NHS National Services Scotland

Considered Judgement Forms

Infection prevention and control (IPC) for safe healthcare water systems

Version 1.0

29 July 2024

ARHAI Scotland

Antimicrobial Resistance and Healthcare Associated Infection

Version history

Version	Date	Summary of changes
1.0		Final for publication

Approvals

Version	Date Approved	Name
1.0		ARHAI Scotland Infection Control in the Built Environment & Decontamination (ICBED) Working Group
1.0		ARHAI Scotland Community Infection Prevention & Control (CIPC) Working Group

Contents

Executive Summary

This work is to inform development of water safety content within Chapter 4 of the National Infection Prevention and Control Manual (NIPCM).

There are 36 research questions within this considered judgement form. Each research question has two sections, Part A and Part B:

- **Part A** outlines the quality of evidence available to answer the research question and summarises the reliability, consistency, applicability, and generalisability of the evidence as well as risk of publication bias.
- **Part B** outlines recommendations and good practice points and summarises how they were developed (how evidence was combined with expert opinion). This section details the intended benefits, potential harms, feasibility of implementation, value judgements, intentional vagueness, and exceptions (scenarios where the recommendation or good practice point would not be applied). Future research needs are also summarised. **A summary of the recommendations and good practice points in list form can be found in** Appendix 1.

Research questions 1-9 cover general information about water-associated organisms in healthcare settings, including the patient groups most at risk, the types of infection caused, transmission routes, and the causes and sources of water system contamination.

Research questions 10-29 cover topics around prevention and control of healthcare water system-associated infection, including routine water testing, routine environmental testing, interpretation of results, flushing, actions for removal of contamination from water outlets, and actions to reduce risk of transmission from direct and indirect water use.

Research questions 30-35 cover outbreak and incident management.

Research question 36 is about organisational management.

Considered Judgement Forms

1. Which organisms associated with healthcare water systems are responsible for colonisation/infection of patients?

2. How do healthcare water system-associated organisms survive in the environment?

3. What are the causes/sources of environmental contamination with healthcare water system-associated organisms?

4. Which patient populations are considered as being at increased risk of colonisation/infection with a healthcare water system-associated organism?

5. What types of infection can healthcare water system-associated organisms cause?

6. What are the incubation periods of healthcare water system-associated organisms?

7. What is the period of communicability for healthcare water system-associated organisms?

8. What are the known transmission routes of healthcare water system-associated organisms?

9. Which healthcare procedures present an increased risk of transmission of healthcare water system-associated organisms?

10. What are the microbiological water testing requirements at commissioning?

11. What are the responsibilities of the IPC team in regards to water safety at commissioning?

12. Is routine water testing to detect healthcare water system-associated organisms recommended?

13. What are the recommended microbiological limits for healthcare water system-associated organisms?

14. How frequently should routine water testing be conducted?

15. When should routine water testing frequency be increased?

16. Where should routine water samples be taken from (which outlets, how many samples)?

17. When should routine water samples from further back in the system be taken?

18. Who should water test results be reported to?

19. How should routine water test results be interpreted?

Research question 1: Which organisms associated with healthcare water systems are responsible for colonisation/infection of patients?

Part A: Quality of evidence

1.1 How reliable is the body of evidence? (see SIGN 50, section 5.3.1, 5.3.4)

Comment here on the quantity of evidence available on this topic and its methodological quality. Please include citations and evidence levels.

If there is insufficient evidence to answer the key question, go to section B.

Comments	Evidence level
95 individual sources of evidence were included for this research question: • 1 systematic literature review,[1] (SIGN50 level 2+) • 80 outbreak studies,[2-81] (SIGN50 level 3) • 8 surveillance studies,[82-89] (SIGN50 level 3) • 1 before and after study,[90] (SIGN50 level 3) • 1 cohort study,[91] (SIGN50 level 3) • 2 case reports,[92, 93] (SIGN50 level 3) • 2 non-systematic guidelines.[94, 95] (SIGN50 level 4) The majority of evidence consists of retrospective outbreak studies (graded SIGN50 level 3). There is no 'standard' reporting structure for outbreak studies therefore there is inconsistency in the type of information and level of detail provided. The retrospective nature of outbreak studies often prevents an accurate analysis of events occurring at the point of exposure. Conducting a case-control study as part of an outbreak investigation	1x SIGN50 level 2+ 92x SIGN50 level 3 2x SIGN50 level 4

Comments	Evidence level
can add rigour however very few outbreak studies included these. Studies were included if molecular typing was performed to investigate the link between the environment and the patient infection and/or colonisation incident. Studies were excluded if microbial typing was not performed. Where studies were able to demonstrate genetic relatedness between patient and environmental isolates, the exact transmission mode and direction of transmission were most times unable to be determined.	

1.2 Is the evidence consistent in its conclusions? (see SIGN 50, section 5.3.2)

Comment here on the degree of consistency demonstrated by the evidence. Where there are conflicting results, indicate how the group formed a judgement as to the overall direction of the evidence.

Comments
It is difficult to assess the level of consistency demonstrated by this body of evidence due to the heterogeneous nature of the outbreak studies, including the varied microorganisms reported, and the settings involved. It must be noted that the volume of literature identified for each organism may not be an accurate representation of the true clinical or environmental risk occurring or burden experienced in healthcare settings. With the above limitations in mind, the evidence was consistent in demonstrating that patient colonisations/infections involving gram-negative bacteria (*Pseudomonas aeruginosa* (33 reports) and species from the Enterobacteriaceae family (26 reports)), non-tuberculous Mycobacteria (21 reports), and other gram-negative bacteria (non-Enterobacteriaceae, non-*Legionella* species) (10 reports) are commonly reported in the literature as associated with healthcare water systems.

Comments

Fusarium solani was only reported in one outbreak study.[78]

Antibiotic resistance within these microorganisms was reported in 38 pieces of evidence.

Four outbreak studies described infections involving *Legionella* species where microbial proliferation within the water system preceded patient colonisation or infection.[3, 6, 9, 92]

In summary, below is a list of the microorganisms associated with healthcare water system infection incidents as identified in the literature (those with an asterisk (*) were identified in published UK incidents/outbreaks):

- *Acinetobacter* species (spp.) (*A. baumannii*, *A. ursingii**)
- *Burkholderia* spp. (*B. cepacia*)
- *Chryseomonas indologenes**
- *Cupriavidus pauculus**
- Enterobacteriaceae (*C. freundii, C. koseri, E. aerogenes, E. cloacae**, *E. coli**. *K. pneumoniae**, *K. oxytoca**, *Pantoea* spp.*, *P. agglomerans**, *S. marcescens**, *R. planticola*)
- *Fusarium solani*
- *Legionella* spp. (*L. pneumophila**)
- Nontuberculous mycobacteria (NTM)* (*M. avium* complex, *M. abscessus, M. canariasense, M. chelonae**, *M. chimaera**, *M. fortuitum, M. gordonae, M. kansasii, M. marinum, M. mucogenicum**, *M. simiae, M. phocaicum, M. terrae, M. ulcerans, M. xenopi*)
- *Pseudomonas* spp. (*P. aeruginosa**, *P. putida**, *P. fluorescens**)
- *Stenotrophomonas maltophilia**
- *Sphingomonas* spp.

1.3 Is the evidence applicable to Scottish health and care settings? (see SIGN 50, section 5.3.3)

For example, do the studies include interventions, comparators or outcomes that are common to Scottish health and care settings?

Comments
Sixteen reports described incidents/outbreaks that occurred in UK settings;[10-12, 14, 27, 45, 53, 54, 62, 71, 82, 84, 88, 90, 94, 96] Similar incidents involving these organisms were also described across the non-UK literature base. Countries included France, Spain, Germany, the Netherlands, Belgium, Switzerland, Norway, Sweden, Canada, the United States of America, Brazil, Japan, Korea, China, Australia. There were similarities in the epidemiological and typing methods described in outbreak studies.

1.4 Are the studies generalisable to the target population?

Comment here on sample size and methods of sample selection. Is the sample representative of the specific population/group of interest? Generalisability is only relevant to primary research studies.

Comments
No primary research studies were included therefore generalisability is not applicable.

1.5 Are there concerns about publication bias? (see SIGN 50, section 5.3.5)

Comment here on whether there is a risk in the evidence base that studies have been selectively published based on their results (and thus a risk that results from published studies are systematically different from unpublished evidence).

Comments
Yes. As the majority of the literature for this research question consisted of outbreak studies, there is a risk of publication bias. Many of the incidents and

Comments
outbreak that occur in healthcare settings are not published in scientific journals so there is the possibility of over or under-reporting of organisms. Studies were only included if microbial typing was performed however there was large variation in the typing methods used and consequently differences in methodological quality across the primary evidence base. A formal assessment of risk of bias was not conducted.

Part B: Evidence to decision

1.6 Recommendations

What Recommendations(s) or good practice point(s) does the Working Group agree are appropriate based on this evidence?

Note the following terminology:

- **"must"** implies that the health and care setting must implement the recommended approach and is used where a recommendation has been directly lifted from legislation or mandatory guidance
- **"should"** implies that the health and care setting "should" implement the recommended approach unless a clear and compelling rationale for an alternative approach is present
- **"should consider"** implies that the health and care setting should consider implementing the recommended approach

Recommendation	Grading
R1.1 Colonisation or infection in any patient should raise a high degree of suspicion for a healthcare associated environmental link if gram-negative microorganisms or non-tuberculous mycobacteria are isolated from a clinical sample. These may include the following: *Acinetobacter* species (spp.), *Burkholderia* spp., *Chryseomonas indologenes*, *Cupriavidus pauculus*,	Recommendation

Recommendation	Grading
Pseudomonas spp., *Stenotrophomonas maltophilia*, *Sphingomonas* spp., *Serratia marcescens*.	
R1.2 Isolation of *Legionella* spp. from a clinical sample in any patient indicates transmission from the environment and should be investigated as a possible healthcare associated infection incident if the incubation period fits and there is no established link to a community source.	Recommendation
GPP1.1 An environmental source should be considered when Enterobacteriaceae is isolated from a clinical sample in the patient groups listed in R4.1 when in association with a data exceedance.	Good Practice Point

1.7 Balancing benefits and harms

Comment here on the potential impact of the Recommendation/Good Practice Point on service users, visitors and staff. Benefits and harms include considerations beyond IPC.

Benefits

List the favourable changes in outcome that would likely occur if the Recommendation/ Good Practice Point were followed correctly. Be explicit, clear about pros.

Benefits
Consideration of environmental sources for the microorganisms listed in R1.1 and GPP1.1 ensures that potential environmental sources are investigated and action taken where any concerns are identified, therefore mitigating transmission risk. R1.1 Acknowledgement of an environmental source for *Legionella* spp. ensures that clinical samples are investigated appropriately (e.g. that an environmental

Benefits
source or reservoir is investigated), with the intention that this will prevent further transmission to additional patients.

Risks and Harms

List the adverse events or other unfavourable outcomes that may occur if the Recommendation/ Good Practice Point were followed correctly. Be explicit, clear about cons.

Risks and Harms
No risks or harms identified.

Benefit-Harm assessment

Classify as “benefits outweigh harms” (or vice versa) or a “balance of benefit and harm.” Description of this balance can be from the individual patient/ staff/ visitor perspective, the societal perspective, or both. Recommendations/ Good Practice Points are possible when clear benefit is not offset by important harms, costs or adverse events (or vice versa).

Benefit-Harm assessment
Only benefits identified.

1.8 Feasibility

Is the Recommendation/ Good Practice Point implementable in the Scottish context? Describe (if applicable) financial implications, opportunity costs, material or human resource requirements, facility needs, sustainability issues, human factors etc., that may be associated with following a Recommendation/Good Practice Point. State clearly if information on feasibility is lacking.

Feasibility
• There will be a requirement for experienced staff to consider the possibility of environmental sources. Education and training may be required.

Feasibility
• There may be a need to improve electronic reporting systems to support surveillance of the microorganisms in R1.1 and GPP1.1.

1.9 Expert Opinion

Summarise the expert opinion used in creating the Recommendation/Good Practice Point; if none were involved, state “none”. Translating evidence into action often involves expert opinion where evidence is insufficient. Clearly outlining expert opinion helps users understand their influence on interpreting objective evidence. Expert opinion may also be required where there is no evidence available.

Expert opinion
While the evidence base for this research question is of low-moderate quality, outbreak studies were numerous and demonstrated that these microorganisms are associated with healthcare water systems in healthcare associated infection colonisation and infection incidents. Extant guidance from the CDC also lists these microorganisms as responsible for healthcare associated infections related to water systems. The evidence is therefore considered sufficient for the development of recommendation R1.1 where a high degree of suspicion for environmental involvement is recommended for the listed microorganisms. For R1.2, four outbreak studies (SIGN50 level 3)[3, 6, 9, 92] and CDC guideline (SIGN50 level 4) described infections involving *Legionella* spp. where microbial proliferation within the water system preceded patient colonisation or infection. It is widely acknowledged that *Legionella* spp. are environmentally-sourced organisms and therefore a recommendation has been developed to account for this risk, when the incubation period fits and there is no established link to a community source. For GPP1.1, evidence supporting the possibility of both endogenous and exogenous sources of Enterobacteriaceae is covered in more detail in research question 3 ‘What are the causes/sources of environmental contamination with healthcare water system-associated organisms?’. It is ARHAI Scotland expert opinion that if an Enterobacteriaceae spp. is isolated from a clinical sample in

Expert opinion
association with a data exceedance, an environmental source should be considered so that appropriate preventative measures can be developed if required to mitigate transmission to other patients.

1.10 Value judgements

Summarise value judgements used by the Working Group in creating the Recommendation/Good Practice Point; if none were involved, state “none”. Translating evidence into action often involves value judgements, which include guiding principles, ethical considerations, or other beliefs and priorities. Stating them clearly helps users understand their influence on interpreting objective evidence.

Value judgements
None.

1.11 Intentional vagueness

State reasons for any intentional vagueness in the Recommendation/Good Practice Point; if none was intended, state “none”. Recommendations/Good Practice Points should be clear and specific, but if there is a decision to be vague, acknowledging the reasoning clearly promotes transparency. Reasons for vagueness may include inadequate evidence; inability to achieve consensus regarding evidence quality, anticipated benefits/harms, or interpretation of evidence; legal considerations; economic reasons; ethical/ religious reasons.

Intentional vagueness
None.

1.12 Exceptions

List situations or circumstances in which the Recommendation/ Good Practice Point should not be applied.

Exceptions
Whilst it is recognised that NTMs are more common amongst specific patient groups (for example cystic fibrosis, lung cavitation, HIV and chronic lung disease) the possibility of an environmental link should not be ruled out on receipt of a new clinical isolate of NTM. Considerations should also include previous patient isolates, local unit surveillance and opportunities for direct person to person transmission.

1.13 Recommendations for research

List any aspects of the question that require further research.

Recommendations for research
Further research is required to assess the epidemiology of sporadic single patient cases of infection that are potentially associated with healthcare water. Research to determine the environmental prevalence of these microorganisms in healthcare settings and whether this varies geographically, would be beneficial.

Research question 2: How do healthcare water system-associated organisms survive in the environment?

Part A: Quality of evidence

2.1 How reliable is the body of evidence? (see SIGN 50, section 5.3.1, 5.3.4)

Comment here on the quantity of evidence available on this topic and its methodological quality. Please include citations and evidence levels.

If there is insufficient evidence to answer the key question, go to section B.

Comments	Evidence level
Fourteen studies were identified to answer this research question which includes: • 8 outbreak studies (SIGN50 level 3),[6, 8, 14, 22, 60, 62, 69, 97] • 1 surveillance study,[98] (SIGN50 level 3) • 2 non-systematic reviews,[99, 100] (SIGN50 level 4) • 3 guidance documents (SIGN50 level 4),[95, 101, 102]	9x SIGN50 level 3 5x SIGN50 level 4

2.2 Is the evidence consistent in its conclusions? (see SIGN 50, section 5.3.2)

Comment here on the degree of consistency demonstrated by the evidence. Where there are conflicting results, indicate how the group formed a judgement as to the overall direction of the evidence.

Comments
There is consistency in the evidence regarding the survival of organisms in water if the temperature is not maintained above 50°C, as well as the ability to survive on low nutrient levels, relative resistance to disinfection, survival within protozoa and the ability to form biofilms and/or survive in biofilms within the water distribution system.

2.3 Is the evidence applicable to Scottish health and care settings? (see SIGN 50, section 5.3.3)

For example, do the studies include interventions, comparators or outcomes that are common to Scottish health and care settings?

Comments
Applicable, the survival of organisms in the environment is ubiquitous.

2.4 Are the studies generalisable to the target population?

Comment here on sample size and methods of sample selection. Is the sample representative of the specific population/group of interest? Generalisability is only relevant to primary research studies.

Comments
N/A – studies are not relating to a specific target population but to the organism and its survival in water systems.

2.5 Are there concerns about publication bias? (see SIGN 50, section 5.3.5)

Comment here on whether there is a risk in the evidence base that studies have been selectively published based on their results (and thus a risk that results from published studies are systematically different from unpublished evidence).

Comments
Yes, outbreak studies are identified for this research question and not all outbreaks/infection incidents are published in scientific peer-reviewed journals. However, the risk regarding this subject is low as there is consistency in how healthcare water system-associated organisms survive.

Part B: Evidence to decision

2.6 Recommendations

What Recommendation(s) does the Working Group agree are appropriate based on this evidence?

Note the following terminology:

- **"must"** implies that the health and care setting must implement the recommended approach and is used where a recommendation has been directly lifted from legislation or mandatory guidance
- **"should"** implies that the health and care setting "should" implement the recommended approach unless a clear and compelling rationale for an alternative approach is present
- **"should consider"** implies that the health and care setting should consider implementing the recommended approach

Recommendation	Grading
Water system-associated organisms naturally possess some physical and biological properties that facilitate their survival and persistence within healthcare water systems including the ability to survive on low nutrient levels, resistance to high water temperatures, relative resistance to disinfection, survival within protozoa and the ability to form biofilms and/or survive in biofilms within the water distribution system.	The answer to this research question is informative and therefore does not generate a practical recommendation or good practice point.

2.7 Balancing benefits and harms

Comment here on the potential impact of the Recommendation/Good Practice Point on service users, visitors and staff. Benefits and harms include considerations beyond IPC.

Benefits

List the favourable changes in outcome that would likely occur if the Recommendation/ Good Practice Point were followed correctly. Be explicit, clear about pros.

Benefits
N/A

Risks and Harms

List the adverse events or other unfavourable outcomes that may occur if the Recommendation/ Good Practice Point were followed correctly. Be explicit, clear about cons.

