Control of waterborne pathogens

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Water Management

A governance approach

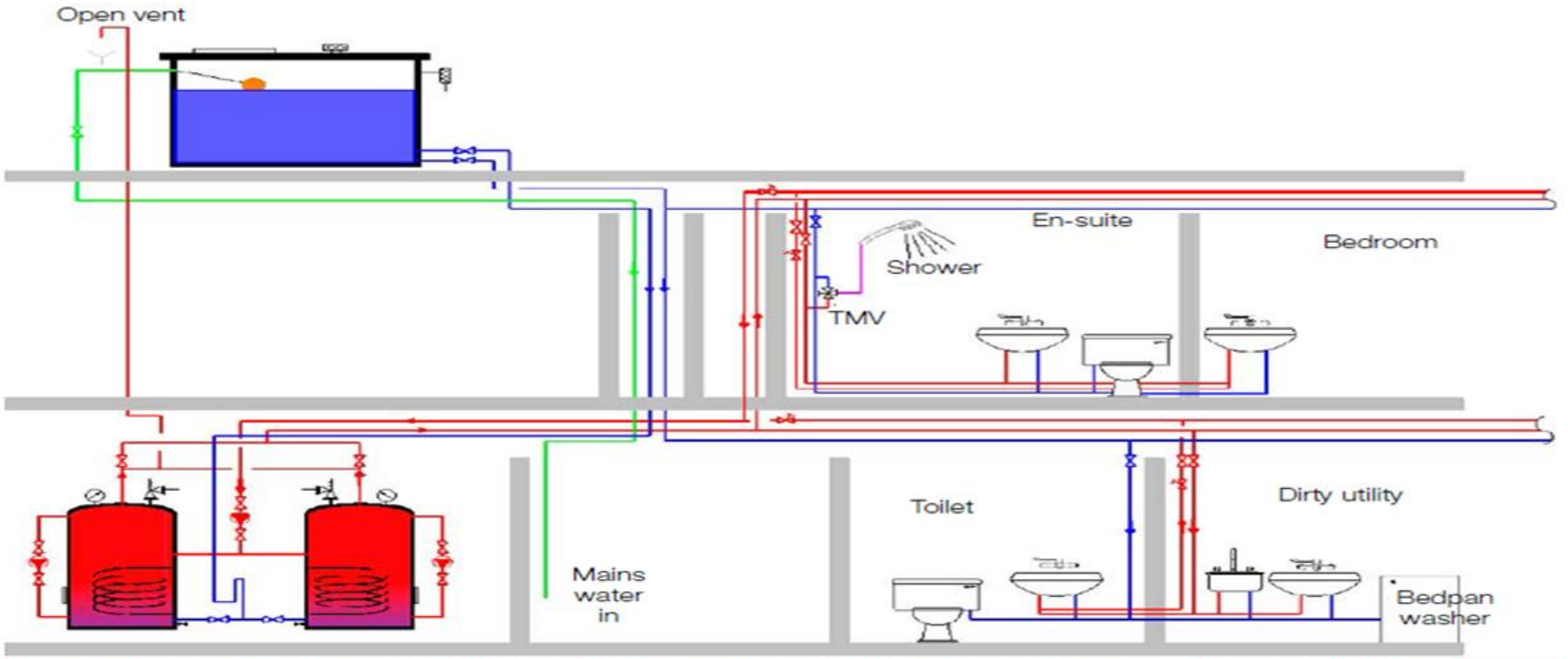


Figure 5 Schematic layout of a cold (and hot) water service system (note: this is a schematic only, and therefore all isolation valves

Why is water safety important?

