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Decontamination & Infection Control

Improving the Quality of the NHS Estate in Line with the New HTM 04-01

Healthcare Acquired Infections

Approx. 300,000 patients per year in England are affected by an HAI as a result of care within the NHS
HAI are estimated to cost the NHS approx. £1 billion/year

“This is not as a result of acquiring the infection in the community and includes a wide remit of Healthcare providers”

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Regulations

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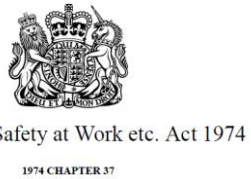
Health & Safety at Work Act 1974



- Employer must control risks to public as well as staff
  - Sets out general duties on organisations
  - Exposure to risk is the critical factor; no incident required

http://www.hse.gov.uk/legislation/hswa.htm

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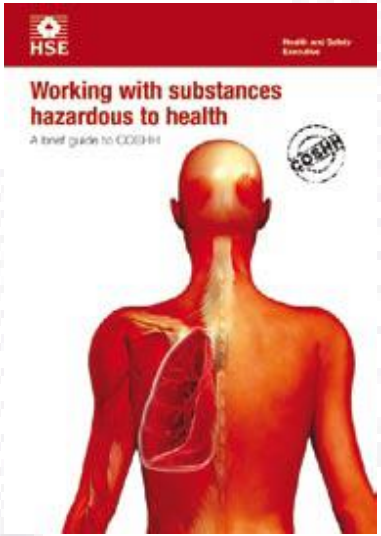
COSHH Regulations 2002

Duty to prevent exposure to hazardous substances or ensure that such exposure is adequately controlled (incl. pathogens)

- Conduct Risk Assessments
- Prevent or control exposure
- Maintain, check and test control measures
- Provide information, instruction & training



http://www.hse.gov.uk/coshh/

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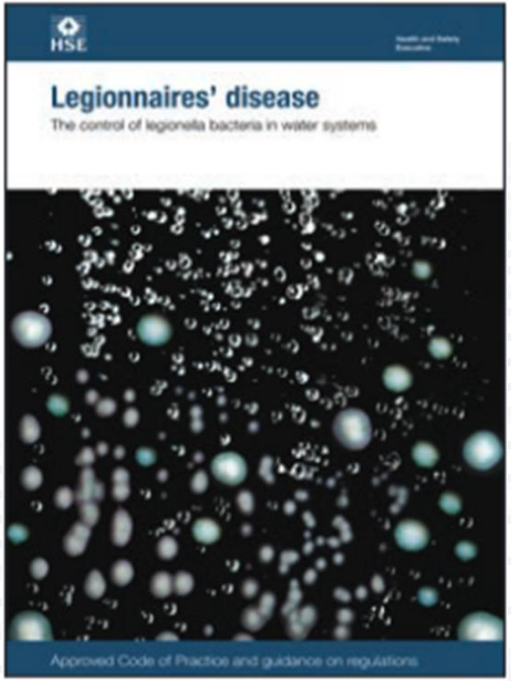
ACoP L8 & HSG 274

- **Legionella specific**
- Conduct Risk Assessments
- Prevent or control exposure
- Maintain, check and test control measures
- Provide information, instruction & training
- **Water Safety Groups & Plans**



L8 (Fourth edition)
Published 2013

http://www.hse.gov.uk/pubns/books/l8.htm

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HTM 04-01

- **Safe Water in Healthcare Premises**
- Conduct Risk Assessments
- Prevent or control exposure
- Maintain, check and test control measures
- Provide information, instruction & training
- Water Safety Groups & Plans

HTM 04-01 Part A: design, installation and commissioning

PDF, 1.19MB, 94 pages

HTM 04-01 Part B: operational management

PDF, 3.67MB, 98 pages

HTM 04-01 Part C: Pseudomonas aeruginosa – advice for augmented care units

PDF, 4.2MB, 20 pages

HTM 04-01 supplement: performance specification D 08 - thermostatic mixing valves (healthcare premises)