Risks/Harms
N/A

Benefit-Harm assessment

Classify as “benefits outweigh harms” (or vice versa) or a “balance of benefit and harm.” Description of this balance can be from the individual patient/staff/visitor perspective, the societal perspective, or both. Recommendations/Good Practice Points are possible when clear benefit is not offset by important harms, costs or adverse events (or vice versa).

Benefit-Harm assessment
N/A

2.8 Feasibility

Is the Recommendation/Good Practice Point implementable in the Scottish context?

Describe (if applicable) financial implications, opportunity costs, material or human resource requirements, facility needs, sustainability issues, human factors etc., that

may be associated with following a Recommendation/ Good Practice Point. State clearly if information on feasibility is lacking.

Feasibility
N/A

2.9 Expert Opinion

Summarise the expert opinion used in creating the Recommendation/ Good Practice Point; if none were involved, state “none”. Translating evidence into action often involves expert opinion where evidence is insufficient. Clearly outlining expert opinion helps users understand their influence on interpreting objective evidence. Expert opinion may also be required where there is no evidence available.

Expert opinion
None.

2.10 Value judgements

Summarise value judgements used by the Working Group in creating the Recommendation/ Good Practice Point; if none were involved, state “none”. Translating evidence into action often involves value judgements, which include guiding principles, ethical considerations, or other beliefs and priorities. Stating them clearly helps users understand their influence on interpreting objective evidence.

Value judgements
None.

2.11 Intentional vagueness

State reasons for any intentional vagueness in the Recommendation/Good Practice Point; if none was intended, state “none”. Recommendations/Good Practice Points should be clear and specific, but if there is a decision to be vague, acknowledging the reasoning clearly promotes transparency. Reasons for vagueness may include inadequate evidence; inability to achieve consensus regarding evidence quality,

anticipated benefits/harms, or interpretation of evidence; legal considerations; economic reasons; ethical/ religious reasons.

Intentional vagueness
N/A

2.12 Exceptions

List situations or circumstances in which the Recommendation/ Good Practice Point should not be applied.

Exceptions
N/A

2.13 Recommendations for research

List any aspects of the question that require further research.

Recommendations for research
N/A

Research question 3: What are the causes/sources of environmental contamination with healthcare water system-associated organisms?

Part A: Quality of evidence

3.1 How reliable is the body of evidence? (see SIGN 50, section 5.3.1, 5.3.4)

Comment here on the quantity of evidence available on this topic and its methodological quality. Please include citations and evidence levels.

If there is insufficient evidence to answer the key question, go to section B.

Comments	Evidence level
In total, 97 pieces of evidence were identified in relation to this research question which includes: • 81 outbreak studies (SIGN50 level 3),[2-52, 54-81, 93, 103] • 9 surveillance studies (SIGN50 level 3),[82-88, 91, 104] • 5 guidance documents graded expert opinion (SIGN50 level 4), [94, 95, 105-107] • 1 systematic review (SIGN50 level 2+),[1] • 1 case report (SIGN50 level 3).[92] There are some general limitations to the evidence included within this research question: most studies are low quality, either SIGN50 level 3 or level 4, and 81 are outbreak studies that typically report retrospectively and are observational in nature.	1x SIGN50 level 2+ 91x SIGN50 level 3 5x SIGN50 level 4

3.2 Is the evidence consistent in its conclusions? (see SIGN 50, section 5.3.2)

Comment here on the degree of consistency demonstrated by the evidence. Where there are conflicting results, indicate how the group formed a judgement as to the overall direction of the evidence.

Comments

There was consistency in the evidence base that the cause of environmental proliferation was due to a failure of controls which can include temperature control, chemical control, water flow or pressure. These control failures allow organisms (that are often naturally found in water) to survive and accumulate, often within biofilms.

The evidence demonstrated with some consistency that the initial source of environmental contamination prior to proliferation can either be the environment itself (microorganisms ubiquitous in the water system), or the patient.

Patient

- Three prospective surveillance studies demonstrated that patients can be the source for transmission to other patients (and transmission to the environment).[83, 86, 87]
- Inappropriate practices and behaviours of healthcare staff, patients and visitors can increase the risk of transmission from a patient to the environment and can also support growth of biofilms within the environment. Four outbreak studies described the disposal of organic matter (food/drinks, body fluids/waste material) and residual antibiotics into sinks (some of which were designated for handwashing only).[59, 61, 63, 85]
- These prospective surveillance studies[83, 86, 87] highlighted the difficulties in determining both the source of contamination and the subsequent direction of transmission (patient-to-patient, environment-to-patient, patient-to-environment) when investigating water-system associated colonisations and infections.

Comments

Environment

- Fifteen outbreak studies detail infection incidents where widespread water system contamination was identified (rather than isolated to distal ends/outlets).[2-10, 53, 54, 79, 80, 92, 93]
- Sixty reports describe microbial proliferation/contamination of the plumbing infrastructure mainly at distal outlets and/or drains. Most of these outbreak studies (n=31) involved patient colonisation and/or infection with *P. aeruginosa,*[11, 12, 14-17, 20-23, 25, 29, 31, 33-36, 39, 45, 46, 48, 52, 53, 55, 56, 83-87, 90, 91] (two of these also involved *Pseudomonas putida*).[53, 55] Other microorganisms included Enterobacteriaceae, detailed in 22 reports.[13, 28, 30, 38, 41-43, 47, 49-51, 57-66, 82] Other gram-negative organisms included *B. cepacia*,[18, 24] *Acinetobacter* species (*A. baumanii*,[19, 37, 40, 67] *A. ursingii*),[53] *Chrysomonas indologenes*,[53] and *S. maltophilia*.[53] NTMs were detailed in 4 reports.[26, 27, 32, 103]
- In these outbreak reports where the environment was found to be considered a source, the possibility of patient-to-environment and patient-to-patient transmission cannot be ruled out.

Water-based equipment

Separate to the water system itself, water-based equipment can also act as an environmental reservoir for ongoing transmission, as demonstrated in 15 studies. This included cardiac water heater coolers,[72, 88, 94] automated endoscope reprocessors,[2, 68, 74] laparoscopy equipment,[75] haemodialysis wall boxes,[70] chilled water dispensers,[44, 69, 71] a tea dispenser,[66] mesotherapy equipment,[73] ice machines,[76] clothes washing machine,[77] and neonatal incubators.[81]

Summary

For most infection incidents and outbreaks it is challenging to determine the exact source as proliferation at distal outlets could be the result of both environmental or patient sources. Consequently, those investigating infection incidents should initially assume that both the environment (water itself plus the plumbing parts) and patients may be the reservoirs for ongoing transmission.

3.3 Is the evidence applicable to Scottish health and care settings? (see SIGN 50, section 5.3.3)

For example, do the studies include interventions, comparators or outcomes that are common to Scottish health and care settings?

Comments
International and UK studies included but findings/conclusions are applicable for Scotland. Sources are relevant for Scotland.

3.4 Are the studies generalisable to the target population?

Comment here on sample size and methods of sample selection. Is the sample representative of the specific population/group of interest? Generalisability is only relevant to primary research studies.

Comments
There were no controlled trials involving sample selection therefore generalisability is not applicable.

3.5 Are there concerns about publication bias? (see SIGN 50, section 5.3.5)

Comment here on whether there is a risk in the evidence base that studies have been selectively published based on their results (and thus a risk that results from published studies are systematically different from unpublished evidence).

Comments
Yes, most of the studies identified for this research question are outbreak studies. Many of the incidents/outbreaks that occur in healthcare settings are not published in scientific journals, possibly as a result of the limitations of sampling technique and laboratory identification so there is the possibility of over or under-reporting of organisms. Studies were excluded if microbial typing was not performed. The variety of discriminatory power in the different typing methods of included evidence is also a limitation of the evidence. Formal assessment of publication bias was not conducted.

Part B: Evidence to decision

3.6 Recommendations

What Recommendations(s) or good practice point(s) does the Working Group agree are appropriate based on this evidence?

Note the following terminology:

- **"must"** implies that the health and care setting must implement the recommended approach and is used where a recommendation has been directly lifted from legislation or mandatory guidance
- **"should"** implies that the health and care setting "should" implement the recommended approach unless a clear and compelling rationale for an alternative approach is present
- **"should consider"** implies that the health and care setting should consider implementing the recommended approach

Recommendation	Grading
R3.1 When conducting water risk assessments and investigating colonisation/infection incidents involving the microorganisms listed in R1.1 and GPP1.1, the Water Safety Group (WSG) (for water risk assessments) and the Incident Management Team (IMT) (for investigating colonisation/infection incidents) should consider that both the environment (water supply itself plus the plumbing components) and patients may be reservoirs, enabling ongoing transmission to other patients and further contamination of the environment.	Recommendation

3.7 Balancing benefits and harms

Comment here on the potential impact of the Recommendation/Good Practice Point on service users, visitors and staff. Benefits and harms include considerations beyond IPC.

Benefits

List the favourable changes in outcome that would likely occur if the Recommendation/ Good Practice Point were followed correctly. Be explicit, clear about pros.

Benefits
The intended benefit is that prevention and management would be focused on managing risk from both patient and environmental reservoirs, and transmission from these reservoirs.

Risks and Harms

List the adverse events or other unfavourable outcomes that may occur if the Recommendation/ Good Practice Point were followed correctly. Be explicit, clear about cons.

Risks/Harms
There are no identified harms.

Benefit-Harm assessment

Classify as “benefits outweigh harms” (or vice versa) or a “balance of benefit and harm.” Description of this balance can be from the individual patient/staff/visitor perspective, the societal perspective, or both. Recommendations/Good Practice Points are possible when clear benefit is not offset by important harms, costs or adverse events (or vice versa).

Benefit-Harm assessment
Only benefits identified.

3.8 Feasibility

Is the Recommendation/ Good Practice Point implementable in the Scottish context? Describe (if applicable) financial implications, opportunity costs, material or human resource requirements, facility needs, sustainability issues, human factors etc., that may be associated with following a Recommendation/ Good Practice Point. State clearly if information on feasibility is lacking.

Feasibility
Conducting risk assessments and assessing infection incidents with these considerations in mind (reservoirs possible from patients and the environment and also the risk of patients contaminating the environment creating further environmental reservoirs (‘seeding’ the environment)) requires knowledge and experience from staff across multiple disciplines. This may require external specialists and/or additional education and training across staff groups with associated financial and time implications. Contractors that undertake risk assessments may only consider risks from the built environment as that is what they have been trained to consider. Most will only consider risks associated with the domestic water systems and may not consider those from the above ground drainage systems or any other assets that may be attached to the water system but are not used for domestic purposes. To understand the risks posed by these [and any other types of micro-organisms] there would need to be a step change in the way in which risk assessments are procured and carried out. There will be material resources required to conduct environmental investigations (water sampling and environmental swabbing) and this will incur financial costs.

3.9 Expert Opinion

Summarise the expert opinion used in creating the Recommendation/Good Practice Point; if none were involved, state “none”. Translating evidence into action often involves expert opinion where evidence is insufficient. Clearly outlining expert opinion helps users understand their influence on interpreting objective evidence. Expert opinion may also be required where there is no evidence available.

Expert opinion
The potential contribution of patient seeding (patients contaminating the environment creating environmental reservoirs) of water systems in Scottish healthcare facilities is unknown. ARHAI Scotland acknowledge that the degree to which patient seeding of the environment exists is largely unknown because colonisation status upon arrival and the impact of treatment and environmental exposure for the majority of patients throughout their stay is largely unknown. Consequently, it is the expert opinion of ARHAI Scotland that the risk of patient seeding should be considered and precautionary principles applied at all times to minimise risk. To assess the potential contribution of environmental reservoirs (contamination of distal outlets in addition to the water itself) would require regular environmental sampling of outlets to build up a location-based picture of risk, which may not be appropriate and/or feasible (see further detail on routine environmental sampling in RQ22). Regardless of whether environmental sampling is carried out, it is the expert opinion of ARHAI Scotland that the precautionary principle should apply, in that it should be assumed that outlets present a transmission risk, with appropriate preventative mitigations developed.

3.10 Value judgements

Summarise value judgements used by the Working Group in creating the Recommendation/Good Practice Point; if none were involved, state “none”. Translating evidence into action often involves value judgements, which include guiding principles, ethical considerations, or other beliefs and priorities. Stating them clearly helps users understand their influence on interpreting objective evidence.

Value judgements
None.

3.11 Intentional vagueness

State reasons for any intentional vagueness in the Recommendation/Good Practice Point; if none was intended, state “none”. Recommendations/Good Practice Points should be clear and specific, but if there is a decision to be vague, acknowledging the reasoning clearly promotes transparency. Reasons for vagueness may include inadequate evidence, inability to achieve consensus regarding evidence quality, anticipated benefits/harms, or interpretation of evidence, legal considerations, economic reasons, ethical/religious reasons.

Intentional vagueness
The recommendation states that WSG/IMT should consider that both patients and the environment can be reservoirs for transmission of the microorganisms in R1.1 and GPP1.1, but does not specify what this would look like in practice. This is due to the variation in patient disease, treatments and environmental factors that can present. For incident and outbreak investigation, both patients and the environment should initially be considered as working hypotheses as reservoirs/sources whilst information is gathered by the IMT to include or exclude. For water risk assessments, all potential environmental sources involving water, and all patient uses of water (including water-based equipment, fixtures and fittings), should be considered by the WSG.

3.12 Exceptions

List situations or circumstances in which the Recommendation/Good Practice Point should not be applied.

Exceptions
None.

3.13 Recommendations for research

List any aspects of the question that require further research.

Recommendations for research
A major limitation of this evidence base is that most studies/outbreak studies do not report on patient colonisation at admission (either because such surveillance was not conducted as it is not routine practice, or because of the difficulties in interpreting this data). It may be beneficial to further explore the benefits of assessing the contribution of patients to environmental seeding/contamination in healthcare settings. Undertaking such a study in a newly constructed facility with widespread environmental testing would be beneficial.

Research question 4: Which patient populations are considered as being at increased risk of colonisation/infection with a healthcare water system-associated organism?

Part A: Quality of evidence

4.1 How reliable is the body of evidence? (see SIGN 50, section 5.3.1, 5.3.4)

Comment here on the quantity of evidence available on this topic and its methodological quality. Please include citations and evidence levels.

If there is insufficient evidence to answer the key question, go to section B.

Comments	Evidence level
In total, 41 pieces of evidence were identified in relation to this research question which includes: • 39 outbreak studies (SIGN50 level 3),[3, 4, 8-15, 18, 20, 24, 26, 27, 29-32, 38, 48, 51, 52, 54, 56, 59, 61, 62, 64, 65, 70, 71, 77-81, 103, 108] • 1 cohort study (SIGN50 level 3),[91] • 1 guidance document (SIGN50 level 4).[107] There are some general limitations to the evidence included within this research question: most studies are low quality, either SIGN50 level 3 or level 4, and 38 are outbreak studies that typically report retrospectively and are observational in nature.	40x SIGN50 level 3 1x SIGN50 level 4

4.2 Is the evidence consistent in its conclusions? (see SIGN 50, section 5.3.2)

Comment here on the degree of consistency demonstrated by the evidence. Where there are conflicting results, indicate how the group formed a judgement as to the overall direction of the evidence.

Comments

There is consistency in the literature (n=41 studies) that those who are defined as immunocompromised and those with underlying health conditions are high-risk patients as they are at increased risk of infection/colonisation with a healthcare water system-associated organism.

Infection/colonisation was described in the following patient groups:

- Haematology and oncology patients; 14 outbreak studies (SIGN50 level 3).[3, 8-11, 26, 27, 29, 38, 59, 64, 78-80]
- neonatal,[48, 81, 108] paediatric[18, 77, 78] and adult ICU patients;[13, 14, 51, 56, 61, 65, 91] 12 outbreak studies, 1 cohort study (13 SIGN50 level 3).
- Bone marrow and stem cell transplant patients; 5 outbreak studies (SIGN50 level 4).[4, 8, 32, 52, 71]
- Cardiac surgery patients; 3 outbreak studies (SIGN50 level 3).[8, 61, 62]
- Burns patients; 3 outbreak studies (SIGN50 level 3)[12, 14, 30]
- Transplant patients; 2 outbreak studies (SIGN50 level 3).[8, 31]
- Patients with non-intact skin or indwelling peripheral/central venous catheters may also be at risk; 3 outbreak studies (SIGN50 level 3).[4, 24, 70, 103]

Additional patient groups that were described in the literature included those with underlying lung disease,[15] and urology patients.[20]

The approved code of practice (L8) published by the Health and Safety Executive (HSE) discusses patients at higher risk for infection with *Legionella* spp. specifically.[107] These include patients aged over 45 years, those with respiratory disease, chronic kidney disease, diabetes, heart disease, or patients with an impaired immune system.

4.3 Is the evidence applicable to Scottish health and care settings? (see SIGN 50, section 5.3.3)

For example, do the studies include interventions, comparators or outcomes that are common to Scottish health and care settings?

Comments
International and UK studies included but findings/conclusions are applicable for Scotland. All from developed countries. Patient populations at risk are relevant for Scotland.

4.4 Are the studies generalisable to the target population?

Comment here on sample size and methods of sample selection. Is the sample representative of the specific population/group of interest? Generalisability is only relevant to primary research studies.

Comments
No primary research studies were included therefore generalisability is not applicable.

4.5 Are there concerns about publication bias? (see SIGN 50, section 5.3.5)

Comment here on whether there is a risk in the evidence base that studies have been selectively published based on their results (and thus a risk that results from published studies are systematically different from unpublished evidence).

Comments
Yes, most of the studies identified for this research question are outbreak studies. However, not all outbreaks/infection incidents are published in scientific peer-reviewed journals.

Part B: Evidence to decision

4.6 Recommendations

What Recommendations(s) or good practice point(s) does the Working Group agree are appropriate based on this evidence?

Note the following terminology:

- **"must"** implies that the health and care setting must implement the recommended approach and is used where a recommendation has been directly lifted from legislation or mandatory guidance
- **"should"** implies that the health and care setting "should" implement the recommended approach unless a clear and compelling rationale for an alternative approach is present
- **"should consider"** implies that the health and care setting should consider implementing the recommended approach

Recommendation	Grading
R4.1 The Water Safety Group (WSG) should agree a local approach to identify the location of high-risk patients within healthcare settings (as a minimum including haematology and oncology patients, cardiac surgery patients, bone marrow and stem cell transplant patients, neonatal, paediatric and adult ICU patients, transplant patients, burns patients, and any other patients that are severely immunocompromised through disease or treatment) particularly those who may not receive care or treatment in a high-risk facility (for example theatres), and these should be included in the board Water Safety Plan.	Recommendation
GPP4.1 Specific patient groups should be considered for being at higher risk for Legionellosis which includes patients over 45 years, patients with respiratory disease,	Good Practice Point

Recommendation	Grading
patients suffering from chronic kidney disease, diabetes patients, patients with heart disease and immunocompromised patients.	