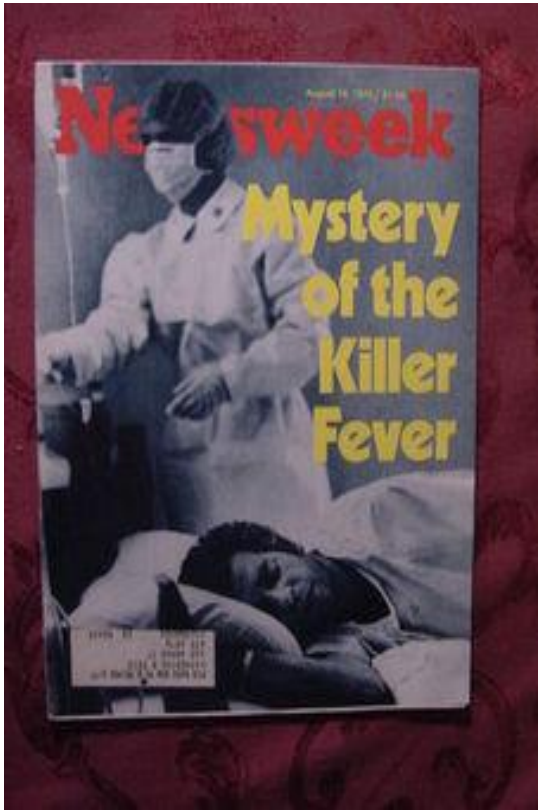


Table 1 continued

Reservoir	Organism(s)	Transmission	Patient Population	Type of Infection	Molecular Typing	Study Type	First Author, Year
Sink	GIM-producing *Pseudomonas aeruginosa*	Inappropriate use of surface areas around washbasins as placement of clean items	Patients in a tertiary care hospital	*P. aeruginosa* infection	PFGE, MLST	Outbreak – strong causation	Wendel, 2015 [55]
Sink	*Pseudomonas aeruginosa*	Contaminated water from sink	Infants in NICU	Pneumonia	Whole-genome sequencing, ERIC-PCR typing	Outbreak – strong causation	Davis, 2015 [56]
Sink	KPC-producing *Klebsiella oxytoca*	Contaminated handwashing sink	Patients with hematological malignancies	Pneumonia, abdominal wall abscess	Repetitive-sequence-based PCR, MLST	Outbreak – strong causation	Leitner, 2015 [57]
Sink / Shower	NDM-producing *Klebsiella pneumoniae*	Interhospital transfer of patients and contaminated sink trap	Older or chronically ill patients	*K. pneumoniae* infection	PFGE, MLST	Outbreak – strong causation	Seara, 2015 [58]
Sink / Tap water	MDR *Pseudomonas aeruginosa*	Contaminated water or patient-to-patient transmission	Patients in a neurosurgery ICU	Multiple (urinary infection, pneumonia, sinusitis)	PFGE	Outbreak – strong causation	Bert, 1998 [59]
Tap water	*Mycobacterium abscessus*	Inadequate sterilization of surgical instruments	Postsurgical patients	Wound infection	NA	Outbreak	Chadha, 1998 [60]
Tap water	Small round structured viruses	Transient contamination of the taps	Patients in a reeducation ward	Gastroenteritis	Sequencing	Outbreak – strong causation	Schvoerer, 1999 [61]
Tap water	*Mycobacterium genavense*	Ingestion of contaminated water	HIV-infected patients treated with HAART	Disseminated mycobacteriosis	NA	Case series (multiple)	Hillebrand-Haverkort, 1999 [62]
Tap water	*Ochrobactrum anthropi*	Unknown	Immunocompromised patients (leukemia) in hematology unit	Bacteremia	PFGE (unrelated)	Case series (multiple)	Deliere, 2000 [63]
Tap water	*Chryseobacterium* (Flavobacterium) *meningosepticum*	Contaminated sink drain and biofilm inside the sink tap	Neonates in NICU	Pneumonia, meningitis with septicemia	PFGE	Outbreak – strong causation	Hoque, 2001 [64]
Tap water	*Sphingomonas paucimobilis*	Contaminated taps and showers used in a hematology ward	A neutropenic patient with leukemia	Bacteremia	RAPD	Case report (single) – strong causation	Perola, 2002 [65]
Tap water	*Mycobacterium simiae*	Potential transmission via showering	Pulmonary cancer, chronic pulmonary disease	Pulmonary infection	PFGE	Outbreak – strong causation	Conger, 2004 [66]
Tap water	*Burkholderia cepacia*	Alcohol skin antiseptic diluted by contaminated tap water that was applied to intravenous catheter site	Patients with cardiovascular disease or cancer	Bacteremia	RFLP	Outbreak – strong causation	Nasser, 2004 [67]
Tap water	*Aspergillus flavus*	Contamination of hospital environment (air, tap water, surface)	Patients in BMTU, ICU, and NICU	Invasive aspergillosis	RAPD	Case report (single) – strong causation	Ao, 2014 [68]
Tap water	*Pseudomonas aeruginosa*	Contaminated tap water	Patients in ICU	Nosocomial infection	NA	Case series (multiple)	Verver, 2014 [69]
Tap water / Wash basin	MDR *Pseudomonas aeruginosa*	Contaminated water taps and wash basins	Patients receiving mechanical ventilation in ICU	Lower respiratory infection and bloodstream infection	AFLP	Outbreak – strong causation	Bukholm, 2002 [70]
Toilet	MDR *Pseudomonas aeruginosa*	Potential cross transmission via toilet brush	Hospitalized patients	Nosocomial infection	PFGE	Case series (multiple) – strong causation	Kouda, 2011 [71]
Toilet / Shower	Norovirus	Possible transmission via hand contact and contaminated items within toilets and the bedside environment	Hospitalized patients with symptoms of gastroenteritis	Gastroenteritis	RT-PCR	Case series (multiple)	Marter, 2011 [72]

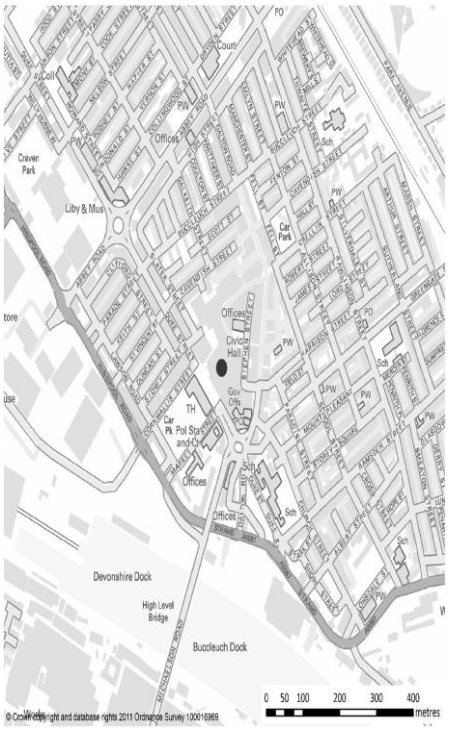
Why is water safety important?