PDF, 3.27MB, 63 pages

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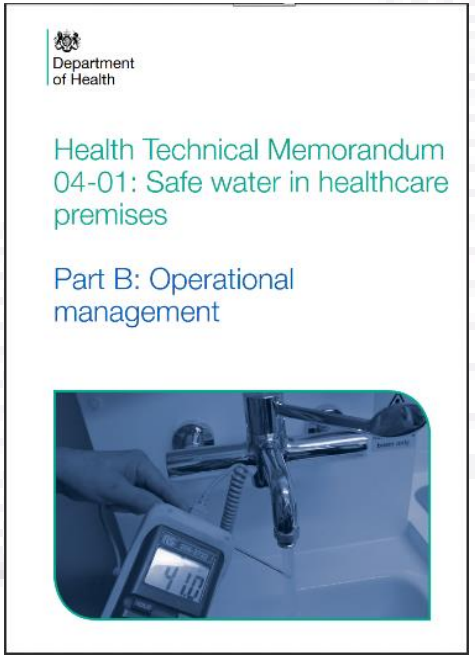
https://www.gov.uk/government/publications/hot-and-cold-water-supply-storage-and-distribution-systems-for-healthcare-premises

HTM 04-01 – Part B

Provides guidance on:

- Constructing a WSG
- Developing WSP's
- Assessing patient risk
- Remedial actions
- Protocols for sampling and monitoring



https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/524882/DH_HTM_0401_PART_B_acc.pdf

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Water Safety Plans

International guidance advocates the formation of Water Safety Groups and Water Safety Plans

1 Water Safety Group
2 Schematics
3 Hazards and Risks
4 Control Measures
5 Operational Limits
6 Monitoring
7 Corrective Actions
8 Record Keeping
9 Validation
10 Verification

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The Water Safety Group

1 DIPC
2 Medical microbiologist
3 Infection control
4 Estates and Facilities
5 Responsible Person/Authorised Engineer
6 Cleaning services staff
7 Clinical staff
8 FM company (if applicable)
9 PFI Managers (if applicable)
10 Independent advisors (if applicable)

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Schematics

- Document and describe the system
- Review existing schematics or construct new
- Ensure all relevant items are included in asset register

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Image courtesy of bls.gov

Hazards and Risks

- HACCP approach
- Undertake hazard analysis and risk characterisation

Control Measures

Physical

- Temperature
- Flushing
- Materials
- Ultraviolet
- Tap design
- Filtration

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Image courtesy of Armitage Shanks

Control Measures

Chemical

- Chlorination
- Chlorine Dioxide (ClO_2)
- Monochloramine
- Copper-silver ionisation (Cu-Ag)
- (Silver) Hydrogen peroxide
- Titanium advanced oxidation process (AOP)

http://woelen.homescience.net/science/index.html

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Operational Limits

Define limits for acceptable performance e.g.

- Time
- Temperature
- Dose
- pH
- Water hardness

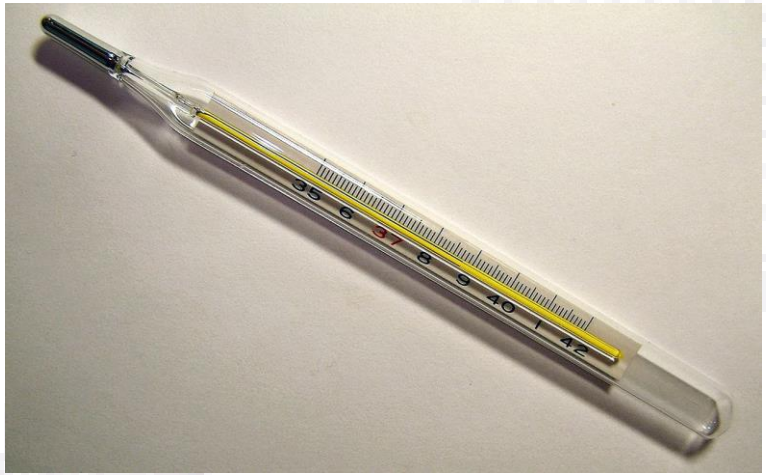

Image courtesy of Menchi

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Monitoring

Define ways and means for assessing control measures performance e.g.