4.7 Balancing benefits and harms

Comment here on the potential impact of the Recommendation/Good Practice Point on service users, visitors and staff. Benefits and harms include considerations beyond IPC.

Benefits

List the favourable changes in outcome that would likely occur if the Recommendation/Good Practice Point were followed correctly. Be explicit, clear about pros.

Benefits
For R4.1, ensuring that high-risk patients are considered in a Water Safety Plan which will allow consideration of preventative measures to reduce the risk of healthcare-associated infections in high-risk patients. For GPP4.1, it is anticipated that awareness of the risk of legionellosis in the high-risk patient groups will allow development of risk assessment to reduce the risk of HAI in these patient groups.

Risks and Harms

List the adverse events or other unfavourable outcomes that may occur if the Recommendation/Good Practice Point were followed correctly. Be explicit, clear about cons.

Risks/Harms
No risks or harms identified.

Benefit-Harm assessment

Classify as “benefits outweigh harms” (or vice versa) or a “balance of benefit and harm.” Description of this balance can be from the individual patient/ staff/ visitor perspective, the societal perspective, or both. Recommendations/ Good Practice Points are possible when clear benefit is not offset by important harms, costs or adverse events (or vice versa).

Benefit-Harm assessment
Only benefits identified.

4.8 Feasibility

Is the Recommendation/Good Practice Point implementable in the Scottish context?

Describe (if applicable) financial implications, opportunity costs, material or human resource requirements, facility needs, sustainability issues, human factors etc., that may be associated with following a Recommendation/Good Practice Point. State clearly if information on feasibility is lacking.

Feasibility
To allow identification of high-risk patient populations requires the WSG to have clinical representation. Acceptance of the risk assessment by each health board should include a review by the Authorised Person [Water] where identification of the patient cohort/risk may be helpful. For example to help prioritise any remedial works.

4.9 Value judgements

Summarise value judgements used by the Working Group in creating the Recommendation/ Good Practice Point; if none were involved, state “none”. Translating evidence into action often involves value judgements, which include guiding principles, ethical considerations, or other beliefs and priorities. Stating them clearly helps users understand their influence on interpreting objective evidence.

Value judgements
None.

4.10 Expert Opinion

Summarise the expert opinion used in creating the Recommendation/ Good Practice Point; if none were involved, state “none”. Translating evidence into action often involves expert opinion where evidence is insufficient. Clearly outlining expert opinion helps users understand their influence on interpreting objective evidence. Expert opinion may also be required where there is no evidence available.

Expert opinion
The evidence for this research question was consistent in demonstrating the patient groups that are most at risk. It is ARHAI Scotland opinion that these patients at risk (including the units in which they are cared for) should be acknowledged and considered in a water safety plan. This is in line with a previous CEL 08 (2013) that advised that all high-risk units where patients may be at increased risk of *Pseudomonas* spp. and related infections are identified and control measures applied.

4.11 Intentional vagueness

State reasons for any intentional vagueness in the Recommendation/Good Practice Point; if none was intended, state “none”. Recommendations/Good Practice Points should be clear and specific, but if there is a decision to be vague, acknowledging the reasoning clearly promotes transparency. Reasons for vagueness may include inadequate evidence; inability to achieve consensus regarding evidence quality, anticipated benefits/harms, or interpretation of evidence; legal considerations; economic reasons; ethical/ religious reasons.

Intentional vagueness
R4.1 includes patient groups ‘as a minimum’ which were identified in the literature, as well as ‘any other patient that is severely immunocompromised through disease

Intentional vagueness
or treatment' to avoid missing out potential high-risk patients and to allow local assessment.

4.12 Exceptions

List situations or circumstances in which the Recommendation/Good Practice Point should not be applied.

Exceptions
None.

4.13 Recommendations for research

List any aspects of the question that require further research.

Recommendations for research
The current evidence base predominantly consists of observational studies (outbreak studies) where patient populations are reported, but it would be beneficial to assess increased risk of specific patient populations by controlled studies (for example good quality case-control or cohort studies).

Research question 5: What types of infection can healthcare water system-associated organisms cause?

Part A: Quality of evidence

5.1 How reliable is the body of evidence? (see SIGN 50, section 5.3.1, 5.3.4)

Comment here on the quantity of evidence available on this topic and its methodological quality. Please include citations and evidence levels.

If there is insufficient evidence to answer the key question, go to section B.

Comments	Evidence level
In total, 22 pieces of evidence were identified in relation to this research question which includes: • 17 outbreak studies (SIGN50 level 3),[2, 4, 5, 8, 12, 24, 26, 27, 32, 34, 64, 68, 70, 74, 79, 80, 103] • 1 cohort study (SIGN50 level 3),[91] • 2 surveillance studies (SIGN50 level 3),[82, 88] • 2 international expert opinion documents (SIGN50 level 4).[95, 102] A general limitation is the low quality of evidence (all 22 studies are either level 3 or level 4) being observational and/or retrospective studies.	20x SIGN50 Level 3 2x SIGN50 level 4

5.2 Is the evidence consistent in its conclusions? (see SIGN 50, section 5.3.2)

Comment here on the degree of consistency demonstrated by the evidence. Where there are conflicting results, indicate how the group formed a judgement as to the overall direction of the evidence.

Comments

Evidence was consistent in demonstrating, via more than one study for each infection type, the following infections associated with water system organisms:

- Bloodstream infection;[4, 8, 24, 26, 27, 64, 70, 79, 80, 82, 91, 103]
- Invasive device-associated infection (for example CVCs) – including central-line associated bloodstream infections;[24, 27, 80, 103]
- Respiratory infection (pneumonia, tracheobronchitis);[8, 91]
- Surgical site infection (endocarditis, wound infection);[8, 12, 88, 91]
- Urinary tract infection (UTI).[91]
- Disseminated disease (Legionellosis) as described by the 2019 CDC guidelines[95] and WHO *Legionella* guidance.[102]

Multiple infection types may occur during an outbreak.[8, 91] Some outbreak studies do not specify clearly whether cases were colonisations or infections; both can occur during an outbreak.[8]

Regarding the invasive-device-associated bloodstream infections, two outbreak studies conducted case-control assessments which demonstrated CVCs to be significant risk factors for infection.[70, 80]

Pseudo-outbreaks, where positive clinical samples were identified but in the absence of clinical colonisation/infection, were described in six outbreak studies linking the contamination of patient samples to a contaminated water source.[2, 5, 32, 34, 68, 74] The 2019 CDC guidelines describe pseudo-outbreaks due to non-tuberculous Mycobacteria.[95]

5.3 Is the evidence applicable to Scottish health and care settings? (see SIGN 50, section 5.3.3)

For example, do the studies include similar target populations, interventions, comparators or outcomes as those common to Scottish health and care settings?

Comments
International and UK studies are included and findings are applicable for Scotland. Type of infections/ colonisations are universal and are relevant for Scotland.

5.4 Are the studies generalisable to the target population?

Comment here on sample size and methods of sample selection. Is the sample representative of the specific population/group of interest? Generalisability is only relevant to primary research studies.

Comments
There were no primary research studies included therefore generalisability is not applicable.

5.5 Are there concerns about publication bias? (see SIGN 50, section 5.3.5)

Comment here on whether there is a risk in the evidence base that studies have been selectively published based on their results (and thus a risk that results from published studies are systematically different from unpublished evidence).

Comments
Yes. Due to most studies (17 out of 22) being outbreak studies, there is a risk of publication bias as not all outbreaks/infection incidents are published in scientific journals and thus some (possibly unusual or rare) types of infection could be missed. Conversely, there is a possibility that rare or unusual types of infections are more likely to be published resulting in an overestimation of their risk. A formal assessment of publication bias was not conducted.

Part B: Evidence to decision

5.6 Recommendations

What Recommendations(s) or good practice point(s) does the Working Group agree are appropriate based on this evidence?

Note the following terminology:

- **"must"** implies that the health and care setting must implement the recommended approach and is used where a recommendation has been directly lifted from legislation or mandatory guidance
- **"should"** implies that the health and care setting "should" implement the recommended approach unless a clear and compelling rationale for an alternative approach is present
- **"should consider"** implies that the health and care setting should consider implementing the recommended approach

Recommendation	Grading
The types of infection that healthcare water system-associated organisms may cause include bloodstream (including CVC-associated bloodstream infection), respiratory (pneumonia), skin and soft tissue (including insertion site infections around any invasive device), surgical site infection (endocarditis, wound infection), urinary tract infection (UTI), and disseminated disease.	The answer to this research question is informative and therefore does not generate a practical recommendation or good practice point.

5.7 Balancing benefits and harms

Comment here on the potential impact of the Recommendation/Good Practice Point on service users, visitors and staff. Benefits and harms include considerations beyond IPC.

Benefits

List the favourable changes in outcome that would likely occur if the Recommendation/Good Practice Point were followed correctly. Be explicit, clear about pros.

Benefits
N/A

Risks and Harms

List the adverse events or other unfavourable outcomes that may occur if the Recommendation/Good Practice Point were followed correctly. Be explicit, clear about cons.

Risks/Harms
N/A

Benefit-Harm assessment

Classify as “benefits outweigh harms” (or vice versa) or a “balance of benefit and harm.” Description of this balance can be from the individual patient/ staff/ visitor perspective, the societal perspective, or both. Recommendations/ Good Practice Points are possible when clear benefit is not offset by important harms, costs or adverse events (or vice versa).

Benefit-Harm assessment
N/A

5.8 Feasibility

Is the Recommendation/ Good Practice Point implementable in the Scottish context?

Describe (if applicable) financial implications, opportunity costs, material or human resource requirements, facility needs, sustainability issues, human factors etc., that

may be associated with following a Recommendation/ Good Practice Point. State clearly if information on feasibility is lacking.

Feasibility
N/A

5.9 Expert Opinion

Summarise the expert opinion used in creating the Recommendation/Good Practice Point; if none were involved, state “none”. Translating evidence into action often involves expert opinion where evidence is insufficient. Clearly outlining expert opinion helps users understand their influence on interpreting objective evidence. Expert opinion may also be required where there is no evidence available.

Expert opinion
N/A

5.10 Value judgements

Summarise value judgements used by the Working Group in creating the Recommendation/Good Practice Point; if none were involved, state “none”. Translating evidence into action often involves value judgements, which include guiding principles, ethical considerations, or other beliefs and priorities. Stating them clearly helps users understand their influence on interpreting objective evidence.

Value judgements
N/A

5.11 Intentional vagueness

State reasons for any intentional vagueness in the Recommendation/Good Practice Point; if none was intended, state “none”. Recommendations/Good Practice Points should be clear and specific, but if there is a decision to be vague, acknowledging the reasoning clearly promotes transparency. Reasons for vagueness may include inadequate evidence; inability to achieve consensus regarding evidence quality,

anticipated benefits/harms, or interpretation of evidence; legal considerations; economic reasons; ethical/ religious reasons.

Intentional vagueness
N/A

5.12 Exceptions

List situations or circumstances in which the Recommendation/ Good Practice Point should not be applied.

Exceptions
N/A

5.13 Recommendations for research

List any aspects of the question that require further research.

Recommendations for research
It would be beneficial if more outbreak studies conducted case-control assessments to add rigour to the evidence base.

Research question 6: What are the incubation periods of healthcare water system-associated organisms?

Part A: Quality of evidence

6.1 How reliable is the body of evidence? (see SIGN 50, section 5.3.1, 5.3.4)

Comment here on the quantity of evidence available on this topic and its methodological quality. Please include citations and evidence levels.

If there is insufficient evidence to answer the key question, go to section B.

Comments	Evidence level
There was insufficient evidence available to answer the research question, with only 4 studies included: • 1 outbreak study (SIGN50 level 3),[72] • 1 surveillance study (SIGN50 level 3),[88] • 2 guidance documents categorised as expert opinions (SIGN50 level 4).[102, 109]	2x SIGN50 level 3 2x SIGN50 level 4

6.2 Is the evidence consistent in its conclusions? (see SIGN50 50, section 5.3.2)

Comment here on the degree of consistency demonstrated by the evidence. Where there are conflicting results, indicate how the group formed a judgement as to the overall direction of the evidence.

Comments
Two sources, both graded as SIGN50 level 4 expert opinions (the World Health Organization (WHO) and ECDC), state the incubation period for Legionnaires' disease to be 2-10 days, rarely up to 20 days.[102, 109] The ECDC reference WHO for this information. Data for *Legionella* is based on community-acquired cases, not healthcare-acquired.

Comments
Two reports specific to cardiopulmonary bypass–associated *M. chimaera* infections indicate an incubation period of between 3 months and 5.1 years for that specific organism and exposure scenario.[72, 88] For other organisms, there is consistency in the fact that there is not a consistent incubation period identified in the literature. It is likely to differ depending on the organism and the exposure scenario. It is challenging to determine the incubation period from outbreak studies as most do not specifically report it.

6.3 Is the evidence applicable to Scottish health and care settings? (see SIGN 50, section 5.3.3)

For example, do the studies include interventions, comparators or outcomes that are common to Scottish health and care settings?

Comments
International evidence (WHO guidance (worldwide), ECDC guidance (European) which is applicable to the patient groups at risk of Legionellosis and *M. chimaera* infections. These patient groups exist in Scottish health and care settings.

6.4 Are the studies generalisable to the target population?

Comment here on sample size and methods of sample selection. Is the sample representative of the specific population/group of interest? Generalisability is only relevant to primary research studies.

Comments
No primary research studies were included therefore generalisability is not applicable.

6.5 Are there concerns about publication bias? (see SIGN 50, section 5.3.5)

Comment here on whether there is a risk in the evidence base that studies have been selectively published based on their results (and thus a risk that results from published studies are systematically different from unpublished evidence).

Comments
Yes, there are likely to be many cases/outbreaks caused by water-associated pathogens that are not published in scientific journals, therefore it is possible that the evidence may not reflect what is being seen in practice. To be able to investigate the incubation period, the source and the exposure need to be known which is rare. Moreover, outbreak studies typically demonstrate a resolution or outcome based on multiple actions and it is possible that incubation periods are not reported as they are perceived as less informative and/or do not follow the same format as an outbreak study.

Part B: Evidence to decision

6.6 Recommendations

What Recommendations(s) or good practice point(s) does the Working Group agree are appropriate based on this evidence?

Note the following terminology:

- **"must"** implies that the health and care setting must implement the recommended approach and is used where a recommendation has been directly lifted from legislation or mandatory guidance
- **"should"** implies that the health and care setting "should" implement the recommended approach unless a clear and compelling rationale for an alternative approach is present
- **"should consider"** implies that the health and care setting should consider implementing the recommended approach

Recommendation	Grading
GPP6.1 When determining HAI status, the incubation period should be considered, acknowledging the wide variation (a few hours to years).	Good Practice Point
GPP6.2 Careful consideration should be applied when assessing an HAI in this category, recognising that	Good Practice Point

Recommendation	Grading
whilst a patient is receiving antibiotics which may assist in selecting a gram-negative organism more readily, HAI status should still be considered and investigated.	

6.7 Balancing benefits and harms

Comment here on the potential impact of the Recommendation/Good Practice Point on service users, visitors and staff. Benefits and harms include considerations beyond IPC.

Benefits

List the favourable changes in outcome that would likely occur if the Recommendation/Good Practice Point were followed correctly. Be explicit, clear about pros.

Benefits
GPP6.1 Acknowledgment of the wide variation of incubation period when assessing cases of infection may assist with recognition of HAI cases. GPP6.2 This approach supports safe practice, by ensuring that antimicrobial selective pressures do not assume previous or alternative transmission in relation to consideration of HAI potential water system-associated pathogens.

Risks and Harms

List the adverse events or other unfavourable outcomes that may occur if the Recommendation/ Good Practice Point were followed correctly. Be explicit, clear about cons.

Risks/Harms
GPP6.1 No harms identified. GPP6.2 No harms identified.

Benefit-Harm assessment

Classify as “benefits outweigh harms” (or vice versa) or a “balance of benefit and harm.” Description of this balance can be from the individual patient/staff/visitor perspective, the societal perspective, or both. Recommendations/ Good Practice Points are possible when clear benefit is not offset by important harms, costs or adverse events (or vice versa).

Benefit-Harm assessment
GPP6.1, GPP6.2 Only benefits identified.

6.8 Feasibility

Is the Recommendation/ Good Practice Point implementable in the Scottish context?

Describe (if applicable) financial implications, opportunity costs, material or human resource requirements, facility needs, sustainability issues, human factors etc., that may be associated with following a Recommendation/Good Practice Point. State clearly if information on feasibility is lacking.

Feasibility
GPP6.1 It can be challenging to calculate an incubation period where the exact time of exposure is unknown; clinical judgement may be required which requires experience supported by available evidence. GPP6.2 It can be challenging to identify risks in relation to antimicrobial selective pressures and HAI; clinical judgement may be required which requires experience supported by available evidence. This GPP recommends ‘consideration’ and an appropriate response to individual cases should ensure that unnecessary or inappropriate investigation is avoided.

6.9 Expert Opinion

Summarise the expert opinion used in creating the Recommendation/ Good Practice Point; if none were involved, state “none”. Translating evidence into action often involves expert opinion where evidence is insufficient. Clearly outlining expert

opinion helps users understand their influence on interpreting objective evidence. Expert opinion may also be required where there is no evidence available.

Expert opinion
GPP6.1 Limited evidence (2 SIGN50 level 3 outbreak reports,[72, 88] 2 SIGN50 level 4 expert opinion guidance[102, 109]) was included to demonstrate variation in incubation period. It is the expert opinion of ARHAI Scotland and its stakeholders that some infections may present rapidly (within a few hours) following exposure to an environmental source or reservoir. Infection may be apparent through rapid clinical deterioration (including clinical signs such as skin redness around an infection site) or clinical sample positivity. Incubation periods may be less than the typically used 48 hours cut off for surveillance purposes when defining a healthcare associated infection. It must be noted that patients susceptible to infection with water system-associated organisms can clinically deteriorate rapidly following exposure. GPP6.2 No published evidence has been included for this good practice point. It is based on the expert opinion of ARHAI Scotland that antimicrobial selective pressures should not be identified as a reason alone to prevent any further environmental investigation. Sources of transmission should be considered on a case-by-case basis, with the aim of actively excluding water systems or the environment as potential transmission sources.

