- 17 died within 3 months;
- **In 12 /17 (71%) the outbreak organism contributed to or directly caused death.**
- The source traced to hand hygiene sink drains, where biofilms containing viable organisms were found.
- Testing by use of a commercial fluorescent marker demonstrated that when the sink was used for handwashing, drain contents splashed at least 1 meter from the sink.
- Various attempts were made to disinfect the drains,
- only when the sinks were renovated to prevent splashing onto surrounding areas that the outbreak was terminated.

* Moving patients out of protected hospital settings to hotels, care and nursing homes



3

Moving immunocompromised patients

* When moving immunocompromised patients from their protected settings, a risk assessment should be carried out to ensure there is a history of effective management of water systems and associated equipment
* Ensure there is temperature control to all outlets and where used effective biocide levels
* Where there is doubt about the safety of water for these patients consider the need to protect them for example; by a precautionary disinfection and installing point of use (POU) filtration for their drinking and personal hygiene needs
* Suitable provision for temporary sinks for the disposal of waste water and other fluids disposal (sluices) should be made away from, but in the vicinity of patient care areas to minimize distances that the material must travel for disposal.
* Ensure there is sufficient space to prevent splashing contamination from sinks to patients but also to equipment, drug preparation areas, food preparation etc.

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ESGLI ESCMID STUDY GROUP FOR LEGIONELLA INFECTIONS
European Society of Clinical Microbiology and Infectious Diseases

It is important to remember that *Legionella* and other waterborne pathogens of relevance in healthcare settings will grow in water systems to levels which may cause infection where: -

- the temperature of the water >25°C and < 50 °C. This does not have to be in the entire system, just relatively small areas at these temperatures will allow *Legionella* to grow; they can then contaminate and spread to other parts of the system and subsequently make it difficult to control their growth. It is therefore important to prevent the hot water from cooling below 50 °C and the cold from warming above 25 °C so a minimum of 55°C is maintained at all outlets in hot water systems and cold water can be delivered at ≤25 °C within 2 minutes of turning on the outlet (or the feeds into thermostatic mixing valves where these are fitted). Effective insulation of hot and cold supply pipework can help reduce heat transfer.
- where there is stagnation as a result of poor or no water flow.
- where materials are used which provide protective niches and nutrients for growth and biofilm formation including sludge, scale, rust, algae and other organic matter which may collect in the system pipework and calorifier particularly during periods of stagnation.
- where *Legionella*, *P. aeruginosa* and other waterborne pathogens are introduced from equipment, fittings, components and pipework which have not been adequately protected from contamination during the build and installation process or which have been pressure or leak tested with contaminated water (the international outbreak of *Mycobacteria chimaera* infections as a result of the colonization of heart heater coolers by the manufacturer is an example of this (Hedge et al., 2017; Kohler et al., 2015; Sax et al., 2015; Walker et al., 2017).
- where there is a means of creating and disseminating inhalable droplets such as the aerosols generated by evaporative air conditioning and humidification systems, operating taps, showering, flushing a toilet, or when using other equipment such as humidifiers, nebulizers etc.
- where there are patients susceptible to aspiration and / or compromised immune systems.
- where there are systems and equipment which can produce aerosols, which can be inhaled or water which can be aspirated. This includes birthing pools filled with water contaminated with *Legionella* or other waterborne pathogens
- contamination as a result of splashing from clinical sinks and wash hand basins can contaminate outlets, patients and staff, equipment, trolleys etc. left close to the sink. Clinical sinks; wash hand basins should not therefore, be situated too close to beds (at least 1 metre away and preferably 2 metres, follow local guidance for distance for COVID-19 patients). [7]
- waste water used for patient hygiene etc and fluids, including the remains of antibiotic infusions should not be disposed of down the sinks as these provide nutrients for pathogens to grow within the drain (Edmonds et al., 1972).
- to avoid the blocking of toilets, drains and waste pipes which could lead to backflow from the waste water to the potable water system, wet/ sanitizing wipes should not be disposed of down toilets / waste sinks (sluices) etc.
- where there is the potential for contamination from poor quality source water and absence of point-of-entry (POE) treatment, for example where supply quality is:
  - not from a public utility
  - from a temporary supply
  - not of consistent potable quality
  - intermittent or through a bowser# or other supply method.

What to do if there are cases of Legionnaire's disease

* It is important when there is a case of Legionnaire's disease associated with premises that:
- when water samples are sent to a testing laboratory, they are instructed to retain the concentrate and any isolates.
- any clinical isolates and lower respiratory specimens obtained from patients are retained for typing.
- both environmental and clinical isolates are referred for typing as per routine country specific guidance.

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Testing DUWL

- Water samples (500mL) from each DUWL feeding a drill should be flushed into sample bottles containing sodium thiosulphate (18mg/L) and tested according to national protocols at laboratories accredited for TVC and *Legionella* spp. Samples should be taken at least 48 hours following disinfection to avoid false negative results. TVCs should ideally be <100 and no more than 200 colony forming units per millilitre (cfu/mL).
- The sensitivity of the *Legionella* method should be capable of detecting ≤ 50cfu/L. *Legionella* results should ideally be < than 100 cfu/ L.
- Any results exceeding these limits should be investigated, risk assessments undertaken and appropriate remedial action taken and the DUWL retested to show remedial actions have been effective. DUWL should not be put back into use until the results show they are safe to use.

Key Resource Documents

- *Guidelines for drinking-water quality 4th edition (GDWQ)* (WHO, 2011)
- *Water safety plan manual (WHO, 2009)*
- Health aspects of plumbing (WHO/WPC, 2006)
- Assessing the Microbial safety of drinking water (WHO /OECD) (2003)
- Protecting groundwater for health: Managing the quality of drinking-water sources (WHO 2006)
- DWI and www.gov.uk , EPA, ASHRAE, CDC, PHE websites

Lots of guidance on using the water safety plan approach including WHO:-

Thanks to the ESGLI Guidance working group

The Guidance working Group

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Mr Duncan Smith (UK)
Dr Paul Mc Dermott (UK).

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What we aim to achieve for all premises