- Paper records
- Electronic log-books
- On-line monitoring
- Process-control
- Trend analysis

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Corrective Actions

Establish actions needed to bring the system back under control:

- Prioritisation
- Safety
- Cost
- Timescale

Record Keeping

Regularly review the adequacy of the Water Safety Plan, controls and monitoring:

- Living document
- Monitoring data
- Risk assessments
- Personnel changes

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Validation and Verification

Determine whether the Water Safety Plan is in compliance with the stated objectives, but also consider:

- Equipment manufacturers data
- Local regulatory approvals (WRAS etc)
- On-site performance
- Peer-reviewed evidence

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EVIDENCE-BASED CONTROL METHODS

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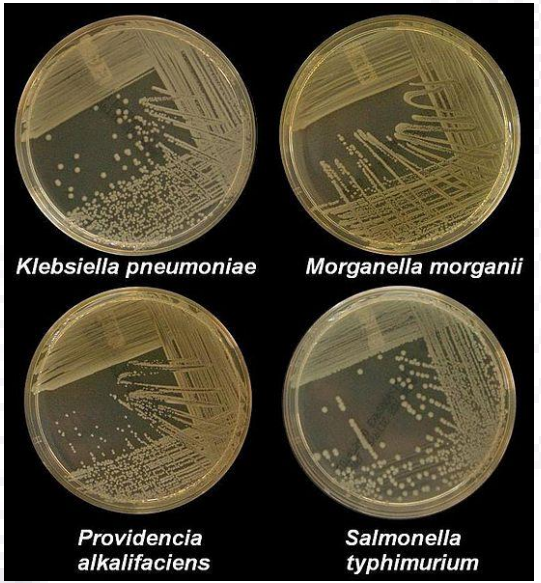
Waterborne Pathogens

Waterborne pathogens cause infections in health-care facilities;

- *Pseudomonas aeruginosa*
- *Stenotrophomonas maltophilia*
- *Chryseobacterium* species
- Non-tuberculous mycobacteria
- *Legionella* species
- *Mycobacterium avium* complex (MAC)
- *Fusarium*
- *Cryptosporidium*
- Viruses



Transmission occurs via contact, ingestion, aspiration; or aerosolisation of potable water; or via the hands of health-care workers

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Squier C, Yu VL, Stout JE. Cur Infect Dis Rep. 2000 Dec;2(6):490-496
Image courtesy of Eukaryotica

Disinfectant Resistance

Not all opportunistic pathogens are equally resistant to disinfectants:

- *M. avium* is the most resistant to chlorine
- Numbers of *E.coli* fall as they move from municipal water plant

BUT

- Numbers of opportunistic pathogens increase

Falkinham J. Int J Environ Res Public Health. 2015 Apr 24;12(5):4533-4545

Image courtesy of Alex Anlicker

Contact Time

Table 1. Chlorine resistance of waterborne pathogens relative to *Escherichia coli*.

Genus or Species	$CT_{99.9\%}$ [a]	Reference
Escherichia coli	0.09 (reference)	Taylor *et al.* (2000) [12]
Legionella pneumophila		
Medium-grown	7.5 (83-fold)	Kuchta *et al.* (1985) [9]
Water-adapted	52.5 (580-fold)	Kuchta *et al.* (1985) [9]
Mycobacterium avium		
Medium-grown	51 (567-fold)	Taylor *et al.* (2000) [12]
Water-adapted		Steed and Falkinham (2006) [13]
Pseudomonas aeruginosa	1.92 (21-fold)	Grobe *et al.* (2001) [14]
Methylobacterium spp.	1.5 (16.7-fold)	Furuhata *et al.* (1989) [15]
Acinetobacter baumanii	59 (658-fold)	Karumathil *et al.* (2014) [16]
Aeromonas hydrophila	2.6 (29-fold)	Sisti *et al.* (1998) [17]

[a] Product of concentration (mg/L) and duration of exposure (min) to kill 99.9% of cells.