6.10 Value judgements

Summarise value judgements used by the Working Group in creating the Recommendation/Good Practice Point; if none were involved, state “none”. Translating evidence into action often involves value judgements, which include guiding principles, ethical considerations, or other beliefs and priorities. Stating them clearly helps users understand their influence on interpreting objective evidence.

Value judgements
GPP6.1, GPP6.2. None.

6.11 Intentional vagueness

State reasons for any intentional vagueness in the Recommendation/Good Practice Point; if none was intended, state “none”. Recommendations/Good Practice Points should be clear and specific, but if there is a decision to be vague, acknowledging the reasoning clearly promotes transparency. Reasons for vagueness may include inadequate evidence; inability to achieve consensus regarding evidence quality, anticipated benefits/harms, or interpretation of evidence; legal considerations; economic reasons; ethical/ religious reasons.

Intentional vagueness
GPP6.1, GPP6.2. None.

6.12 Exceptions

List situations or circumstances in which the Recommendation/Good Practice Point should not be applied.

Exceptions
None.

6.13 Recommendations for research

List any aspects of the question that require further research.

Recommendations for research
Further research is required to examine the potential incubation period for infection caused by the various organisms associated with water systems-whereby knowledge of the source and time of exposure is important. This may require further targeted search strategies.

Research question 7: What is the period of communicability for healthcare water system-associated organisms?

Part A: Quality of evidence

7.1 How reliable is the body of evidence? (see SIGN 50, section 5.3.1, 5.3.4)

Comment here on the quantity of evidence available on this topic and its methodological quality. Please include citations and evidence levels.

If there is insufficient evidence to answer the key question, go to section B.

Comments	Evidence level
No evidence was identified to support this research question.	N/A

7.2 Is the evidence consistent in its conclusions? (see SIGN 50, section 5.3.2)

Comment here on the degree of consistency demonstrated by the evidence. Where there are conflicting results, indicate how the group formed a judgement as to the overall direction of the evidence.

Comments
N/A

7.3 Is the evidence applicable to Scottish health and care settings? (see SIGN 50, section 5.3.3)

For example, do the studies include interventions, comparators or outcomes that are common to Scottish health and care settings?

Comments
N/A

7.4 Are the studies generalisable to the target population?

Comment here on sample size and methods of sample selection. Is the sample representative of the specific population/group of interest? Generalisability is only relevant to primary research studies.

Comments
N/A

7.5 Are there concerns about publication bias? (see SIGN 50, section 5.3.5)

Comment here on whether there is a risk in the evidence base that studies have been selectively published based on their results (and thus a risk that results from published studies are systematically different from unpublished evidence).

Comments
N/A

Part B: Evidence to decision

7.6 Recommendations

What Recommendations(s) or good practice point(s) does the Working Group agree are appropriate based on this evidence?

Note the following terminology:

- **"must"** implies that the health and care setting must implement the recommended approach and is used where a recommendation has been directly lifted from legislation or mandatory guidance
- **"should"** implies that the health and care setting "should" implement the recommended approach unless a clear and compelling rationale for an alternative approach is present
- **"should consider"** implies that the health and care setting should consider implementing the recommended approach

Recommendation	Grading
GPP7.1 When considering whether to declare an infection incident or outbreak as ‘closed’, the IMT should provide assurance that transmission risk from any remaining colonised or infected patient(s) in the care area is mitigated.	Good Practice Point

7.7 Balancing benefits and harms

Comment here on the potential impact of the Recommendation/Good Practice Point on service users, visitors and staff. Benefits and harms include considerations beyond IPC.

Benefits

List the favourable changes in outcome that would likely occur if the Recommendation/ Good Practice Point were followed correctly. Be explicit, clear about pros.

Benefits
The intended benefit of mitigating transmission risk from colonised and/or infected patients is the avoidance of transmission to subsequent patients.

Risks and Harms

List the adverse events or other unfavourable outcomes that may occur if the Recommendation/ Good Practice Point were followed correctly. Be explicit, clear about cons.

Risks/Harms
None identified.

Benefit-Harm assessment

Classify as “benefits outweigh harms” (or vice versa) or a “balance of benefit and harm.” Description of this balance can be from the individual patient/ staff/ visitor perspective, the societal perspective, or both. Recommendations/ Good Practice Points are possible when clear benefit is not offset by important harms, costs or adverse events (or vice versa).

Benefit-Harm assessment
It is anticipated that benefits will outweigh harms.

7.8 Feasibility

Is the Recommendation/Good Practice Point implementable in the Scottish context?

Describe (if applicable) financial implications, opportunity costs, material or human resource requirements, facility needs, sustainability issues, human factors etc., that may be associated with following a Recommendation/Good Practice Point. State clearly if information on feasibility is lacking.

Feasibility
Mitigating transmission risk will require assessment and decision making from the IMT. There may be a requirement to consider patient placement and the layout of the care area.

7.9 Expert Opinion

Summarise the expert opinion used in creating the Recommendation/Good Practice Point; if none were involved, state “none”. Translating evidence into action often involves expert opinion where evidence is insufficient. Clearly outlining expert opinion helps users understand their influence on interpreting objective evidence. Expert opinion may also be required where there is no evidence available.

Expert opinion
The general definition of the period of communicability is the time during which an infectious agent may be transferred directly or indirectly from an infected person to

Expert opinion
another person. In general, patient-to-patient transmission in water system-associated cases is usually via indirect contact. In theory, as long as a patient remains colonised or infected, there is a risk for indirect transmission to another patient. In acknowledgement of this, and in the absence of evidence for this research question, ARHAI Scotland expert opinion supports development of a Good Practice Point

7.10 Value judgements

Summarise value judgements used by the Working Group in creating the Recommendation/ Good Practice Point; if none were involved, state “none”. Translating evidence into action often involves value judgements, which include guiding principles, ethical considerations, or other beliefs and priorities. Stating them clearly helps users understand their influence on interpreting objective evidence.

Value judgements
None.

7.11 Intentional vagueness

State reasons for any intentional vagueness in the Recommendation/Good Practice Point; if none was intended, state “none”. Recommendations/Good Practice Points should be clear and specific, but if there is a decision to be vague, acknowledging the reasoning clearly promotes transparency. Reasons for vagueness may include inadequate evidence; inability to achieve consensus regarding evidence quality, anticipated benefits/harms, or interpretation of evidence; legal considerations; economic reasons; ethical/ religious reasons.

Intentional vagueness
None.

7.12 Exceptions

List situations or circumstances in which the Recommendation/ Good Practice Point should not be applied.

Exceptions
This good practice point would not be applicable to incidents and outbreaks where there are no further colonised or infected patients present.

7.13 Recommendations for research

List any aspects of the question that require further research.

Recommendations for research
For the next update to this literature review, a research question that looks specifically at closure of infection incidents and outbreaks would be beneficial.

Research question 8: What are the known transmission routes of healthcare water system-associated organisms in healthcare settings?

Part A: Quality of evidence

8.1 How reliable is the body of evidence? (see SIGN 50, section 5.3.1, 5.3.4)

Comment here on the quantity of evidence available on this topic and its methodological quality. Please include citations and evidence levels.

If there is insufficient evidence to answer the key question, go to section B.

Comments	Evidence level
In total, 41 studies were identified in relation to this research question which includes: • 34 outbreak studies (SIGN50 level 3),[2, 4, 8, 11, 13, 14, 16, 17, 20, 22-24, 26, 27, 30, 33, 34, 36, 58-61, 64, 68, 69, 71, 72, 77, 80, 83, 87, 103, 110, 111] • 2 surveillance studies (SIGN50 level 3),[84, 88] • 1 cohort study (SIGN50 level 3),[91] • 4 expert opinion documents (SIGN50 level 4).[94, 95, 112, 113] Most studies identified in literature investigating the association between infection and water systems are outbreak studies (34 out of 41 studies) which are low quality due to their observational and usually retrospective nature.	37x SIGN50 level 3 4x SIGN50 level 4

8.2 Is the evidence consistent in its conclusions? (see SIGN 50, section 5.3.2)

Comment here on the degree of consistency demonstrated by the evidence. Where there are conflicting results, indicate how the group formed a judgement as to the overall direction of the evidence.

Comments
Evidence was consistent in demonstrating possible routes of transmission where an environmental source or reservoir was positively identified and likely routes of transmission to the patient from those sources/reservoirs, based on the way the water was used, were described. All evidence can be categorised into one or more of four transmission modes: direct contact, indirect contact, aerosolization, and aspiration. Direct contact • through ingestion of contaminated water or ice,[8, 69, 71] • direct contact of contaminated water with any portal of entry (for example surgical site wound, invasive devices, exposed or wounded skin).[4, 8, 24, 26, 27, 30, 80, 103] Indirect contact • via contact with contaminated equipment, for instance diagnostic equipment (bronchoscopes,[34, 68] bronchoscope automatic washing machine[2, 77]), medicine prep trays,[11] surgical equipment (arthroscope),[23] ventilator equipment (suction apparatus),[36] breast pump equipment,[33] surgical drape that was re-used despite being single-use,[20] hydrotherapy shower mattress;[14] • via contact with contaminated personnel for example the hands of healthcare workers from their contact with contaminated water or with a colonised/infected patient.[16, 17, 56, 64, 87, 91, 111]

Comments
Aerosolization • contaminated water droplets generated from the process of water splashing and spraying onto and from clinical wash hand basins, drains, sinks, shower cubicles, and when flushing toilets;[17, 22, 58, 60, 61, 64, 95] • aerosols released from contaminated water-based equipment for example cardiopulmonary bypass machines and heater-cooler units used during cardiac surgery,[8, 72, 88, 94, 112] humidifiers within mechanical ventilators,[33, 95] as well as room air humidifiers.[95] Aspiration • the inhalation of contaminated water into the airways, usually by patients that are intubated, via nasogastric tubes (where the contaminated water has been used to prepare the food),[110] those requiring oral fluid replacement and those requiring orally administered medications (where contaminated water has been used to prepare the medication).[110] The 2019 CDC guidelines (expert opinion) state that aspiration is a transmission mode, however the references provided are all in relation to *Legionella* spp. and all published before the year 2000.[95] In many instances, an exact transmission mode from an identified environmental source or reservoir to a patient could not be determined.[59, 83, 84] In such cases, multiple water uses present multiple possible transmission routes.

8.3 Is the evidence applicable to Scottish health and care settings? (see SIGN 50, section 5.3.3)

For example, do the studies include interventions, comparators or outcomes that are common to Scottish health and care settings?

Comments
International and UK studies included but findings/conclusions are applicable for Scotland. All from developed countries. Transmission modes are universally recognised and are relevant for Scotland.

Comments
There were no studies included from care home settings.

8.4 Are the studies generalisable to the target population?

Comment here on sample size and methods of sample selection. Is the sample representative of the specific population/group of interest? Generalisability is only relevant to primary research studies.

Comments
Not applicable as no primary research included.

8.5 Are there concerns about publication bias? (see SIGN 50, section 5.3.5)

Comment here on whether there is a risk in the evidence base that studies have been selectively published based on their results (and thus a risk that results from published studies are systematically different from unpublished evidence).

Comments
There is a risk of publication bias within this research question as it is mainly based on outbreak studies (34 out of the 41 studies). Not all outbreaks/infection incidents are published in scientific journals and therefore there is the possibility that the evidence may not fully reflect what is being seen in practice. A formal assessment of publication bias was not carried out.

Part B: Evidence to decision

8.6 Recommendations

What Recommendations(s) or good practice point(s) does the Working Group agree are appropriate based on this evidence?

Note the following terminology:

- **“must”** implies that the health and care setting must implement the recommended approach and is used where a recommendation has been directly lifted from legislation or mandatory guidance
- **“should”** implies that the health and care setting “should” implement the recommended approach unless a clear and compelling rationale for an alternative approach is present
- **“should consider”** implies that the health and care setting should consider implementing the recommended approach

Recommendation	Grading
R8.1 NHSScotland boards should acknowledge within water safety plans and amongst incident management teams (IMTs) the following potential transmission routes for water system associated organisms: direct contact, indirect contact (including via contaminated personnel/patients, environment, equipment, and medical products), aerosolisation, and aspiration.	Recommendation

8.7 Balancing benefits and harms

Comment here on the potential impact of the Recommendation/Good Practice Point on service users, visitors and staff. Benefits and harms include considerations beyond IPC.

Benefits

List the favourable changes in outcome that would likely occur if the Recommendation/ Good Practice Point were followed correctly. Be explicit, clear about pros.

Benefits
• Awareness of the transmission routes could reduce the risk of transmission of water-system associated HAI. • Increased patient safety.

Risks and Harms

List the adverse events or other unfavourable outcomes that may occur if the Recommendation/ Good Practice Point were followed correctly. Be explicit, clear about cons.

Risks/Harms
No risks identified.

Benefit-Harm assessment

Classify as “benefits outweigh harms” (or vice versa) or a “balance of benefit and harm.” Description of this balance can be from the individual patient/ staff/ visitor perspective, the societal perspective, or both. Recommendations/ Good Practice Points are possible when clear benefit is not offset by important harms, costs or adverse events (or vice versa).

Benefit-Harm assessment
Only benefits identified.

8.8 Feasibility

Is the Recommendation/ Good Practice Point implementable in the Scottish context?

Describe (if applicable) financial implications, opportunity costs, material or human resource requirements, facility needs, sustainability issues, human factors etc., that may be associated with following a Recommendation/ Good Practice Point. State clearly if information on feasibility is lacking.

Feasibility
Staff experience and knowledge is required to recognise the chain of infection in the context of the healthcare environment as a reservoir; education and training may be required.

8.9 Expert Opinion

Summarise the expert opinion used in creating the Recommendation/Good Practice Point; if none were involved, state “none”. Translating evidence into action often involves expert opinion where evidence is insufficient. Clearly outlining expert opinion helps users understand their influence on interpreting objective evidence. Expert opinion may also be required where there is no evidence available.

Expert opinion
Although the volume of evidence can be considered sufficient for this research question, the quality of evidence is low, and most studies were not able to definitely demonstrate a specific mode of transmission. It is ARHAI Scotland expert opinion that knowledge of the ways in which transmission can potentially occur will lead to a reduction in clinical risk if modification to clinical practice interrupts transmission modes.

8.10 Value judgements

Summarise value judgements used by the Working Group in creating the Recommendation/ Good Practice Point; if none were involved, state “none”. Translating evidence into action often involves value judgements, which include guiding principles, ethical considerations, or other beliefs and priorities. Stating them clearly helps users understand their influence on interpreting objective evidence.

Value judgements
None.

8.11 Intentional vagueness

State reasons for any intentional vagueness in the Recommendation/Good Practice Point; if none was intended, state “none”. Recommendations/Good Practice Points should be clear and specific, but if there is a decision to be vague, acknowledging the reasoning clearly promotes transparency. Reasons for vagueness may include inadequate evidence; inability to achieve consensus regarding evidence quality,

anticipated benefits/harms, or interpretation of evidence; legal considerations; economic reasons; ethical/ religious reasons.

Intentional vagueness
None.

8.12 Exceptions

List situations or circumstances in which the Recommendation/ Good Practice Point should not be applied.

Exceptions
None.

8.13 Recommendations for research

List any aspects of the question that require further research.

Recommendations for research
It would be beneficial if the evidence base regarding water transmission routes could be strengthened with higher quality studies such as case control or cohort studies.

Research question 9: Which healthcare procedures present an increased risk of transmission of healthcare water system-associated organisms?

Part A: Quality of evidence

9.1 How reliable is the body of evidence? (see SIGN 50, section 5.3.1, 5.3.4)

Comment here on the quantity of evidence available on this topic and its methodological quality. Please include citations and evidence levels.

If there is insufficient evidence to answer the key question, go to section B.

Comments	Evidence level
In total, 20 studies were included in relation to this research question which includes: • 14 outbreak studies (SIGN50 level 3),[4, 8, 11, 14, 24, 26, 27, 34, 58, 68, 70, 72, 80, 103] • 2 Scottish expert opinion documents (SIGN50 level 4),[112, 113] • 1 English expert opinion document (SIGN50 level 4),[94] • 1 international guideline (SIGN50 level 4),[95] • 1 cohort study (SIGN50 level 3),[91] • 1 surveillance study (SIGN50 level 3).[88] A general limitation is the low quality of evidence (all 20 studies are either level 3 or level 4). Due to the large number of studies (14 out of 20) being outbreak studies, there is a possibility of publication bias as not all outbreaks/infection incidents are published in scientific journals and thus the risk of transmission of healthcare water system-associated organisms following some	16x SIGN50 level 3 4x SIGN50 level 4

Comments	Evidence level
healthcare procedures might be underestimated. Moreover, the international guidelines included (CDC, SIGN50 level 4) are limited as they are mostly based on studies published pre-2000 and therefore might not reflect current IPC practices and the associated risks.[95]	

9.2 Is the evidence consistent in its conclusions? (see SIGN 50, section 5.3.2)

Comment here on the degree of consistency demonstrated by the evidence. Where there are conflicting results, indicate how the group formed a judgement as to the overall direction of the evidence.

Comments
• Two outbreak reports[34, 68] (SIGN50 level 3), 1 international guideline (CDC)[95] (SIGN50 level 4) and 1 other expert opinion guidance[113] provide evidence that reusable medical equipment (bronchoscopy, endoscopy) present a risk due to poor disinfection and inappropriate reprocessing of instruments with tap water. • Patient hygiene (bathing/washing) including wound care was evidenced in 3 outbreak reports and 1 cohort study (all SIGN50 level 3).[4, 8, 58, 91] • Involvement of CVCs via submersion in water was evidenced in 3 outbreak reports[26, 27, 103] (SIGN50 level 3) and in CDC guidelines (SIGN50 level 4). Procedures involving CVC care including haemodialysis[11, 24] was described in 2 outbreak reports (SIGN50 level 3). Two outbreak studies conducted case-control assessments which demonstrated CVCs to be significant risk factors for infection.[70, 80] • Hydrotherapy was evidenced in 1 outbreak report[14] (SIGN50 level 3) and CDC guidelines (SIGN50 level 4). • Oral care and enteral tube flushes was evidenced in 1 outbreak study (SIGN50 level 3).[8]

Comments
• Use of cardiac heater cooler units during surgery was evidenced in 4 outbreak reports and 1 surveillance study (all SIGN50 level 3) and 2 guidance documents (both SIGN50 level 4).[8, 72, 88, 94, 112] In summary, the evidence was consistent in demonstrating that any diagnostic, treatment or patient care procedure that involves a water source (for example oral care, washing/bathing, enteral tube flushes, intravenous procedures including management, hydrotherapy, use of cardiac heater coolers during surgery) may present a risk of transmission.