Barrow-in-Furness Legionnaires' Disease Outbreak

Location: Cumbria, England (2002)
Organism: *Legionella pneumophila*
Cases: Approximately 172-180 cases
Deaths: 7

What happened?

A poorly maintained air-conditioning system at the council-owned Forum 28 arts centre generated contaminated aerosols into a busy pedestrian area. The outbreak spread widely through the community



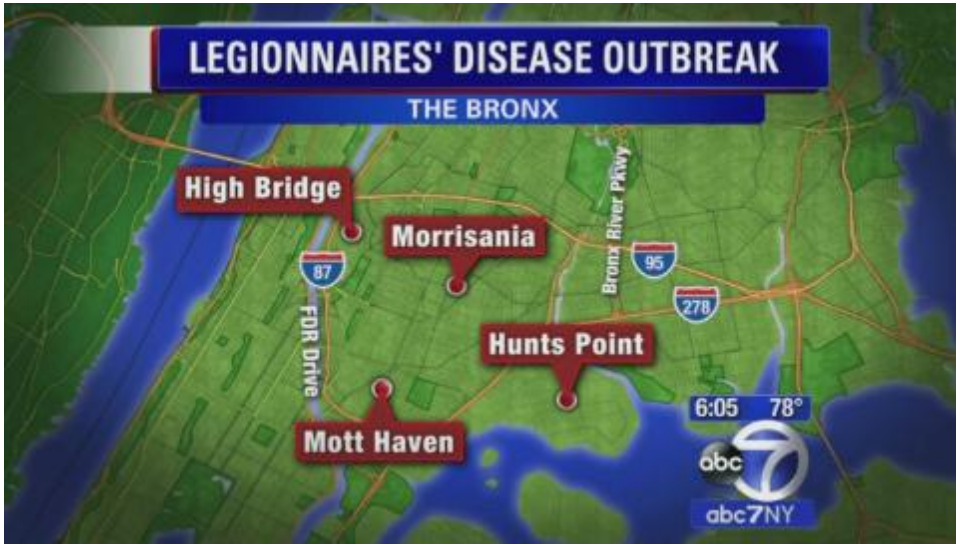
Why is water safety important?

South Bronx Legionnaires' Disease Outbreak

Location: New York City, USA (2015)
Organism: *Legionella pneumophila*
Cases: Nearly 140 cases
Deaths: 16

What happened?

The outbreak was linked to cooling towers in the South Bronx and became the largest Legionnaires' outbreak in New York City's history



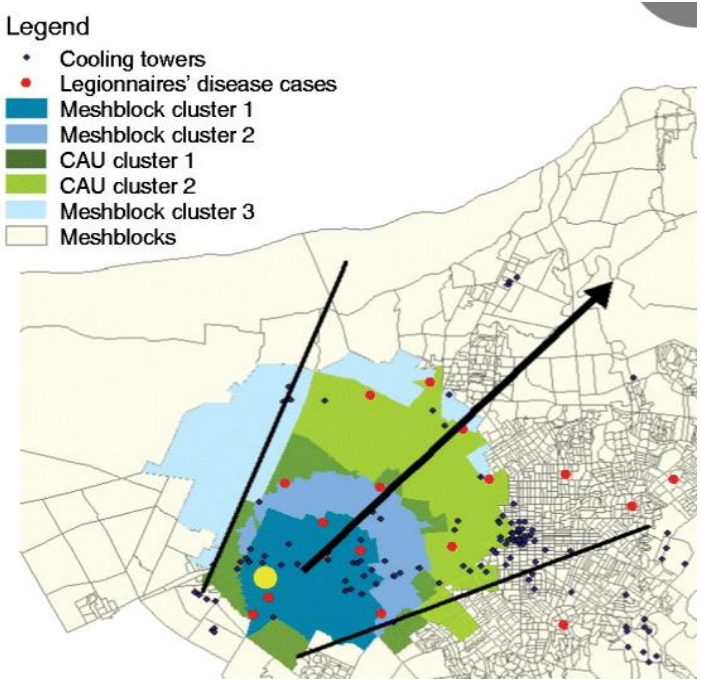
Why is water safety important?

Christchurch Legionnaires' Disease Outbreak

Location: Christchurch, New Zealand (2005)
Organism: *Legionella pneumophila* serogroup 1
Cases: 19 confirmed cases
Deaths: 3

What happened?