Falkinham J. Int J Environ Res Public Health. 2015 Apr 24;12(5):4533-4545.

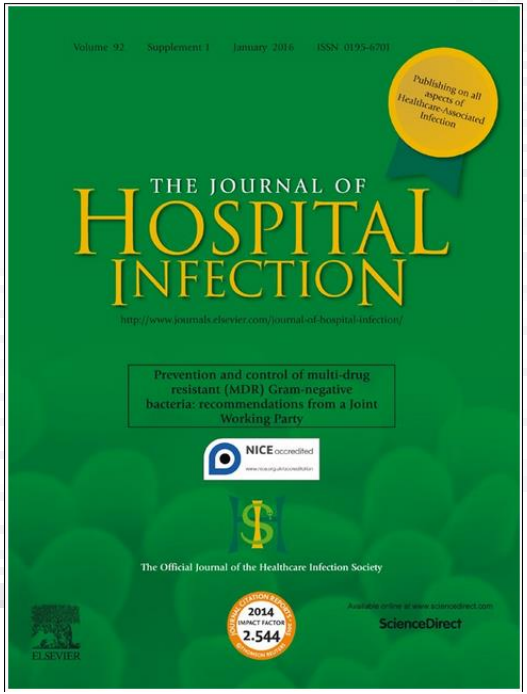
Pseudomonas aeruginosa

- Systemic review of association between healthcare water systems and *Pseudomonas aeruginosa* infections
- 25 of 196 were of sufficient high-quality
- All demonstrated evidence of transmission of *P. aeruginosa* from water systems to patients & vice versa
- Two studies provided evidence for effective interventions – POU filters and increasing chlorine disinfection

Loveday, H. *et al*. Journal of Hospital Infection 2014; 86(1): 7-15.

NICE – MDR Recommendations

- **Good Practice Recommendation** to not discard patient wash-water, body fluids, secretions or exudates into hand-wash basins
- **Strong evidence** that a risk assessment should be made in accordance with the organisations' WSP, when levels of patient colonisation or infection rise, in order to determine if POU filters should be installed or taps changed



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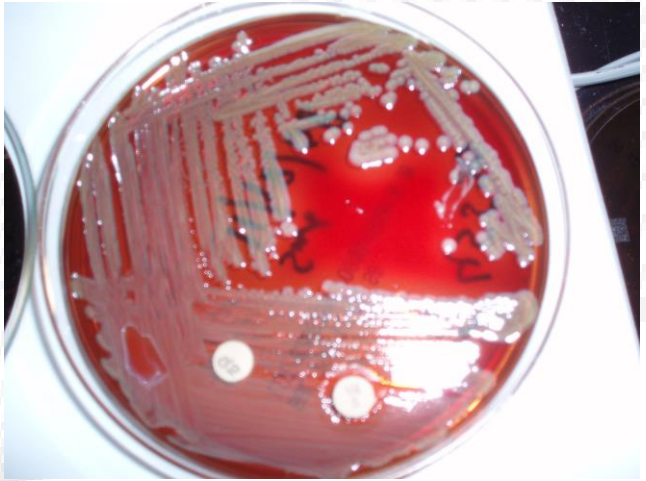
Wilson, A. P. R. *et al*. JHI 2016. 92, Suppl 1, S1-S44

Elizabethkingia meningoseptica

Formerly *Flavobacterium* and *Chryseobacterium*:

- 22 month ICU outbreak
- Difficult to culture and misidentification
- MALDI-ToF
- Found in taps (biofilm producer)
- 3 x automatic daily flush



Moore *et al* EID 2016; 22 (1): 9-17
Image courtesy of Dr. Saptarshi

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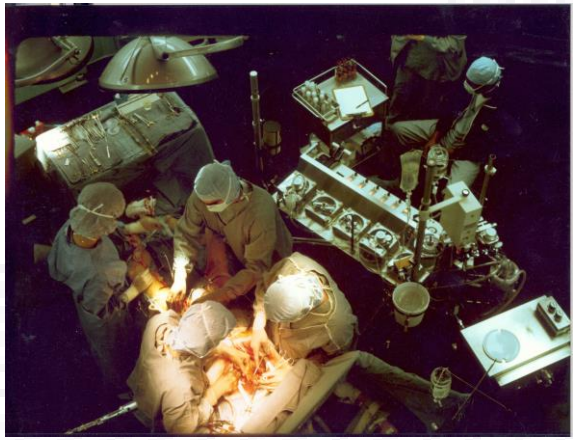
Non-Tuberculous Mycobacteria



- Contaminated heater–cooler units (HCU)
- Coliforms, *Pseudomonas* spp, NTM's & fungi
- Decontamination regimen:
  - Initial 2 consecutive cycles with peracetic acid after tubing replacement
  - Water from HCU's decanted daily, refilled with filtered tap water & medical grade 3% hydrogen peroxide added to HCU tanks
  - Weekly full system decontamination with peracetic acid
- Weekly TVC & NTM plus regular tubing replacement

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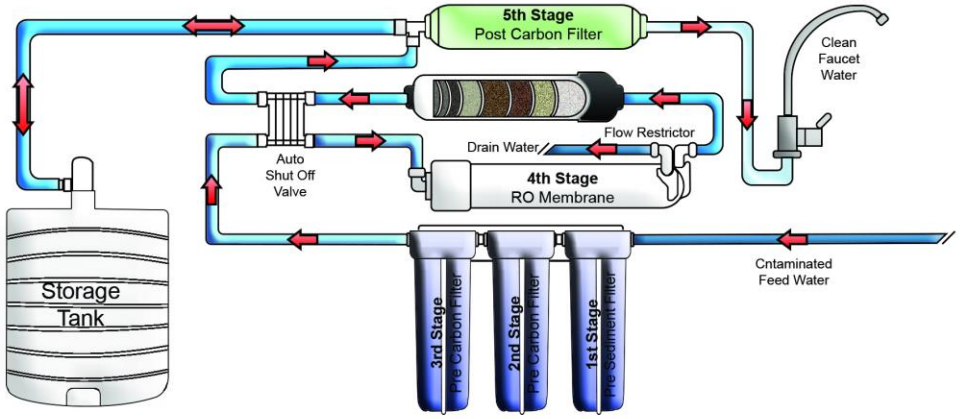
Garvey *et al*. JHI. 2015; 93(3): 229-234
Image courtesy of: http://fmp.cit.nih.gov/hi/ - Image ID: 657 C

Ralstonia pickettii

- Identified in biofilms in plastic water pipes
- Capable of surviving with very low nutrient concentrations
- Able to persist in harsh conditions, such as reverse osmosis systems



http://www.watersoftenercritic.com/reverse-osmosis-reviews/

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Ralstonia pickettii

- Outbreaks – in patients with Cystic Fibrosis and Crohn's Disease
- 55 reported cases - majority due to contaminated solutions such as water, saline and sterile drugs
- *A*ble to pass 0.45 & 0.2 µm filters used to sterilise medicinal products
- Susceptible to most of the antibiotics tested

Ryan, MP; Adley, CC. J Med Microbiol 2013. 62 (7): 1025–31

Summary

Infection Prevention & Control Requires Excellent Water Management

- Skills
- Knowledge
- Development
- Training
- Education
- Networking

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Further Information

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