9.3 Is the evidence applicable to Scottish health and care settings? (see SIGN 50, section 5.3.3)

For example, do the studies include interventions, comparators or outcomes that are common to Scottish health and care settings?

Comments
International and UK studies included but findings/conclusions are applicable for Scotland. All from developed countries. The included evidence is applicable to Scottish health and care settings.

9.4 Are the studies generalisable to the target population?

Comment here on sample size and methods of sample selection. Is the sample representative of the specific population/group of interest? Generalisability is only relevant to primary research studies.

Comments
Only 1 primary evidence study was included which was specific to cases of *Pseudomonas aeruginosa* in surgical ICUs and therefore may not be generalisable to other patient groups or microorganisms.

9.5 Are there concerns about publication bias? (see SIGN 50, section 5.3.5)

Comment here on whether there is a risk in the evidence base that studies have been selectively published based on their results (and thus a risk that results from published studies are systematically different from unpublished evidence).

Comments
Due to the large number of studies (14 out of 20) being outbreak studies, there is a possibility of publication bias as not all outbreaks/infection incidents are published in scientific journals and thus the risk of transmission of healthcare water system-associated organisms following some healthcare procedures might be underestimated.

Part B: Evidence to decision

9.6 Recommendations

What Recommendations(s) or good practice point(s) does the Working Group agree are appropriate based on this evidence?

Note the following terminology:

- **"must"** implies that the health and care setting must implement the recommended approach and is used where a recommendation has been directly lifted from legislation or mandatory guidance
- **"should"** implies that the health and care setting "should" implement the recommended approach unless a clear and compelling rationale for an alternative approach is present
- **"should consider"** implies that the health and care setting should consider implementing the recommended approach

Recommendation	Grading
R9.1 All staff, including the Water Safety Group, should be aware of the risks from all uses of water in healthcare procedures which may include oral care,	Recommendation

Recommendation	Grading
washing/bathing, enteral tube flushes, intravenous procedures including their ongoing management, hydrotherapy, use of cardiac heater coolers during surgery.	

9.7 Balancing benefits and harms

Comment here on the potential impact of the Recommendation/Good Practice Point on service users, visitors and staff. Benefits and harms include considerations beyond IPC.

Benefits

List the favourable changes in outcome that would likely occur if the Recommendation/ Good Practice Point were followed correctly. Be explicit, clear about pros.

Benefits
It is anticipated that recognition of all the possible uses of water in healthcare will allow for risk assessment and development of prevention and control measures to reduce the risk of HAI from water sources.

Risks and Harms

List the adverse events or other unfavourable outcomes that may occur if the Recommendation/ Good Practice Point were followed correctly. Be explicit, clear about cons.

Risks/Harms
There are no anticipated risks.

Benefit-Harm assessment

Classify as “benefits outweigh harms” (or vice versa) or a “balance of benefit and harm.” Description of this balance can be from the individual patient/staff/visitor perspective, the societal perspective, or both. Recommendations/ Good Practice Points are possible when clear benefit is not offset by important harms, costs or adverse events (or vice versa).

Benefit-Harm assessment
Only benefits identified.

9.8 Feasibility

Is the Recommendation/ Good Practice Point implementable in the Scottish context?

Describe (if applicable) financial implications, opportunity costs, material or human resource requirements, facility needs, sustainability issues, human factors etc., that may be associated with following a Recommendation/ Good Practice Point. State clearly if information on feasibility is lacking.

Feasibility
Staff education may be required to ensure all uses of water in healthcare are known and recognised.

9.9 Expert Opinion

Summarise the expert opinion used in creating the Recommendation/ Good Practice Point; if none were involved, state “none”. Translating evidence into action often involves expert opinion where evidence is insufficient. Clearly outlining expert opinion helps users understand their influence on interpreting objective evidence. Expert opinion may also be required where there is no evidence available.

Expert opinion
Although the evidence for this research question is mainly of low quality, the combined evidence is considered sufficient for the development of a recommendation.

9.10 Value judgements

Summarise value judgements used by the Working Group in creating the Recommendation/ Good Practice Point; if none were involved, state “none”. Translating evidence into action often involves value judgements, which include guiding principles, ethical considerations, or other beliefs and priorities. Stating them clearly helps users understand their influence on interpreting objective evidence.

Value judgements
None.

9.11 Intentional vagueness

State reasons for any intentional vagueness in the Recommendation/Good Practice Point; if none was intended, state “none”. Recommendations/Good Practice Points should be clear and specific, but if there is a decision to be vague, acknowledging the reasoning clearly promotes transparency. Reasons for vagueness may include inadequate evidence; inability to achieve consensus regarding evidence quality, anticipated benefits/harms, or interpretation of evidence; legal considerations; economic reasons; ethical/ religious reasons.

Intentional vagueness
The list of items within the recommendation are provided as examples and are not exhaustive.

9.12 Exceptions

List situations or circumstances in which the Recommendation/Good Practice Point should not be applied.

Exceptions
None.

9.13 Recommendations for research

List any aspects of the question that require further research.

Recommendations for research
None.

Research question 10: What are the microbiological water testing requirements at commissioning?

Part A: Quality of evidence

10.1 How reliable is the body of evidence? (see SIGN 50, section 5.3.1, 5.3.4)

Comment here on the quantity of evidence available on this topic and its methodological quality. Please include citations and evidence levels.

If there is insufficient evidence to answer the key question, go to section B.

Comments	Evidence level
In total, six pieces of evidence were identified to answer this research question: • 2 guidance documents published by the British Standard Institution[114, 115] (including one code of practice[114]) (SIGN50 level 4), • 2 Scottish guidance documents, part of the Engineering SHTM 04-01 series on water safety. (SIGN50 level 4),[116, 117] • 1 British guidance document, part of the Department of Health, Health Technical Memorandum (HTM) 04-01 series on water safety (SIGN50 level 4),[118] • 1 Scottish incident report (SIGN50 level 4).[53] All six pieces were deemed to be expert opinions due to the lack of a rigorous search and/or methodology in developing the guidance. The small amount of evidence and the lack of high-quality evidence is a limiting factor and makes it challenging to answer this research question.	6x SIGN50 level 4

10.2 Is the evidence consistent in its conclusions? (see SIGN 50, section 5.3.2)

Comment here on the degree of consistency demonstrated by the evidence. Where there are conflicting results, indicate how the group formed a judgement as to the overall direction of the evidence.

Comments
There is consistency in the included evidence that water samples should be obtained at water system commissioning to ensure a safe handover of a newly constructed or refurbished water system from the contractor.[53, 114, 116-118] Scottish guidelines SHTM 04-01 (Water safety for healthcare premises, Part A) and the British Standard BS 7592:2022 state that the NHS board water safety group (WSG) should agree a sampling regime and appropriate parameters prior to tender, including microbiological, depending on the intended use of the system and vulnerability of the patients.[114, 118] No guideline/expert opinion mentions specific microbiological water testing requirements for commissioning. It is mentioned in SHTM 04-01 (Water safety for healthcare premises, Part A) that after disinfection (which is also part of the pre-commissioning process), microbiological tests for bacteria colony counts at 37°C and coliform bacteria, including *Escherichia coli*, should be carried out to confirm that the water is of potable quality.[116] None of the included evidence provides advice on testing beyond ensuring potability. There was inconsistent evidence regarding the timing for microbiological sampling following disinfection, which is typically carried out during/prior to commissioning. UK guidance (HTM 04-01 Part A)[118] recommends microbiological sampling no sooner than 48 hours after disinfection, but in the case of *Legionella* (SHTM 04-01 Part E)[117] it recommends a period of at least three days - and preferably five should be allowed for the system to settle prior to sampling activities commencing. The British Standards Institution PD 855468:2015 extends this period, stating that samples should be taken between two and seven days after disinfection to avoid false negative results.[115] In the case of *Legionella*, Scottish guidance indicates that

Comments
a period of three days – and preferably five – should be allowed following disinfection for the system to settle prior to sampling.[117]

10.3 Is the evidence applicable to Scottish health and care settings? (see SIGN 50, section 5.3.3)

For example, do the studies include interventions, comparators or outcomes that are common to Scottish health and care settings?

Comments
All evidence is Scottish or from the UK, so therefore fully applicable.

10.4 Are the studies generalisable to the target population?

Comment here on sample size and methods of sample selection. Is the sample representative of the specific population/group of interest? Generalisability is only relevant to primary research studies.

Comments
Not applicable as no primary studies were identified for this research question.

10.5 Are there concerns about publication bias? (see SIGN 50, section 5.3.5)

Comment here on whether there is a risk in the evidence base that studies have been selectively published based on their results (and thus a risk that results from published studies are systematically different from unpublished evidence).

Comments
Not applicable.

Part B: Evidence to decision

10.6 Recommendations

What Recommendations(s) or good practice point(s) does the Working Group agree are appropriate based on this evidence?

Note the following terminology:

- **"must"** implies that the health and care setting must implement the recommended approach and is used where a recommendation has been directly lifted from legislation or mandatory guidance
- **"should"** implies that the health and care setting "should" implement the recommended approach unless a clear and compelling rationale for an alternative approach is present
- **"should consider"** implies that the health and care setting should consider implementing the recommended approach

Recommendation	Grading
GPP10.1 A sampling regime with microbiological parameters should be agreed by the board water safety group (WSG) prior to tender. As a minimum it should include testing for TVCs, coliform bacteria (including *E. coli*) and *Legionella* spp. (all settings). Testing for *P. aeruginosa* should be conducted in (but not limited to) high-risk settings including haematology and oncology, bone marrow and stem cell transplant units, neonatal, paediatric and adult ICUs (including surgical), transplant and burns units). A risk assessment should be carried out to determine if there are additional testing requirements.	Good Practice Point
GPP10.2 Samples should be taken no sooner than five days and no later than seven days after a full disinfection process and another set of samples should	Good Practice Point

Recommendation	Grading
be taken immediately prior to handover. Accredited testing should be undertaken by an independent organisation.	

10.7 Balancing benefits and harms

Comment here on the potential impact of the Recommendation/Good Practice Point on service users, visitors and staff. Benefits and harms include considerations beyond IPC.

Benefits

List the favourable changes in outcome that would likely occur if the Recommendation/ Good Practice Point were followed correctly. Be explicit, clear about pros.

Benefits
For GPP10.1: • Clarity on sampling regime and appropriate microbiological parameters prior to tender. • Reduced risk of water system-associated infections. • Increased patient safety. For GPP10.2: • Potential reduction in failed tests (false negatives) due to possibility of remaining disinfectants between 0- and 5-days post disinfection process. • Potential reduction in delays between commissioning and handover.

Risks and Harms

List the adverse events or other unfavourable outcomes that may occur if the Recommendation/Good Practice Point were followed correctly. Be explicit, clear about cons.

Risks/Harms
There are no anticipated harms.

Benefit-Harm assessment

Classify as “benefits outweigh harms” (or vice versa) or a “balance of benefit and harm.” Description of this balance can be from the individual patient/ staff/ visitor perspective, the societal perspective, or both. Recommendations/ Good Practice Points are possible when clear benefit is not offset by important harms, costs or adverse events (or vice versa).

Benefit-Harm assessment
Benefits outweigh harms.

10.8 Feasibility

Is the Recommendation/Good Practice Point implementable in the Scottish context?

Describe (if applicable) financial implications, opportunity costs, material or human resource requirements, facility needs, sustainability issues, human factors etc., that may be associated with following a Recommendation/ Good Practice Point. State clearly if information on feasibility is lacking.

Feasibility
For GPP10.1, there may be financial implications due to material and human resource requirements to perform sampling. For GPP10.1 and GPP10.2, a lack of clarity on interpretation of commissioning sampling results may be a problem. Additional education and training may be required with associated financial and time implications.

10.9 Expert Opinion

Summarise the expert opinion used in creating the Recommendation/Good Practice Point; if none were involved, state “none”. Translating evidence into action often involves expert opinion where evidence is insufficient. Clearly outlining expert

opinion helps users understand their influence on interpreting objective evidence. Expert opinion may also be required where there is no evidence available.

Expert opinion
GPP10.1 Agreement of the sampling plan by the WSG has been put forward as a Good Practice Point as the WSG is the board governance route for water quality control; board responsibilities are defined in SHTM 04-01, part B: Operational management. It is ARHAI Scotland expert opinion that this should allow local groups to determine the appropriate type of sampling to be undertaken based on the size and complexity of the project whilst factoring in the patient susceptibility. GPP10.2 Expert opinion from Health Facilities Scotland explained that the reasoning for the five-day waiting period prior to undertaking testing following disinfection is to allow sufficient time for the residual chemicals to be flushed away or become inactive. This will allow sampling to determine if the completed disinfection process was successful or if there is another source of contamination. Waiting for too long (more than a week) before sampling after disinfection will make it hard to track back any system failure with regards to contamination. The reference to the use of an 'independent organisation' to undertake the testing means that this should not be an NHS laboratory owned by the board.

10.10 Value judgements

Summarise value judgements used by the Working Group in creating the Recommendation/ Good Practice Point; if none were involved, state "none". Translating evidence into action often involves value judgements, which include guiding principles, ethical considerations, or other beliefs and priorities. Stating them clearly helps users understand their influence on interpreting objective evidence.

Value judgements
None.

10.11 Intentional vagueness

State reasons for any intentional vagueness in the Recommendation/Good Practice Point; if none was intended, state “none”. Recommendations/Good Practice Points should be clear and specific, but if there is a decision to be vague, acknowledging the reasoning clearly promotes transparency. Reasons for vagueness may include inadequate evidence; inability to achieve consensus regarding evidence quality, anticipated benefits/harms, or interpretation of evidence; legal considerations; economic reasons; ethical/ religious reasons.

Intentional vagueness
None.

10.12 Exceptions

List situations or circumstances in which the Recommendation/Good Practice Point should not be applied.

Exceptions
None.

10.13 Recommendations for research

List any aspects of the question that require further research.

Recommendations for research
Further research to inform more comprehensive guidance on testing at commissioning would be beneficial.

Research question 11: What are the responsibilities of the IPC team in regards to water safety at commissioning?

Part A: Quality of evidence

11.1 How reliable is the body of evidence? (see SIGN50, section 5.3.1, 5.3.4)

Comment here on the quantity of evidence available on this topic and its methodological quality. Please include citations and evidence levels.

If there is insufficient evidence to answer the key question, go to section B.

Comments	Evidence level
In total, six pieces of evidence were identified in relation to this research question: • 3 Scottish guidance (SIGN50 level 4),[101, 119, 120] • 2 British Standards (SIGN50 level 4),[121, 122] • 1 Scottish incident report (SIGN50 level 4).[53] All six pieces were deemed to be expert opinions due to the lack of a rigorous search and/or methodology in developing the guidance. The lack of high quality evidence is a limiting factor for this research question. Expert opinion is required.	6x SIGN50 level 4

11.2 Is the evidence consistent in its conclusions? (see SIGN50, section 5.3.2)

Comment here on the degree of consistency demonstrated by the evidence. Where there are conflicting results, indicate how the group formed a judgement as to the overall direction of the evidence.

Comments
Commissioning:

Comments

- In general, there is a lack of detail in extant guidance regarding the specific roles and responsibilities expected of the IPC team at commissioning. The Scottish Health Facilities note (SHFN 30) describe that upon completion of the construction, test results and the water system should be signed off at commissioning by a multidisciplinary team.[119]
- Involvement of the IPC team is only mentioned in SHTM 04-01 Part A minimally in relation to design of water supply for specialised systems such as endoscope cleaning installations and dialysis units, where it states that the designer should consult the hospital infection prevention and control (IPC) team.[116] The guidance also states that the water system should not be brought into service until the IPC team certifies that the water is of potable quality.

General:

- There is consensus in four expert opinion guidance documents that IPC teams should be represented in WSGs within NHS boards who commission and develop a Water Safety Plan (WSP) as outlined in SHTM 04-01 and BS 8680 which includes a risk assessment and actions to mitigate risks.[101, 119, 121]
- The British Standard (BS 8580-2:2022) also mentions the input of IPC teams during the development of a risk assessment to identify the types and location of healthcare water system associated infections which could be linked to water exposure and for assessment of surveillance practices.[122]

11.3 Is the evidence applicable to Scottish health and care settings? (see SIGN50, section 5.3.3)

For example, do the studies include interventions, comparators or outcomes that are common to Scottish health and care settings?

Comments
All pieces of evidence derived from the UK. Three are Scottish guidance,[101, 119, 120] one is an incident report[53] from an outbreak in Scotland and the other two pieces are from the UK.[121, 122] Therefore, all is applicable to Scotland.

11.4 Are the studies generalisable to the target population?

Comment here on sample size and methods of sample selection. Is the sample representative of the specific population/group of interest? Generalisability is only relevant to primary research studies.

Comments
N/A - no primary studies were identified for this research question.

11.5 Are there concerns about publication bias? (see SIGN50, section 5.3.5)

Comment here on whether there is a risk in the evidence base that studies have been selectively published based on their results (and thus a risk that results from published studies are systematically different from unpublished evidence).

Comments
N/A

Part B: Evidence to decision

11.6 Recommendations

What Recommendations(s) or good practice point(s) does the Working Group agree are appropriate based on this evidence?

Note the following terminology:

- **"must"** implies that the health and care setting must implement the recommended approach and is used where a recommendation has been directly lifted from legislation or mandatory guidance

- **"should"** implies that the health and care setting "should" implement the recommended approach unless a clear and compelling rationale for an alternative approach is present
- **"should consider"** implies that the health and care setting should consider implementing the recommended approach

Recommendation	Grading
GPP11.1 The IPC team should be represented at WSGs within NHS boards and have ongoing input throughout the building process including during commissioning, the development of risk assessments, the water safety plan and involvement with the HAI-SCRIBE process.	Good Practice Point
GPP11.2 IPC teams should be involved from the outset in the design and planning process and engaged through to commissioning in order to ensure IPC input and oversight of IPC risk.	Good Practice Point
GPP11.3 The WSG should confirm the water is of potable quality and meets other minimum testing requirements (for example around *Pseudomonas* spp. or *Legionella* spp.) with clinical and microbiological oversight from the ICD/microbiologist who is a member of the WSG.	Good Practice Point

11.7 Balancing benefits and harms

Comment here on the potential impact of the Recommendation/Good Practice Point on service users, visitors and staff. Benefits and harms include considerations beyond IPC.

Benefits

List the favourable changes in outcome that would likely occur if the Recommendation/ Good Practice Point were followed correctly. Be explicit, clear about pros.