Investigators linked cases to a contaminated cooling tower using epidemiological, environmental and spatial analysis. Aerosol dispersal was estimated to have occurred over distances exceeding 10 km



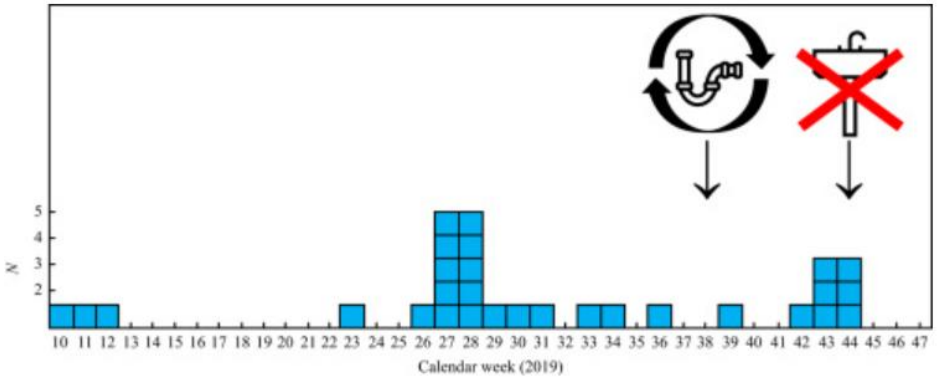
Healthcare-associated waterborne infections

Swiss ICU MDR Pseudomonas aeruginosa Outbreak

Location: University Hospital Zurich (2019-2020)
Organism: *Pseudomonas aeruginosa*
Cases: 29 confirmed cases
Deaths: Unknown

What happened?

An outbreak affecting intensive care patients was traced to contaminated sink siphons connected by a common wastewater system. Despite replacement of sink components, the outbreak strain persisted and new patient cases continued to occur. Transmission ceased only after sinks near patients were removed and waterless patient care practices were introduced.



Healthcare-associated waterborne infections

Stafford District Hospital Legionnaires' Disease Outbreak

Location: Stafford, England (1985)
Organism: *Legionella pneumophila*
Cases: 175 cases
Deaths: 28

What happened?

A major hospital-associated outbreak was traced to the hospital's air-conditioning cooling tower. It remains one of the deadliest Legionella outbreaks in UK history

Organisms of significance

- Legionella sp. (Not all pathogenic)
- Pseudomonas aeruginosa (NICU/Dialysis)
- Stenotrophomonas (NICU/haematology oncology wards/Dialysis)

NB Presence of hetrophilic bacteria can mask the presence of organisms of significance

Risks associated with sinks and drains

- Stagnant water and waterborne bacteria in the sinks plumbing trap
- Biofilm forms in the drains
- Reservoir where antibiotic resistant genes are transferred between bacterial species
- Can become contaminated with MDRO’s

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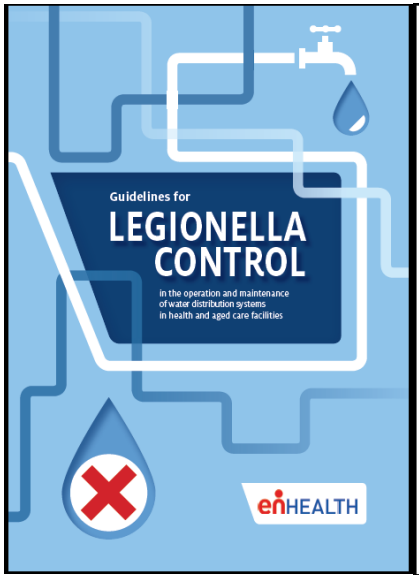
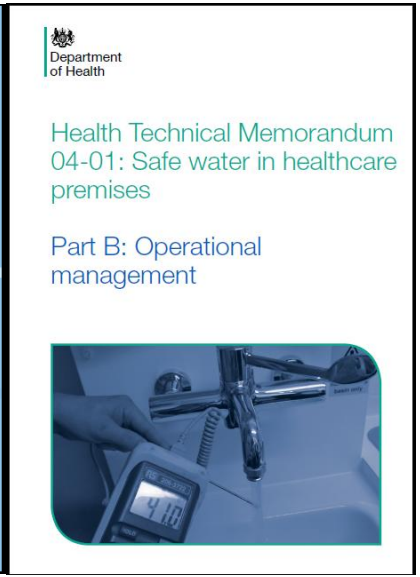
Standards and Guidance

1. **The prevention of legionellosis in New Zealand: Guidelines for the control of legionella bacteria 04/2025**
2. **HTM 04-01 Safe water in healthcare premises (UK) 3 parts Part C specifically addresses augmented care**
3. **enHealth Guidelines for Legionella control (Aus)**
4. **NZ Building code**
5. **NZS 4305**
6. **AS/NZS 3500**
7. **AS NZS 3666 Pt 2**
8. **ASHRAE**

The Prevention of Legionellosis in New Zealand

Guidelines for the Control of *Legionella* Bacteria





Definition

Clinical governance is best defined as:

> **“The system through which organisations are accountable for continuously improving the quality and safety of clinical care, ensuring high standards are maintained, and doing so in partnership with consumers, whānau, and communities.”**

This definition acknowledges both **assurance** (systems, oversight, risk management) and **improvement** (learning, transparency, culture). It aligns with HQSC principles but extends them to reflect Aotearoa’s obligations under Te Tiriti. It also emphasises that governance must consider not only outcomes but relationships, equity, and cultural meaning.