Benefits
• GPP11.1, GPP11.2 IPC team participation and oversight on water safety during commissioning process. • GPP11.1, GPP11.2, GPP11.3 Identification of HAI risks in advance of clinical occupation during the commissioning stage. • GPP11.1, GPP11.2, GPP11.3 There is a reduced likelihood that water system-associated infection risks are being designed in or remain prior to clinical occupation. • GPP11.1, GPP11.2, GPP11.3 The project multidisciplinary (MD) team's decision-making ability is informed and enhanced by inclusion of the IPC team.

Risks and Harms

List the adverse events or other unfavourable outcomes that may occur if the Recommendation/ Good Practice Point were followed correctly. Be explicit, clear about cons.

Risks/Harms
No harms identified.

Benefit-Harm assessment

Classify as “benefits outweigh harms” (or vice versa) or a “balance of benefit and harm.” Description of this balance can be from the individual patient/staff/visitor perspective, the societal perspective, or both. Recommendations/ Good Practice Points are possible when clear benefit is not offset by important harms, costs or adverse events (or vice versa).

Benefit-Harm assessment
Only benefits identified.

11.8 Feasibility

Is the Recommendation/ Good Practice Point implementable in the Scottish context?

Describe (if applicable) financial implications, opportunity costs, material or human resource requirements, facility needs, sustainability issues, human factors etc., that may be associated with following a Recommendation/ Good Practice Point. State clearly if information on feasibility is lacking.

Feasibility
• GPP11.1, GPP11.2 The provision of ongoing IPC input to the WSG and construction projects might result in a reduction of IPC staff resource for clinical duties/competing demands. • GPP11.1, GPP11.2 There may be additional education and developmental requirements for IPC staff to gain the required skillset and experience.

11.9 Expert Opinion

Summarise the expert opinion used in creating the Recommendation/ Good Practice Point; if none were involved, state “none”. Translating evidence into action often involves expert opinion where evidence is insufficient. Clearly outlining expert opinion helps users understand their influence on interpreting objective evidence. Expert opinion may also be required where there is no evidence available.

Expert opinion
GPP11.1 ARHAI Scotland support extant expert opinion guidance (from the British Standards Institution and Scotland) that IPC teams should be represented in WSGs and therefore provide input during commissioning, the development of risk assessments, the water safety plan and involvement with the HAI-SCRIBE process.[101, 119, 121] It is ARHAI Scotland expert opinion that this should be throughout the building process. GPP11.2 In addition to the minimal mention of the IPC team in extant guidance, expert feedback and lessons from the NHS Assure NDAP and KSAR teams is that IPC team should be involved in all stages of the design of the water system

Expert opinion
inclusive of commissioning. A good practice point has been developed to take account of this. GPP11.3 ARHAI Scotland support extant expert opinion guidance (from Scotland, SHTM 04-01 part A) that the water system should not be brought into service until it is certified that the water is of potable quality. This guidance mentions the responsibility of the IPC team; however, it is ARHAI Scotland opinion that the WSG should confirm the water is of potable quality with oversight from the ICD/microbiologist who is a member of the WSG.[116] This also includes confirmation of other minimum testing requirements such as *Pseudomonas* spp. or *Legionella* spp. Therefore, a good practice point has been developed.

11.10 Value judgements

Summarise value judgements used by the Working Group in creating the Recommendation/ Good Practice Point; if none were involved, state “none”. Translating evidence into action often involves value judgements, which include guiding principles, ethical considerations, or other beliefs and priorities. Stating them clearly helps users understand their influence on interpreting objective evidence.

Value judgements
None.

11.11 Intentional vagueness

State reasons for any intentional vagueness in the Recommendation/Good Practice Point; if none was intended, state “none”. Recommendations/Good Practice Points should be clear and specific, but if there is a decision to be vague, acknowledging the reasoning clearly promotes transparency. Reasons for vagueness may include inadequate evidence; inability to achieve consensus regarding evidence quality, anticipated benefits/harms, or interpretation of evidence; legal considerations; economic reasons; ethical/ religious reasons.

Intentional vagueness
Current literature/guidance is not comprehensive regarding specific roles and responsibilities of the IPC team at commissioning.

11.12 Exceptions

List situations or circumstances in which the Recommendation/ Good Practice Point should not be applied.

Exceptions
None.

11.13 Recommendations for research

List any aspects of the question that require further research.

Recommendations for research
More detailed guidance regarding the specific roles and responsibilities of the IPC team and other relevant stakeholders at commissioning is needed.

Research question 12: Is routine water testing to detect healthcare water system-associated organisms recommended?

Part A: Quality of evidence

12.1 How reliable is the body of evidence? (see SIGN50, section 5.3.1, 5.3.4)

Comment here on the quantity of evidence available on this topic and its methodological quality. Please include citations and evidence levels.

If there is insufficient evidence to answer the key question, go to section B.

Comments	Evidence level
In total, 15 pieces of evidence were identified in relation to this research question which includes: • 3 guidance documents published by the British Standards Institution (SIGN50 level 4),[105, 114, 122] • 2 Scottish Heath Technical Memorandums (SIGN50 level 4),[101, 123] • 5 guidance documents that were classed as expert opinion (including two derived from Scotland, three from England, one from the Republic of Ireland, one WHO guidance document and one CDC guidance document) (SIGN50 level 4),[95, 102, 112, 113, 124-127] • 1 outbreak study (SIGN50 level 3),[54] • 1 evidence-based guidelines (Healthcare Infection Society (HIS) Working Party guidelines) (AGREE 'Recommend').[95, 128] The low quality of evidence is a general limitation of the included evidence (out of the 15 studies included, 13 are	1x AGREE: Recommend 1x SIGN50 level 3 13x SIGN50 level 4

Comments	Evidence level
level 4 and one is level 3). Most of the included guidance documents are classed as expert opinion due to their limited methodology and/or lack of a rigorous search of evidence. The CDC guidelines included are mostly based on studies published pre-2000 and therefore might not reflect current IPC practices and the associated risks.	

12.2 Is the evidence consistent in its conclusions? (see SIGN50, section 5.3.2)

Comment here on the degree of consistency demonstrated by the evidence. Where there are conflicting results, indicate how the group formed a judgement as to the overall direction of the evidence.

Comments
Routine water testing: • There is consistency on not needing routine water testing unless there is a higher risk present for (vulnerable) patients, which is described in guidance and international guidelines for *Legionella* spp.[95, 101, 102, 105, 114, 125, 126] and *Pseudomonas aeruginosa.*[124] • Two British Standards (BS8580-1 and BS8580-2) describe that routine water testing out with augmented care and for organisms other than *Legionella* and *P. aeruginosa* (for example NTMs) should be decided per risk assessment.[105, 122] BS8580-1 advises that 'if standard methods are not available e.g. for unusual waterborne opportunistic pathogens, input should be sought from expert microbiologists from national reference laboratories'. • The CDC guidelines mention that environmental surveillance involving periodic culturing of water samples from the hospital's potable water system can be an advantage as this is less costly than routine lab diagnostic testing for all patients who have healthcare associated pneumonia.[95]

Comments
Equipment • Three guidance documents describe water testing of specific equipment that use water (not from the hot and cold distribution system and thus not tested routinely) which includes heater cooler units (HCUs) and endoscopy rinse water.[112, 113, 124] • The recommendations from HIS Working Party guidelines, guidance from Public Health England and the Republic of Ireland guidance extend to include water used for renal dialysis and hydrotherapy pool water.[124, 127, 128] TVC levels: • Three guidance documents are consistent in advising that monitoring TVC levels could provide an early warning sign for possible problems with the water quality.[101, 105, 123] The benefit of this in practice is evidenced in one outbreak study where routine TVC testing resulted in timely recognition of elevated TVC levels and minimised the clinical impact of the outbreak.[54] • The HTM 04-01 does not recommend routine TVC testing unless there is a smell or odour problem[126] and other guidance do not mention TVC levels.

12.3 Is the evidence applicable to Scottish health and care settings? (see SIGN50, section 5.3.3)

For example, do the studies include interventions, comparators or outcomes that are common to Scottish health and care settings?

Comments
International and UK studies included but all from developed countries findings/conclusions are applicable for Scotland. The evidence includes four Scottish guidance documents and one Scottish outbreak study.[54, 101, 112, 113, 123] Six guidance documents are derived from England/UK (including three UK codes of practice), one from Republic of Ireland and three from the US.[95, 102, 124-127] The guidelines scored as AGREE: 'Recommend' were from the UK.[128]

12.4 Are the studies generalisable to the target population?

Comment here on sample size and methods of sample selection. Is the sample representative of the specific population/group of interest? Generalisability is only relevant to primary research studies.

Comments
Not applicable as the included primary evidence was an outbreak study and thus observational (uncontrolled).[54]

12.5 Are there concerns about publication bias? (see SIGN50, section 5.3.5)

Comment here on whether there is a risk in the evidence base that studies have been selectively published based on their results (and thus a risk that results from published studies are systematically different from unpublished evidence).

Comments
Yes – although most references used here are guidance documents, there is only one outbreak study identified that mentions TVC/routine testing. There is a risk of publication bias since not all outbreaks/incidents are published in scientific journals and there might be an underestimation of the degree of routine water testing and the impact it has had on clinical outcomes.

Part B: Evidence to decision

12.6 Recommendations

What Recommendations(s) or good practice point(s) does the Working Group agree are appropriate based on this evidence?

Note the following terminology:

- **"must"** implies that the health and care setting must implement the recommended approach and is used where a recommendation has been directly lifted from legislation or mandatory guidance

- **“should”** implies that the health and care setting “should” implement the recommended approach unless a clear and compelling rationale for an alternative approach is present
- **“should consider”** implies that the health and care setting should consider implementing the recommended approach

Recommendation	Grading
R12.1 Routine water testing should be undertaken for *P. aeruginosa* and *Legionella* spp. in high-risk units.	Recommendation
GPP12.1 A risk assessment according to BS 8580-1 and BS 8580-2 should be undertaken to determine the need for routine water testing in other care areas and testing for organisms other than *P. aeruginosa* and *Legionella* spp.	Good Practice Point
GPP12.2 Routine total viable count (TVC) testing could be considered to monitor water quality and only if trend analysis is performed.	Good Practice Point
GPP12.3 Equipment and/or medical procedures that use water that is separate from the main hot and cold water distribution system should be routinely tested in line with relevant guidance/manufacturer’s instructions which includes water for heater cooler units, endoscopy rinse water, water used for renal dialysis and hydrotherapy pool water.	Good Practice Point
GPP12.4 The WSG should have sight of routine testing results of water used in procedures (for example heater cooler units, endoscopy rinse water, water used for renal dialysis and hydrotherapy pool water).	Good Practice Point

Recommendation	Grading
GPP12.5 Where no UKAS accreditation exists for specific healthcare water system-associated organisms, boards should still consider testing and can seek advice from ARHAI Scotland.	Good Practice Point

12.7 Balancing benefits and harms

Comment here on the potential impact of the Recommendation/Good Practice Point on service users, visitors and staff. Benefits and harms include considerations beyond IPC.

Benefits

List the favourable changes in outcome that would likely occur if the Recommendation/ Good Practice Point were followed correctly. Be explicit, clear about pros.

Benefits
• R12.1, GPP12.2, GPP12.3, GPP2.5 History of water test results improves knowledge of the water system, provides a timeline of events, and assists in the identification of trends and the interpretation of risk. • R12.1, GPP12.2, GPP12.3, GPP12.5 Regular sampling may increase confidence and provide assurance around the board water safety plan and is indicative of current water quality. • R12.1, GPP12.2, GPP12.3, GPP12.5 Regular sampling enables identification of developing water safety risks and potentially increases service user safety. • GPP12.4 Sight of test results by the WSG provides assurance for water safety within NHSScotland healthcare facilities.

Risks and Harms

List the adverse events or other unfavourable outcomes that may occur if the Recommendation/ Good Practice Point were followed correctly. Be explicit, clear about cons.

Risks/Harms
None identified.

Benefit-Harm assessment

Classify as “benefits outweigh harms” (or vice versa) or a “balance of benefit and harm.” Description of this balance can be from the individual patient/ staff/ visitor perspective, the societal perspective, or both. Recommendations/ Good Practice Points are possible when clear benefit is not offset by important harms, costs or adverse events (or vice versa).

Benefit-Harm assessment
Only benefits identified.

12.8 Feasibility

Is the Recommendation/ Good Practice Point implementable in the Scottish context?

Describe (if applicable) financial implications, opportunity costs, material or human resource requirements, facility needs, sustainability issues, human factors etc., that may be associated with following a Recommendation/ Good Practice Point. State clearly if information on feasibility is lacking.

Feasibility
• R12.1, GPP12.2, GPP12.3, GPP12.5 There may be financial implications due to material and human resource requirements to perform sampling. • R12.1, GPP12.2, GPP12.3, GPP12.5 There may be resource and financial implications in relation to staff education on how to perform sampling and its interpretation.

Feasibility
• R12.1, GPP12.2, GPP12.3, GPP12.5 There may not be standard UKAS-accredited tests available for all organisms. • GPP12.2 TVC trend analysis is dependent on there being a sufficient number of samples available over time to analyse. • GPP12.4 The provision of sight of the water test results might result in additional demands on staff resource.

12.9 Expert Opinion

Summarise the expert opinion used in creating the Recommendation/Good Practice Point; if none were involved, state “none”. Translating evidence into action often involves expert opinion where evidence is insufficient. Clearly outlining expert opinion helps users understand their influence on interpreting objective evidence. Expert opinion may also be required where there is no evidence available.

Expert opinion
R12.1 The evidence is sufficient to support this recommendation, no expert opinion to note. GPP12.1 ARHAI Scotland support extant expert opinion guidance (from the British Standards Institution) that a risk assessment should be undertaken to determine the need for routine water testing in other care areas or testing for organisms other than those mentioned in GPP12.1.[105, 122] GPP12.2 ARHAI Scotland support extant expert opinion guidance (from the British Standards Institution, UK and Scotland) that routine TVC testing can be useful to indicate deteriorating water quality.[101, 105, 123, 126] However, it is not a direct indicator of the presence or absence of pathogenic microorganisms. Expert opinion from stakeholders during consultation mentioned that trend analysis is essential when undertaking routine TVC samples and ARHAI Scotland share this opinion. TVC testing can be valuable, but only when it is not taken in isolation and taken from fixed locations to ensure consistency. It is essential to have knowledge of previous results to have a clear understanding of when results are deviating from the norm. Therefore, a good practice point has been developed.

Expert opinion

GPP12.3 ARHAI Scotland support extant expert opinion guidance (from the UK) that equipment and/or medical procedures that use water that is separate from the main hot and cold water distribution system (including water for heater cooler units, endoscopy rinse water, water used for renal dialysis and hydrotherapy pool water) should be routinely tested. It is ARHAI Scotland expert opinion that this depends on the equipment/procedure and thus should be in line with relevant guidance/manufacturer's instructions.

GPP12.4 It is the opinion of ARHAI Scotland that the WSG should have sight of routine testing results of water used in procedures to be able to have general oversight of water safety as described in SHTM 04-01 part B operational management.[101]

GPP12.4 Since there may not be standard UKAS-accredited tests available for all healthcare water system-associated organisms, a good practice point has been developed to make boards aware that this does not preclude testing. Boards who do not feel they have relevant expertise to undertake testing can seek advice from ARHAI Scotland.

GPP12.5 It is the joint opinion of ARHAI Scotland and UKAS that the lack of UKAS accreditation for a specific test does not preclude laboratories from processing such samples.[129] There is significant ongoing risk to patients if sources during outbreaks are not detected and mitigated against. Such specimens can be processed provided the laboratory states on the report that the test is not UKAS accredited. The lack of accreditation for required methods should not limit the laboratory's overall capability to respond to customer needs.

12.10 Value judgements

Summarise value judgements used by the Working Group in creating the Recommendation/Good Practice Point; if none were involved, state "none". Translating evidence into action often involves value judgements, which include guiding principles, ethical considerations, or other beliefs and priorities. Stating them clearly helps users understand their influence on interpreting objective evidence.

Value judgements
None.

12.11 Intentional vagueness

State reasons for any intentional vagueness in the Recommendation/Good Practice Point; if none was intended, state “none”. Recommendations/Good Practice Points should be clear and specific, but if there is a decision to be vague, acknowledging the reasoning clearly promotes transparency. Reasons for vagueness may include inadequate evidence; inability to achieve consensus regarding evidence quality, anticipated benefits/harms, or interpretation of evidence; legal considerations; economic reasons; ethical/ religious reasons.

Intentional vagueness
12.GPP1 Performing trend analysis and what this entails has not been established in literature for TVC testing. More research is needed regarding this, see “Recommendations for research”. 12.GPP4 Not all evidence (guidance documents) advises testing of the same water equipment/environmental reservoirs, but in general they recommend testing water that is used in patient care procedures that use water separately from the main hot and cold water distribution system. These include but is not limited to water for heater cooler units, endoscopy rinse water, water used for renal dialysis and hydrotherapy pool water.

12.12 Exceptions

List situations or circumstances in which the Recommendation/ Good Practice Point should not be applied.

Exceptions
None.

12.13 Recommendations for research

List any aspects of the question that require further research.

Recommendations for research
Further research, for example a pilot study in an NHSScotland healthcare facility, would be valuable to create a baseline for TVC testing. Regular TVC reads should be collected and interpreted and this could lead into a new piece of guidance that includes the frequency, number of samples needed, sample locations etc.

Research question 13: What are the recommended microbiological limits for healthcare water system-associated organisms?

Part A: Quality of evidence

13.1 How reliable is the body of evidence? (see SIGN50, section 5.3.1, 5.3.4)

Comment here on the quantity of evidence available on this topic and its methodological quality. Please include citations and evidence levels.

If there is insufficient evidence to answer the key question, go to section B.

Comments	Evidence level
In total, 19 pieces of evidence were identified in relation to this research question which includes: • 7 Scottish guidance documents (SIGN50 level 4),[101, 106, 112, 113, 116, 123, 130] • 3 English guidance documents (SIGN50 level 4),[125, 127, 131] • 4 British standards (SIGN50 level 4),[105, 115, 122, 132] • 1 mandatory Scottish legislation (Mandatory),[133] • 1 Republic of Ireland guidance document (SIGN50 level 4),[124] • 1 international guidance document (SIGN50 level 4),[102] • 1 UK guidelines (AGREE: 'Recommend'),[128] • 1 outbreak study (SIGN50 level 3).[54]	1x Mandatory 1x AGREE: Recommend 1x SIGN50 level 3 16x SIGN50 level 4

13.2 Is the evidence consistent in its conclusions? (see SIGN50, section 5.3.2)

Comment here on the degree of consistency demonstrated by the evidence. Where there are conflicting results, indicate how the group formed a judgement as to the overall direction of the evidence.