Governance

- Water safety is a core component of Infection Prevention and Control (IPC) programmes across New Zealand - however it is often an undervalued component - In particular, in clinical environments.
- At the micro/service-delivery level, changes in governance structures within Health New Zealand in 2020 have resulted in the current management of positive Legionella results being reactive rather than measured and systematic.
- At a meso-level, the governance fragmentation has unintentionally disconnected facilities decision making from clinical governance structures. This has resulted in unclear accountability for urgent escalation of incidents or the overview of long term assurances ie compliance with NZ Legionella guidelines (2025).

Governance - Waitematā experience 2015 - 2020

- Increasing awareness
- More proactive than reactive
- Development of DHB wide policy
- Water safety group convened
- Active controls such as copper silver implemented
- Governance over results beginning
- Results database developed

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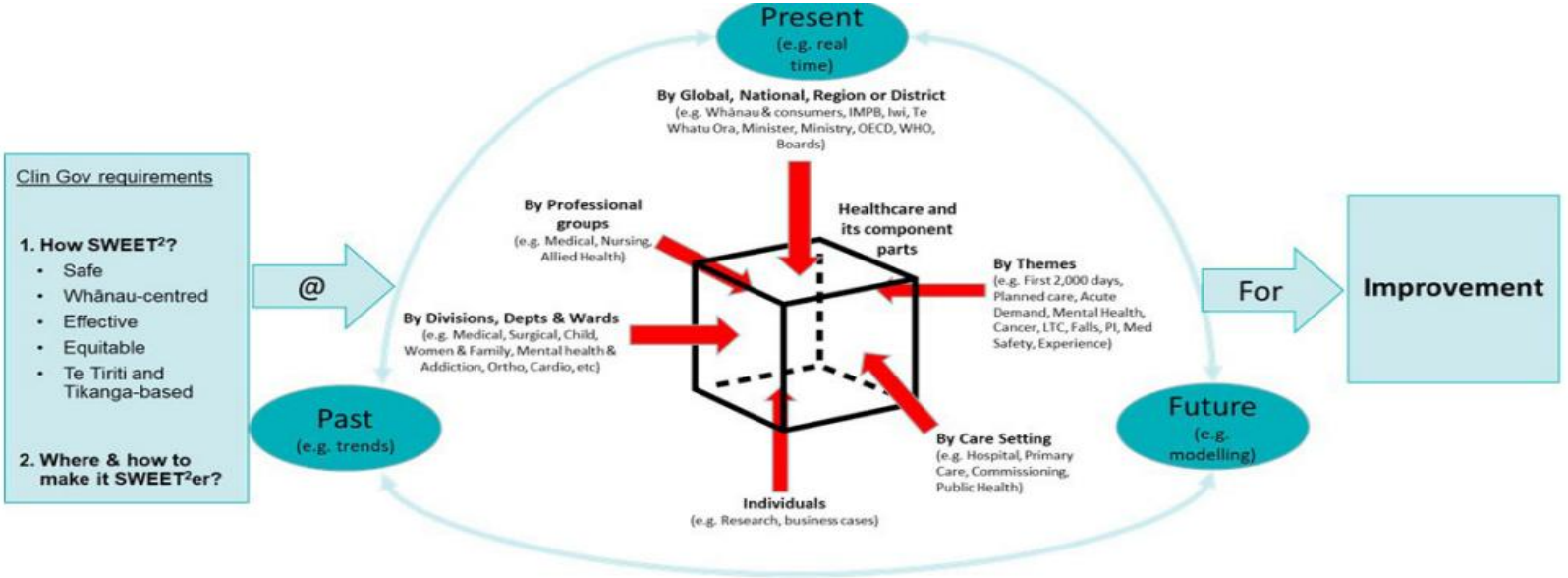
SWOT analysis - Health New Zealand experience 2020 onwards

STRENGTHS	WEAKNESSES
• Water sampling schedule well-established. • Front-line IPC teams experienced at responding to ad hoc results. • National IPC expectations (HNZ) provide baseline guidance • Existing technical knowledge of remediation strategies	• Limited access to integrated regional or national water safety datasets restricts trend analysis and organisational learning • Structural separation has created challenges in maintaining established communication pathways between clinical and infrastructure teams • Limited visibility of water safety risks for clinical governance committees. • Lack of expertise around the risks of poorly managed water safety among senior decision makers
OPPORTUNITIES	**THREATS**
• Implement SWEET² as a cultural-clinical governance lens. • Development of standardised national/regional water safety governance framework. • Improved data integration enabling trend analysis and system learning to improve risk mitigation • Reinstate or clarify accountability lines. • Leading a Te- Tiriti-informed approach to risks from infra-structure	• Unidentified patterns leading to preventable outbreaks. • Reputational risk if a significant event occurs. • Vulnerable patients exposed to avoidable harm. • Erosion of organisational trust and public trust due to lack of clear governance. • Unclear how to maintain current systems • Lack of clarity on roles and responsibilities

Governance Framework

The SWEET² framework (Ng et al 2025) —Safety, Whānau, Equity, Experience, Teamwork, and Tikanga—offers a uniquely Aotearoa-specific lens for examining clinical governance. When applied to water safety, SWEET² can expose gaps that purely technical or compliance-based frameworks often miss.