Comments
Hot and cold water systems • Five evidence sources provide detail regarding TVC testing limits. For hot and cold water systems, SHTM04-01 Parts B[101] and C[123] and the British Standard Code of Practice BS 8554:2015[132] infer that trend analysis is required should TVC testing be conducted, whereby elevated levels would trigger investigation. The mandatory Public Water Supplies (Scotland) Regulations state that water should have 'no abnormal change' for TVCs at 22°C and 37°C.[133] The use of abnormal change (an elevation) as an indicator is also described in an outbreak study.[54] The British Standards guide PD 855468:2015 provides a measurable limit; TVC results in excess of a 2 log difference above that found in incoming water.[115] • Where water is being tested for 'potability', two guidance documents (Republic of Ireland HPSC and Public Health England (PHE) microbiological guidelines for healthcare)[124, 127] and the mandatory Public Water Supplies (Scotland) Regulations[133] are consistent that water must have the following microbiological limits: ○ 0 colony forming units (cfu)/100 ml for Enterococci ○ 0 cfu/100 ml Coliform bacteria (including *Escherichia coli*) ○ No abnormal change for TVCs • Seven guidance documents describe the microbiological limits for *Legionella* spp. including the microbiological limits for high-risk units.[101, 102, 106, 123, 125, 127, 131] There is consistency in Scottish and English guidance that the microbiological limits for *Legionella* spp. in healthcare facility hot and cold water systems should be no greater than 100 cfu/litre.[101, 106, 123, 125, 127, 131] WHO and English guidelines advise a limit of 0 cfu/litre in high-risk areas

Comments

such as transplant units and ICUs in order to protect susceptible patients.[102, 125, 131]

- Two guidance documents (Republic of Ireland HPSC guidance, and PHE microbiological guidelines for healthcare) describe the microbiological limits for *Pseudomonas* spp.; 0 cfu/100ml in high-risk settings.[124, 127]
- Two British Standards (BS 8580-2:2022, and BS 8580-1:2019)[105, 122] advise risk assessment for determining acceptable limits for other locations (those that are not high-risk settings/units).

Limits for high-risk procedures

- Six guidance documents (5x SIGN50, 1 AGREE 'Recommend') describe additional microbiological limits for high-risk procedures including heater cooler unit (HCU) water, hydrotherapy water, endoscopy final rinse water, final rinse water in surgical instrument washer disinfectors and renal dialysis fluid/water).[112, 113, 124, 127, 128, 130]
- The limits stated are for endotoxin levels to measure the presence of gram-negative bacteria (<0.25 EU/ml in endoscopy and surgical instrument washer disinfector final rinse water and <0.125 EU/ml in renal dialysis fluid/water), TVC levels (<100 cfu/100 ml in HCU waters, <50 cfu/ml in renal dialysis fluid/water, <10 cfu/ml in hydrotherapy water, <10 cfu/100 ml in endoscopy final rinse water and <1 cfu/100 ml in final rinse water in surgical instrument washer disinfectors) *Mycobacterium* spp. (0 cfu/100 ml for HCU water and endoscopy final rinse water),[112, 124, 127, 128, 130] <20 cfu/litre *Legionella* spp. and 0 cfu/100 ml *Staphylococcus aureus* (hydrotherapy water).[124, 127] The latter only requiring measurement as part of wider investigations. The limits provided across guidance were consistent.

For organisms other than *Legionella* spp., *Pseudomonas* spp., coliform bacteria, enterococci, *Staphylococcus aureus* and *Mycobacterium* spp. there was no evidence identified regarding their microbiological limits.

13.3 Is the evidence applicable to Scottish health and care settings? (see SIGN50, section 5.3.3)

For example, do the studies include interventions, comparators or outcomes that are common to Scottish health and care settings?

Comments
The majority of evidence is Scottish (9x) [54, 101, 106, 112, 113, 116, 123, 130, 133] or are derived from the British Standards Institution (4x).[105, 115, 122, 132] Other guidance, which is also deemed expert opinion, are derived from England (3x),[126] Republic of Ireland (1x)[124] and one guidance is from the World Health Organization.[102] The guidelines are from the UK.[128] All are applicable to Scotland.

13.4 Are the studies generalisable to the target population?

Comment here on sample size and methods of sample selection. Is the sample representative of the specific population/group of interest? Generalisability is only relevant to primary research studies.

Comments
Not applicable as the included primary evidence was an outbreak study and thus observational (uncontrolled).[54]

13.5 Are there concerns about publication bias? (see SIGN50, section 5.3.5)

Comment here on whether there is a risk in the evidence base that studies have been selectively published based on their results (and thus a risk that results from published studies are systematically different from unpublished evidence).

Comments
Most references used here are guidance documents which were retrieved via a grey literature search on the internet and it might be possible that some guidance documents have been missed unintentionally. Moreover, there is only one outbreak study identified that mentions TVC/routine testing and the used

Comments
microbiological limits. There is a risk of publication bias since not all outbreaks/incidents are published in scientific journals.

Part B: Evidence to decision

13.6 Recommendations

What Recommendations(s) or good practice point(s) does the Working Group agree are appropriate based on this evidence?

Note the following terminology:

- **"must"** implies that the health and care setting must implement the recommended approach and is used where a recommendation has been directly lifted from legislation or mandatory guidance
- **"should"** implies that the health and care setting "should" implement the recommended approach unless a clear and compelling rationale for an alternative approach is present
- **"should consider"** implies that the health and care setting should consider implementing the recommended approach

Recommendation	Grading
R13.1 The following microbiological limits are recommended for all water system testing in healthcare facilities: • Coliform bacteria (incl. *Escherichia coli*): 0 cfu/100 ml; • Enterococci: 0 cfu/100 ml; • *P. aeruginosa*: 0 cfu/100 ml; • *Legionella* spp.: <100 cfu/litre in non-high-risk units and undetectable in high-risk units and procedures.	Recommendation

Recommendation	Grading

GPP13.1 The following additional microbiological limits are recommended for healthcare procedures that present an increased risk:
 	
• Heater cooler unit water
  ○ 0 cfu/100ml for *Mycobacterium* spp.
  ○ TVC cut-off levels of <100 cfu/100 ml
• Hydrotherapy water
  ○ <20 cfu/litre for *Legionella* spp.
  ○ 0 cfu/100 ml for *Staphylococcus aureus* as part of wider investigations only (local decision)
  ○ TVC cut-off levels of <10 cfu/ml
• Endoscopy final rinse water
  ○ 0 cfu/100ml for *Mycobacterium* spp.
  ○ TVC cut-off levels of <10 cfu/100 ml
  ○ Endotoxin limit of <0.25 EU/ml
• Final rinse water in surgical instrument washer disinfectors
  ○ TVC cut-off levels of <1 cfu/100 ml
  ○ Endotoxin limit of <0.25 EU/ml
• Renal dialysis fluid and water
  ○ TVC cut-off levels of <50 cfu/ml
  ○ Endotoxin limit of <0.125 EU/ml
	Good Practice Point

GPP13.2 The microbiological limit for *Legionella pneumophila* serogroup 1 (Lp1) should be undetectable for all water system testing in healthcare facilities.	Good Practice Point
GPP13.3 For gram-negative healthcare water system-associated organisms other than those mentioned in R13.1, GPP13.1 and GPP13.2, microbiological limits	Good Practice Point

Recommendation	Grading
and actions should be the same as those for *Pseudomonas* spp. (0 cfu/100 ml).	

13.7 Balancing benefits and harms

Comment here on the potential impact of the Recommendation/Good Practice Point on service users, visitors and staff. Benefits and harms include considerations beyond IPC.

Benefits

List the favourable changes in outcome that would likely occur if the Recommendation/ Good Practice Point were followed correctly. Be explicit, clear about pros.

Benefits
• R13.1, GPP13.1, GPP13.2, GPP13.3 Clarity on microbiological limits will aid interpretation of water test results and indicates when actions need to be taken. • R13.1, GPP13.1, GPP13.2, GPP13.3 The microbiological limits will be the indicator for actions, which in turn will reduce the risk of environmental contamination of water system and outlets and could lead to a reduced risk of water system-associated nosocomial infections. • R13.1, GPP13.1, GPP13.2, GPP13.3 Increased service user safety is anticipated.

Risks and Harms

List the adverse events or other unfavourable outcomes that may occur if the Recommendation/ Good Practice Point were followed correctly. Be explicit, clear about cons.

Risks/Harms
No risks identified.

Benefit-Harm assessment

Classify as “benefits outweigh harms” (or vice versa) or a “balance of benefit and harm.” Description of this balance can be from the individual patient/ staff/ visitor perspective, the societal perspective, or both. Recommendations/Good Practice Points are possible when clear benefit is not offset by important harms, costs or adverse events (or vice versa).

Benefit-Harm assessment
Only benefits identified.

13.8 Feasibility

Is the Recommendation/Good Practice Point implementable in the Scottish context? Describe (if applicable) financial implications, opportunity costs, material or human resource requirements, facility needs, sustainability issues, human factors etc., that may be associated with following a Recommendation/Good Practice Point. State clearly if information on feasibility is lacking.

Feasibility
• R13.1, GPP13.1, GPP13.2, GPP13.3 There may be resource and financial implications in relation to staff education, and costs related to carrying out the laboratory testing whether in-house or provided by an external provider. • R13.1, GPP13.1 There may not be standard UKAS-accredited tests available for all organisms. However, it is the joint opinion of ARHAI Scotland and UKAS that the lack of UKAS accreditation for a specific test does not preclude laboratories from processing such samples.[129] There is significant ongoing risk to patients if sources during outbreaks are not detected and mitigated against. Such specimens can be processed provided the laboratory states on the report that the test is not UKAS accredited. The

Feasibility
lack of accreditation for required methods should not limit the laboratory's overall capability to respond to customer needs.

13.9 Expert Opinion

Summarise the expert opinion used in creating the Recommendation/ Good Practice Point; if none were involved, state "none". Translating evidence into action often involves expert opinion where evidence is insufficient. Clearly outlining expert opinion helps users understand their influence on interpreting objective evidence. Expert opinion may also be required where there is no evidence available.

Expert opinion
R13.1 The evidence is sufficient to support this recommendation, no expert opinion to note.
GPP13.1 ARHAI Scotland support extant expert opinion guidance and one AGREE 'Recommend' guideline (from the Republic of Ireland HPSC, Scotland and UK) describing the microbiological limits for healthcare procedures that present an increased risk which includes HCU water, hydrotherapy water, endoscopy final rinse water, final rinse water in surgical instrument washer disinfectors and renal dialysis fluid/water. [112, 113, 124, 127, 128, 130]
GPP13.2 It is ARHAI Scotland expert opinion that the microbiological limits for *Legionella pneumophila* serogroup 1 (Lp1) should be 0 cfu/litre for all water system testing in healthcare facilities. This because Lp1 is responsible for most human infections compared to the other serogroups hence requiring a lower detection (0 cfu/litre or 'undetectable')
GPP13.3 No evidence is available regarding microbiological limits of organisms other than those described above. In practice, guidance has been followed for *Pseudomonas* spp. when dealing with suspected outbreaks involving other gram-negative healthcare water system-associated organisms as these organisms present a similar level of risk as detailed in BS 8580-2:2022 (Part 2: risk assessments for *Pseudomonas aeruginosa* and other waterborne pathogens – code of practice). It is therefore ARHAI Scotland expert opinion that the

Expert opinion
microbiological limits and the following actions for these organisms should be the same as those for *Pseudomonas* spp. (0 cfu/100 ml).

13.10 Value judgements

Summarise value judgements used by the Working Group in creating the Recommendation/ Good Practice Point; if none were involved, state “none”. Translating evidence into action often involves value judgements, which include guiding principles, ethical considerations, or other beliefs and priorities. Stating them clearly helps users understand their influence on interpreting objective evidence.

Value judgements
None.

13.11 Intentional vagueness

State reasons for any intentional vagueness in the Recommendation/Good Practice Point; if none was intended, state “none”. Recommendations/Good Practice Points should be clear and specific, but if there is a decision to be vague, acknowledging the reasoning clearly promotes transparency. Reasons for vagueness may include inadequate evidence; inability to achieve consensus regarding evidence quality, anticipated benefits/harms, or interpretation of evidence; legal considerations; economic reasons; ethical/ religious reasons.

Intentional vagueness
None.

13.12 Exceptions

List situations or circumstances in which the Recommendation/Good Practice Point should not be applied.

Exceptions
None.

13.13 Recommendations for research

List any aspects of the question that require further research.

Recommendations for research
It would be beneficial if SOPs/standardised UKAS accredited tests are developed for other healthcare water system-associated organisms.

Research question 14: How frequently should routine water testing be conducted?

Part A: Quality of evidence

14.1 How reliable is the body of evidence? (see SIGN50, section 5.3.1, 5.3.4)

Comment here on the quantity of evidence available on this topic and its methodological quality. Please include citations and evidence levels.

If there is insufficient evidence to answer the key question, go to section B.

Comments	Evidence level
In total, 10 pieces of evidence were identified in relation to this research question which includes: • 6 expert opinion guidance documents (SIGN50 level 4),[102, 124, 126, 127, 131, 134] • 3 British standards (SIGN50 level 4),[114, 115, 122] • 1 before-after study (SIGN50 level 3).[90] All of the included guidance documents are classed as expert opinion due to their limited methodology and/or lack of a rigorous search of evidence. Moreover, no high quality evidence was identified (out of the 10 studies, nine are level 4 and one is level 3) which is a limitation of the evidence base for this question.	1x SIGN50 level 3 9x SIGN50 level 4

14.2 Is the evidence consistent in its conclusions? (see SIGN50, section 5.3.2)

Comment here on the degree of consistency demonstrated by the evidence. Where there are conflicting results, indicate how the group formed a judgement as to the overall direction of the evidence.

Comments
○ Four guidance documents (from the British Standards Institution, the Republic of Ireland HPSC and the UK) are consistent in recommending that the frequency of microbiological water testing should be based on a comprehensive risk assessment and in agreement with the WSG.[114, 122, 124, 131] BS 8580-2 states 'the frequency of microbiological sampling, where there are high-risk patients, should be sufficient for trend analysis to establish evidence-based confidence that control measures remain effective.' • The WHO mentions that the frequency of testing for *Legionella* depends on the status of the water system (for example variation in biocide treatment, storage or distribution temperatures).[102] • Regarding a specific timeframe – two English guidance documents recommend testing water outlets at least every 6 months for *P. aeruginosa*; however, these recommendations are based on expert opinion and do not have scientific studies referenced.[126, 127] Six-monthly testing may be insufficient particularly in settings where contamination of taps/water outlets has been found.[90]

14.3 Is the evidence applicable to Scottish health and care settings? (see SIGN50, section 5.3.3)

For example, do the studies include interventions, comparators or outcomes that are common to Scottish health and care settings?

Comments
The majority of evidence is derived from the UK. There are three British standards[114, 115, 122] and other guidance derived from the Republic of Ireland, England and the US (World Health Organization).[102, 124, 126, 127, 131, 134] The before and after study was performed in England.[90] All are applicable to Scotland.

14.4 Are the studies generalisable to the target population?

Comment here on sample size and methods of sample selection. Is the sample representative of the specific population/group of interest? Generalisability is only relevant to primary research studies.

Comments
The one primary study identified (before and after study) is generalisable to the target population.[90] The study took place in ICUs in a tertiary referral NHS teaching hospital in England and investigated the impact of installation of new tap outlets on the number of outlets colonised with *P. aeruginosa*. They also investigated how often water sampling needed to be done in a setting where contamination of tap outlets with *P. aeruginosa* is high.

14.5 Are there concerns about publication bias? (see SIGN50, section 5.3.5)

Comment here on whether there is a risk in the evidence base that studies have been selectively published based on their results (and thus a risk that results from published studies are systematically different from unpublished evidence).

Comments
No concerns.

Part B: Evidence to decision

14.6 Recommendations

What Recommendations(s) or good practice point(s) does the Working Group agree are appropriate based on this evidence?

Note the following terminology:

- **"must"** implies that the health and care setting must implement the recommended approach and is used where a recommendation has been directly lifted from legislation or mandatory guidance
- **"should"** implies that the health and care setting "should" implement the recommended approach unless a clear and compelling rationale for an alternative approach is present
- **"should consider"** implies that the health and care setting should consider implementing the recommended approach

Recommendation	Grading
GPP14.1 The frequency of routine microbiological water testing (see R12.1 and GPP12.1) should be based on a comprehensive risk assessment and in agreement with the WSG; however, six-monthly should be the minimum.	Good Practice Point
GPP14.2 The frequency of testing may be increased to improve trend analysis depending on the status of the water system.	Good Practice Point

14.7 Balancing benefits and harms

Comment here on the potential impact of the Recommendation/Good Practice Point on service users, visitors and staff. Benefits and harms include considerations beyond IPC.

Benefits

List the favourable changes in outcome that would likely occur if the Recommendation/ Good Practice Point were followed correctly. Be explicit, clear about pros.

Benefits
• GPP14.1, GPP14.2 Performing trend analysis improves understanding of the water system and potentially the timeline of contamination and/or outbreak/incident events and the interpretation of risk. • GPP14.1, GPP14.2 Improves the ability to detect contamination of water system and outlets at an earlier stage which could lead to reduced risk of water system-associated nosocomial infections and potentially increased service user safety.

Risks and Harms

List the adverse events or other unfavourable outcomes that may occur if the Recommendation/ Good Practice Point were followed correctly. Be explicit, clear about cons.

Risks/Harms
• GPP14.1 Testing frequency might be insufficient in detecting water system associated organisms in a timely manner and therefore also in reducing the risk of water system-associated nosocomial infections. • GPP14.1, GPP14.2 There is a risk that staff may respond in isolation to test results rather than applying experience to look at results as a trend and in combination with other factors. • GPP14.1, GPP14.2 There is the potential for disruption of healthcare provision during water testing.

Benefit-Harm assessment

Classify as “benefits outweigh harms” (or vice versa) or a “balance of benefit and harm.” Description of this balance can be from the individual patient/ staff/ visitor perspective, the societal perspective, or both. Recommendations/ Good Practice Points are possible when clear benefit is not offset by important harms, costs or adverse events (or vice versa).

Benefit-Harm assessment
Benefits outweigh harms.