Safety

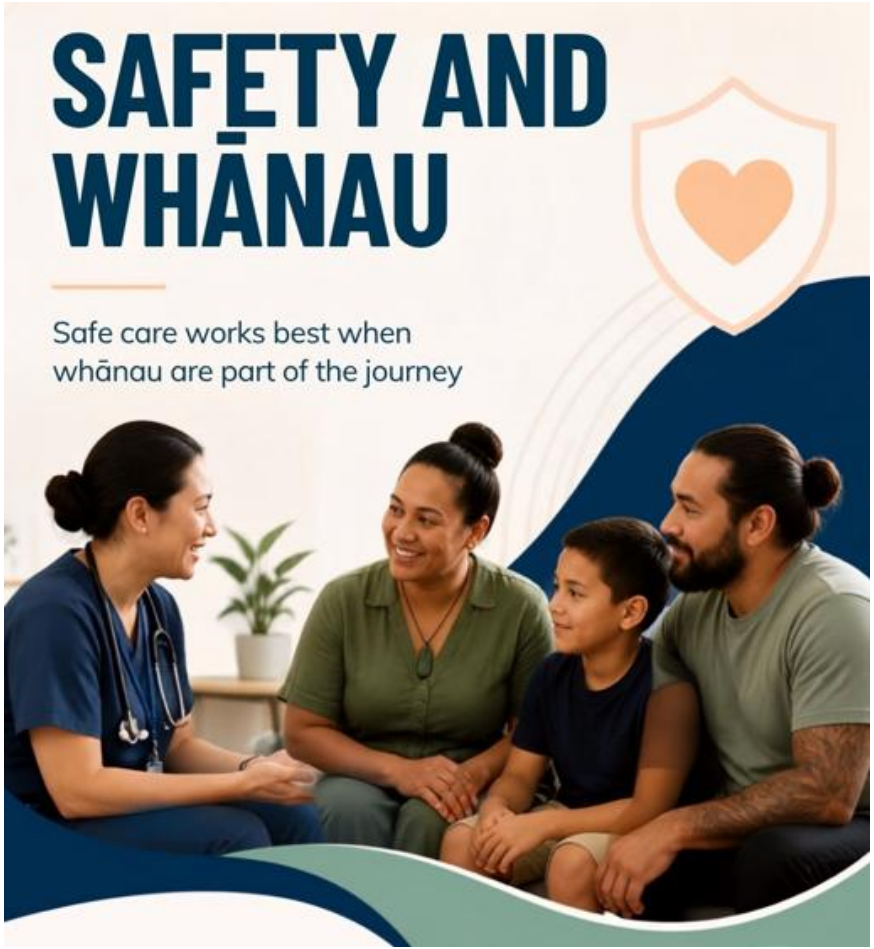
- ★ Current system relies heavily on reactive controls and there is little governance to prevent reoccurence. Water safety is seen as an engineering issue rather than a core organisational risk.
- ★ No centralised reporting accountability
- ★ Proactive sampling programme
- ★ No trend analysis

Strategy: Create a national–regional dashboard capturing environmental results, corrective actions, and repeat incidents. Allocate roles, responsibilities and actions to clear define what is action required by each service. Embed processes such as

Whanau

- ★ Water safety directly affects patient wellbeing and trust, especially for immunocompromised Māori and Pacific whānau.

Strategy: Develop whānau-centred communication guidelines for water safety incidents, ensuring culturally respectful processes.



Equity

- ★ Legionella exposure disproportionately affects people with chronic respiratory conditions
  Strategy: Stratify patient exposure risks and environmental results by service type and population vulnerability. Integrate equity impact assessments into all water safety

Experience

- ★ Front-line staff describe inconsistent advice and unclear escalation pathways when positives occur.
  Strategy: Develop a standardised Legionella Incident Response Protocols with clear response pathways
- ★ Clarity of roles, responsibilities, and reporting lines

Teamwork

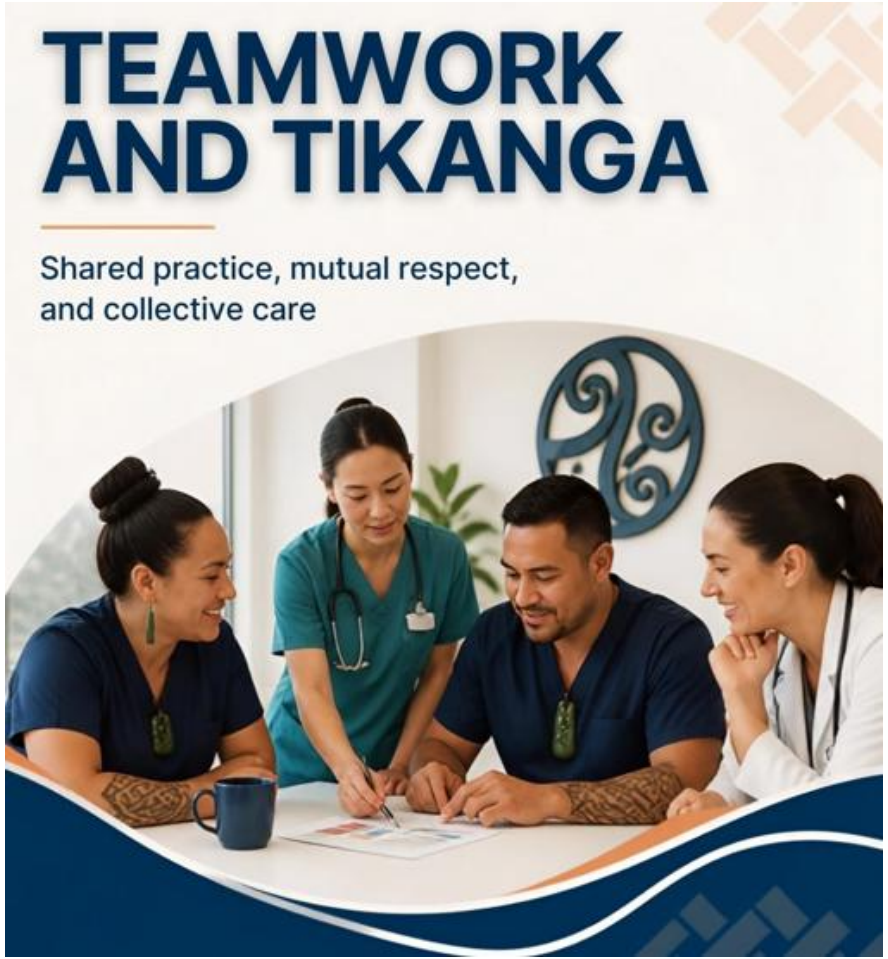
The shift of Facilities to IIG removed informal communication channels that previously supported joint problem-solving.

Strategy: Establish a Water Safety Committee

Tikanga

Water has cultural significance; contamination incidents can intersect with tikanga and spiritual safety.

Strategy: Include cultural advisors in governance oversight



Where to from here?

1. A national water safety framework
2. Governance at District, region and National level
3. Local documentation of water system, hazards, risk assessment, control measures, critical limits, corrective actions, sampling activities, incident management, and robust record keeping
4. Transparent commissioning requirements
5. Risk assessments of legionella exposure by patient type and area

Where to from here?

https://www.cdc.gov/healthcare-associated-infections/media/pdfs/PHS-ReduceWaterRisk-ChecklistTool-508.pdf

https://www.cdc.gov/infection-control/media/pdfs/IPC-mod11-water-exposure-508.pdf

https://www.cdc.gov/healthcare-associated-infections/media/pdfs/water-assessment-tool-508.pdf?CDC_AAref_Val=https://www.cdc.gov/hai/pdfs/prevent/water-assessment-tool-508.pdf

NIPC Guidelines on Water Management for Acute Healthcare Facilities 2026 - Early Chapter Release.pdf (Singapore)

WATER SOURCES

Patients are potentially exposed to water via the healthcare environment, equipment, or procedures. Water sources include, but are not limited to:

- **Sinks**
- **Water source**
- **Sinks**
- **Drains**
- **Showers**
- **Toilets**
- **Hoppers**
- **Humidification devices**
- **Mechanical ventilators**
- **Endoscopes**
- **Heater cooler devices**
- **Ice machines**
- **Indoor decorative fountains**
- **Lactation equipment**
- **Enteral feeding**
- **Bathing procedures**
- **Oral care**

MODES OF TRANSMISSION

When assessing risk of healthcare-associated infections caused by waterborne pathogens, consider the diverse modes of transmission, including:

- **Direct contact** *(e.g., bathing, showering)*
- **Ingestion of water** *(e.g., consumption of contaminated ice)*
- **Indirect contact** *(e.g., from an improperly reprocessed medical device)*
- **Inhalation of aerosols dispersed from water sources** *(e.g. faucets with aerators)*
- **Aspiration of contaminated water** *(e.g. use of tap water to flush enteral feedings)*

PATIENT SUSCEPTIBILITY

Patient populations with compromised immune status, comorbidities, and exposure to certain procedures are more vulnerable to infections caused by waterborne pathogens. Units/wards/wings can be classified according to those patients treated in these areas:

- **Highest** *(e.g., BMT, solid-organ transplant, hematology, medical oncology, burn unit, NICU)*
- **High** *(e.g., non-transplant ICUs, ORs)*
- **Moderate** *(e.g., general inpatient units)*
- **Low** *(e.g., waiting rooms, administrative office areas)*

PATIENT EXPOSURE

In order to characterize patient exposure to water sources, consider a categorization scheme that encompasses factors such as the frequency (how often), magnitude (how much), and duration (how long) of exposure:

- **High** *(e.g., high frequency, magnitude, and duration)*
- **Moderate** *(e.g., combination of high and low frequency, magnitude, and duration)*
- **Low** *(e.g., low frequency, magnitude, and duration)*
- **None** *(e.g., patients are not exposed to the water source)*

CURRENT PREPAREDNESS

Consider how your WMP addresses different water sources, as determined by factors such as policies and procedures already in place, relevant staff practice, and implemented mitigation strategies.

- **Poor** *(e.g., limited policies and procedures, staff practice, and mitigation strategies)*
- **Fair** *(e.g., some policies and procedures, staff practice, and mitigation strategies)*
- **Good** *(e.g., robust policies and procedures, staff practice, and mitigation strategies)*

Water Infection Control Risk Assessment (WICRA) for Healthcare Settings

Facility Name: Hospital A **Assessment Location:** Burn ICU

Performed By (names): Jane Smith and John Doe **Assessment Date:** 10/01/2020

WMP Team Role(s) *(check all that apply):*

- ☑ Hospital Epidemiologist/Infection Preventionist
- ☐ Risk/Quality Management Staff
- ☐ Equipment/Chemical Acquisition/Supplier
- ☑ Facilities Manager/Engineer
- ☐ Infectious Disease Clinician
- ☐ Other *(please specify):*
- ☐ Environmental Services
- ☐ Consultant
- ☐ Compliance/Safety Officer

Location	Water Source	Modes of Transmission	Patient Susceptibility Highest = 4 High = 3 Moderate = 2 Low = 1	Patient Exposure High = 3 Moderate = 2 Low = 1 None = 0	Current Preparedness Poor = 3 Fair = 2 Good = 1	Total Risk Score = Patient Susceptability *x* Patient Exposure *x* Preparedness	Comments
BICU Inpatient Rooms	Sink counter storage of patient care supplies	Indirect contact; splashing onto supplies	4	3	3	36	Install splash guards; QI for sink hygiene; and flushing
BICU Inpatient Rooms	Toilets without lid	Direct contact	4	3	2	24	Place lid on toilet if in patient room
BICU Soiled Utility	Hopper, no lid, behind closed door	Indirect contact	4	2	1	8	Automatic door closure; appropriate soiled equipment storage
BICU Medication Preparation Room	Sink with aerator, no splash guard	Aerosolization, and potential for splashing	4	2	3	24	Install splash guards; evaluate removing aerator
BICU Hydrotherapy Room	Debridement showers	Direct contact	4	3	1	12	Monthly EVS audits room indicating 95% adherence to policies
BICU Nurses Station	Sink closest to door	Indirect contact; HCW hands; devices	4	2	3	24	Install splash guards or move IV bags storage

Water Infection Control Risk Assessment (WICRA) for Healthcare Settings

INTRODUCTION

- A water infection control risk assessment (WICRA) is a critical component of water management programs (WMP) in healthcare settings. WMP team members can use a WICRA to evaluate water sources, modes of transmission, patient susceptibility, patient exposure, and program preparedness.
- A WICRA may be conducted during the initial development of a WMP and updated over time. The frequency of subsequent assessments should be informed by and defined in the WMP.
- Performing a WICRA using this tool will generate numerical scores of perceived risk, which can assist in prioritizing WMP activities such as monitoring and mitigation efforts. Total risk scores are intended for internal prioritization and do not hold significance outside the context of each site-specific WMP. Typically, the risks with highest scores will be used for priority focus, though some with lower scores may be given special consideration (e.g., mitigation can be quickly and easily implemented). Specific risk management actions should be determined in accordance with WMP activities.
- This WICRA tool provides a completed example for a Burn Intensive Care Unit (BICU). This may be used as a reference when completing the fillable document, which is intended to be flexible for different WMP needs.

For more information about water-associated pathogens, see CDC's Reduce Risk from Water page.

INSTRUCTIONS

- **Step 1:** Identify the areas within your facility to assess using the WICRA tool. Consider grouping each page by location (e.g., unit/ward/wing/building). Use the Location column for additional information (e.g., space/room/area).
- **Step 2:** Identify potential water sources, considering the examples on the next page. Each row of the WICRA table may be used for a unique exposure, or set of like exposures, in a location (e.g., sink, hopper, shower, fountain, ice machine).
- **Step 3:** Categorize potential modes of transmission for water-associated pathogens, considering the categories on the next page. Record this in the Modes of Transmission column.
- **Step 4:** Classify the patient susceptibility for each water source, considering the categories on the next page (highest, high, moderate, low). Record a score in the Patient Susceptibility column (e.g., from 4 to 1).
- **Step 5:** Characterize patient exposure, considering the categories on the next page (high, moderate, low, none). Record a score in the Patient Exposure column (e.g., from 3 to 0).
- **Step 6:** Determine the current level of preparedness in your WMP, considering the categories on the next page (poor, fair, good). Record a score in the Current Preparedness column (e.g., from 3 to 1).
- **Step 7:** Multiply the numerical scores in each column to calculate a total risk score for each water source. Record notes on specific pathogens or other considerations in the Comments column.
- **Step 8**: Rank the total risk scores, by location and across the facility. Use this internal ranking to inform WMP activities.

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Centers for Disease Control and Prevention

Key Messages

- Water systems are a recognised source of preventable healthcare-associated infections, including Legionella, Pseudomonas and other waterborne pathogens.
- International outbreaks consistently demonstrate that inadequate governance, oversight and monitoring can result in significant patient harm and reputational damage.
- Current governance arrangements create challenges in accountability, escalation, trend analysis and system-wide assurance.
- Effective water safety requires partnership between Infection Prevention & Control, Facilities, Engineering, Microbiology, Quality & Risk, Māori Health, and Executive Leadership.
- The SWEET² framework provides an Aotearoa-specific lens to ensure water safety is safe, equitable, whānau-centred, collaborative and culturally responsive

Water safety is a patient safety and clinical governance issue, not simply a facilities management issue