14.8 Feasibility

Is the Recommendation/ Good Practice Point implementable in the Scottish context? Describe (if applicable) financial implications, opportunity costs, material or human resource requirements, facility needs, sustainability issues, human factors etc., that may be associated with following a Recommendation/ Good Practice Point. State clearly if information on feasibility is lacking.

Feasibility
GPP14.1, GPP14.2 There may be financial implications due to material and human resource requirements to perform frequent sampling. GPP14.1, GPP14.2 Additional education and training may be required with associated financial and time implications.

14.9 Expert Opinion

Summarise the expert opinion used in creating the Recommendation/ Good Practice Point; if none were involved, state “none”. Translating evidence into action often involves expert opinion where evidence is insufficient. Clearly outlining expert opinion helps users understand their influence on interpreting objective evidence. Expert opinion may also be required where there is no evidence available.

Expert opinion
GPP14.1 Evidence was considered insufficient for the development of a recommendation. However, ARHAI Scotland support extant expert opinion guidance (from the WHO on *Legionella* testing) that the water testing frequency might vary per water system depending on its status.[102] The recommendations of the extant expert opinion guidance (from the British Standards Institution, Republic of Ireland HPSC, and UK) that a comprehensive risk assessment is needed and the frequency should be in agreement with the WSG, seems appropriate.[114, 122, 124, 131] It is emphasised in the good practice point that six-monthly should be the minimum, as recommended in English *P. aeruginosa* guidance but ARHAI Scotland expert opinion is that this should extend for all recommended water testing (see R12.1 and GPP12.1).[126, 127] GPP14.2 The before-after study described that six-monthly testing may be insufficient particularly in settings where contamination of tap outlets has been found.[90] ARHAI Scotland opinion is that performing trend analysis may improve understanding of the water system, the timeline of events and the interpretation of risk. This depends on the status of the water system (as seen in the before-after study) and thus the frequency advised in GPP14.1 might need to be increased in

Expert opinion
certain NHS boards/situations. A good practice point has been developed to cover this.

14.10 Value judgements

Summarise value judgements used by the Working Group in creating the Recommendation/ Good Practice Point; if none were involved, state “none”. Translating evidence into action often involves value judgements, which include guiding principles, ethical considerations, or other beliefs and priorities. Stating them clearly helps users understand their influence on interpreting objective evidence.

Value judgements
None.

14.11 Intentional vagueness

State reasons for any intentional vagueness in the Recommendation/Good Practice Point; if none was intended, state “none”. Recommendations/Good Practice Points should be clear and specific, but if there is a decision to be vague, acknowledging the reasoning clearly promotes transparency. Reasons for vagueness may include inadequate evidence; inability to achieve consensus regarding evidence quality, anticipated benefits/harms, or interpretation of evidence; legal considerations; economic reasons; ethical/ religious reasons.

Intentional vagueness
GPP14.1 Most guidance do not mention a specific timeframe (but recommend that it should be based on a comprehensive risk assessment) except for PHE and UK Department of Health guidance that mention six-monthly *P. aeruginosa* testing. Both guidance documents are based on expert opinion and a before-and-after study discussed that six-monthly testing may be insufficient particularly in settings where contamination of tap outlets has been found. The WHO mentions that it is dependent on the status of the system (for example variation in biocide treatment, storage or distribution temperatures). It might also depend on the intended use of the system/outlet and patient vulnerability. Therefore, it is difficult to set a general

Intentional vagueness
frequency for all healthcare facilities and a risk assessment is needed to confirm the frequency of testing. There might be a need for more frequent testing when there are concerns regarding water quality.

14.12 Exceptions

List situations or circumstances in which the Recommendation/ Good Practice Point should not be applied.

Exceptions
See next research question: “When should routine water testing frequency be increased?”

14.13 Recommendations for research

List any aspects of the question that require further research.

Recommendations for research
UK studies that assess routine water testing over time, and the anticipated benefits, would strengthen the evidence base.

Research question 15: When should routine water testing frequency be increased?

Part A: Quality of evidence

15.1 How reliable is the body of evidence? (see SIGN50, section 5.3.1, 5.3.4)

Comment here on the quantity of evidence available on this topic and its methodological quality. Please include citations and evidence levels.

If there is insufficient evidence to answer the key question, go to section B.

Comments	Evidence level
In total, 8 pieces of evidence on this subject were identified which includes: • 2 Scottish guidance documents (SIGN50 level 4),[101, 123] • 3 UK guidance documents (including 2 codes of practice) (SIGN50 level 4),[114, 125, 126] • 2 other guidance documents (SIGN50 level 4),[102, 124] • 1 outbreak study (SIGN50 level 3).[9] All seven guidance documents were deemed to be expert opinions due to the lack of a rigorous search and/or methodology in developing the guidance.	1x SIGN50 level 3 7x SIGN50 level 4

15.2 Is the evidence consistent in its conclusions? (see SIGN50, section 5.3.2)

Comment here on the degree of consistency demonstrated by the evidence. Where there are conflicting results, indicate how the group formed a judgement as to the overall direction of the evidence.

Comments
Three guidance documents (Scottish, UK and from Republic of Ireland or the WHO) are consistent in advising to increase the water testing frequency during the following two situations: • during a suspected or confirmed outbreak or if surveillance identifies an increased incidence of infection[101, 114, 124] • when control levels of the treatment regime (for example temperature or disinfectant concentrations) are not consistently achieved.[101, 102, 125] Two guidance documents (Scottish and UK) and an outbreak study advise to increase the water testing frequency in the following situation: • after implementing changes to the water system and/or its treatment strategy (for example contamination has been resolved and system is brought back into use).[9, 123, 126] One guidance document (HTM part B) adds to the above that water testing frequency should also be increased in the following situation: • when pre-flush trend analysis demonstrates increasing cfu/100 ml for *P. aeruginosa.*[126]

15.3 Is the evidence applicable to Scottish health and care settings? (see SIGN50, section 5.3.3)

For example, do the studies include interventions, comparators or outcomes that are common to Scottish health and care settings?

Comments
Two guidance documents derived from Scotland,[101, 123] three from England (of which two are codes of practice within the UK),[114, 125, 126] one from the Republic of Ireland[124] and one from the WHO.[102] The outbreak study is from the US.[9] All are from developed countries and applicable to Scotland.

15.4 Are the studies generalisable to the target population?

Comment here on sample size and methods of sample selection. Is the sample representative of the specific population/group of interest? Generalisability is only relevant to primary research studies.

Comments
Not applicable as the included primary evidence was an outbreak study and thus observational (uncontrolled).[9]

15.5 Are there concerns about publication bias? (see SIGN50, section 5.3.5)

Comment here on whether there is a risk in the evidence base that studies have been selectively published based on their results (and thus a risk that results from published studies are systematically different from unpublished evidence).

Comments
No concerns.

Part B: Evidence to decision

15.6 Recommendations

What Recommendations(s) or good practice point(s) does the Working Group agree are appropriate based on this evidence?

Note the following terminology:

- **"must"** implies that the health and care setting must implement the recommended approach and is used where a recommendation has been directly lifted from legislation or mandatory guidance
- **"should"** implies that the health and care setting "should" implement the recommended approach unless a clear and compelling rationale for an alternative approach is present
- **"should consider"** implies that the health and care setting should consider implementing the recommended approach

Recommendation	Grading
GPP15.1 The frequency of routine water testing should be increased after implementing changes (for example after biocide dosing, remedial works, refurbishment) to the water system and/or its treatment strategy.	Good Practice Point
GPP15.2 The frequency of water testing should be increased during a suspected or confirmed outbreak known or suspected to be associated with the water system or if surveillance identifies an increased incidence of infection known or suspected to be associated with the water system.	Good Practice Point
GPP15.3 The frequency of routine water testing should be increased when control levels of the treatment regime are not achieved (for example when levels of biocide are lower than the agreed limit).	Good Practice Point
GPP15.4 Consideration may be given to increasing the frequency of routine water testing when pre-flush trend analysis demonstrates increasing cfu/100 ml for *P. aeruginosa*.	Good Practice Point

15.7 Balancing benefits and harms

Comment here on the potential impact of the Recommendation/Good Practice Point on service users, visitors and staff. Benefits and harms include considerations beyond IPC.

Benefits

List the favourable changes in outcome that would likely occur if the Recommendation/ Good Practice Point were followed correctly. Be explicit, clear about pros.

Benefits
• GPP15.1 Evidence-based confidence that control measures remain effective. • GPP15.2, GPP15.3, GPP15.4 Enabling of trend analysis to assist with problem solving until resolution of water associated infection risk. • GPP15.2, GPP15.3, GPP15.4 Awareness of risk enabling control measures to be implemented with the aim of reducing the risk of nosocomial infection which potentially increases service user safety.

Risks and Harms

List the adverse events or other unfavourable outcomes that may occur if the Recommendation/ Good Practice Point were followed correctly. Be explicit, clear about cons.

Risks/Harms
GPP15.1, GPP15.2, GPP15.3, GPP15.4 Potential for the disruption of healthcare provision during water testing.

Benefit-Harm assessment

Classify as “benefits outweigh harms” (or vice versa) or a “balance of benefit and harm.” Description of this balance can be from the individual patient/ staff/ visitor perspective, the societal perspective, or both. Recommendations/ Good Practice Points are possible when clear benefit is not offset by important harms, costs or adverse events (or vice versa).

Benefit-Harm assessment
Benefits outweigh harms.

15.8 Feasibility

Is the Recommendation/Good Practice Point implementable in the Scottish context? Describe (if applicable) financial implications, opportunity costs, material or human resource requirements, facility needs, sustainability issues, human factors etc., that may be associated with following a Recommendation/ Good Practice Point. State clearly if information on feasibility is lacking.

Feasibility
GPP15.1, GPP15.2, GPP15.3, GPP15.4 There may be financial implications due to material and human resource requirements to perform more frequent sampling. GPP15.2 There may be a requirement to set up additional alerts/triggers.

15.9 Expert Opinion

Summarise the expert opinion used in creating the Recommendation/Good Practice Point; if none were involved, state “none”. Translating evidence into action often involves expert opinion where evidence is insufficient. Clearly outlining expert opinion helps users understand their influence on interpreting objective evidence. Expert opinion may also be required where there is no evidence available.

Expert opinion
GPP15.1 One outbreak study and two guidance documents (SHTM and HTM part B) advise to increase the water testing frequency after changes have been made to the water system and/or its treatment strategy.[9, 123, 126] This evidence was considered insufficient for the development of a recommendation. However, it is ARHAI Scotland opinion that it is important to have evidence-based confidence that control measures remain effective by testing after changes have been made to either the water system or its treatment. Therefore, a good practice point has been developed. GPP15.2 ARHAI Scotland support extant expert opinion guidance (from the Republic of Ireland HPSC, British Standards Institution and Scotland) that during a suspected or confirmed outbreak or if surveillance identifies an increased incidence of infection, the water testing frequency should be increased.[101, 114, 124]

Expert opinion
GPP15.3 ARHAI Scotland support extant expert opinion guidance (from the UK, WHO and Scotland) that when control levels of the treatment regime are not consistently achieved, the water testing frequency should be increased.[101, 102, 125] GPP15.4 One guidance document (from the Department of Health) mentioned to increase the water testing frequency when pre-flush trend analysis demonstrates increasing cfu/100 ml for *P. aeruginosa.*[126] This is limited evidence, but ARHAI Scotland opinion is that consideration of increasing the water testing frequency in this situation is important for monitoring the *P. aeruginosa* levels over time and being aware of a potential risk. Therefore, a good practice point has been developed to consider this.

15.10 Value judgements

Summarise value judgements used by the Working Group in creating the Recommendation/Good Practice Point; if none were involved, state “none”. Translating evidence into action often involves value judgements, which include guiding principles, ethical considerations, or other beliefs and priorities. Stating them clearly helps users understand their influence on interpreting objective evidence.

Value judgements
None.

15.11 Intentional vagueness

State reasons for any intentional vagueness in the Recommendation/Good Practice Point; if none was intended, state “none”. Recommendations/Good Practice Points should be clear and specific, but if there is a decision to be vague, acknowledging the reasoning clearly promotes transparency. Reasons for vagueness may include inadequate evidence; inability to achieve consensus regarding evidence quality, anticipated benefits/harms, or interpretation of evidence; legal considerations; economic reasons; ethical/ religious reasons.

Intentional vagueness
None.

15.12 Exceptions

List situations or circumstances in which the Recommendation/ Good Practice Point should not be applied.

Exceptions
None.

15.13 Recommendations for research

List any aspects of the question that require further research.

Recommendations for research
None.

Research question 16: Where should routine water samples be taken from (which outlets, how many samples)?

Part A: Quality of evidence

16.1 How reliable is the body of evidence? (see SIGN50, section 5.3.1, 5.3.4)

Comment here on the quantity of evidence available on this topic and its methodological quality. Please include citations and evidence levels.

If there is insufficient evidence to answer the key question, go to section B.

Comments	Evidence level
In total, 10 pieces of evidence were identified in relation to this research question which includes: • 4 Scottish guidance documents (SIGN50 level 4),[101, 116, 123, 135] • 3 documents published by the British Standards Institution (SIGN50 level 4),[114, 115, 132] • 2 English guidance documents (SIGN50 level 4),[127, 131] • 1 Republic of Ireland guidance document (SIGN50 level 4).[124] All 10 pieces of evidence were deemed to be expert opinions due to the lack of a rigorous search and/or methodology in developing the guidance. The lack of high-quality evidence is a general limitation for this research question.	10x SIGN50 level 4

16.2 Is the evidence consistent in its conclusions? (see SIGN50, section 5.3.2)

Comment here on the degree of consistency demonstrated by the evidence. Where there are conflicting results, indicate how the group formed a judgement as to the overall direction of the evidence.

Comments
• Three guidance documents (The BS codes of practice BS 8554:2015 and BS 7592:2022 and English guidance), are consistent in advising that a sampling plan should be established.[114, 127, 132] • There is consensus within the guidance documents that sampling should ensure that areas identified as 'high risk' both in terms of supporting microorganism growth (i.e. cooler parts of the hot water system, warmer parts of the cold water system) and patient susceptibility (i.e. high-risk units), are represented. There are examples mentioned for sampling points which overlap in most guidance, but some guidance (SHTM 04-01) mentions additional/more specific examples.[101, 116] • There is limited evidence regarding the number of samples to be taken, but it is consistent in two guidance documents (Republic of Ireland HPSC and BSI guidance PD 855468:2015) that the exact number of samples required for each area/outlet type should be sufficient in number to be fully representative of the distribution system.[115, 124]

16.3 Is the evidence applicable to Scottish health and care settings? (see SIGN50, section 5.3.3)

For example, do the studies include interventions, comparators or outcomes that are common to Scottish health and care settings?

Comments
All guidance documents included derived from the UK or Republic of Ireland. Four are Scottish and two are codes of practice within the UK.[101, 114, 116, 123, 132, 135] All are applicable to Scotland.

16.4 Are the studies generalisable to the target population?

Comment here on sample size and methods of sample selection. Is the sample representative of the specific population/group of interest? Generalisability is only relevant to primary research studies.

Comments
N/A - no primary studies were identified for this research question.

16.5 Are there concerns about publication bias? (see SIGN50, section 5.3.5)

Comment here on whether there is a risk in the evidence base that studies have been selectively published based on their results (and thus a risk that results from published studies are systematically different from unpublished evidence).

Comments
No concerns.

Part B: Evidence to decision

16.6 Recommendations

What Recommendations(s) or good practice point(s) does the Working Group agree are appropriate based on this evidence?

Note the following terminology:

- **"must"** implies that the health and care setting must implement the recommended approach and is used where a recommendation has been directly lifted from legislation or mandatory guidance
- **"should"** implies that the health and care setting "should" implement the recommended approach unless a clear and compelling rationale for an alternative approach is present
- **"should consider"** implies that the health and care setting should consider implementing the recommended approach

Recommendation	Grading
GPP16.1 A sampling plan should be developed by the water safety group which includes an up-to-date schematic of the system(s) with identified sampling points noted to enable resampling and trend analysis.	Good Practice Point
GPP16.2 Water samples should be taken from selected areas within the water distribution system and this selection should be on the basis of risk assessments ensuring that areas identified as 'high risk' both in terms of supporting microorganism growth and patient susceptibility (see section 2.6 and R4.1) are represented.	Good Practice Point
GPP16.3 As a minimum, samples should be taken from the proximal and distal ends of each water system with an agreed number of sampling points in between.	Good Practice Point
GPP16.4 The number of samples obtained during any single round of sampling should be sufficient to be fully representative of the water distribution system.	Good Practice Point
GPP16.5 Sampling of outlets within clinical facilities should be rotated at each sampling round unless a decision has been made to sample all outlets.	Good Practice Point
GPP16.6 Outlets within common shared facilities such as staff kitchen, domestic services room (DSR), treatment room, preparation room, should be tested at every sampling round.	Good Practice Point

16.7 Balancing benefits and harms

Comment here on the potential impact of the Recommendation/Good Practice Point on service users, visitors and staff. Benefits and harms include considerations beyond IPC.

Benefits

List the favourable changes in outcome that would likely occur if the Recommendation/ Good Practice Point were followed correctly. Be explicit, clear about pros.

Benefits
• GPP16.1 An agreed sampling plan will provide clarity to all those involved in sampling. • GPP16.1 Having a sampling plan identifying both fixed and rotational sampling points will assist in the identification of trends, potentially improve understanding of the timeline of events and the interpretation of risk. • GPP16.1 Evidence-based confidence that control measures remain effective. • GPP16.2, GPP16.3, GPP16.4, GPP16.5 Taking water samples from a variety of points increases awareness of potential risk of environmental contamination of water system and outlets and ensures targeted control measures can be implemented with the aim of reducing the risk of nosocomial infection which potentially increases service user safety.

Risks and Harms

List the adverse events or other unfavourable outcomes that may occur if the Recommendation/ Good Practice Point were followed correctly. Be explicit, clear about cons.

Risks/Harms
GPP16.1 There may be a false sense of security with a sampling plan in that a contaminated unsampled outlet may remain undiscovered.

Benefit-Harm assessment

Classify as “benefits outweigh harms” (or vice versa) or a “balance of benefit and harm.” Description of this balance can be from the individual patient/ staff/ visitor perspective, the societal perspective, or both. Recommendations/ Good Practice Points are possible when clear benefit is not offset by important harms, costs or adverse events (or vice versa).

Benefit-Harm assessment
Benefits outweigh harms.

16.8 Feasibility

Is the Recommendation/ Good Practice Point implementable in the Scottish context? Describe (if applicable) financial implications, opportunity costs, material or human resource requirements, facility needs, sustainability issues, human factors etc., that may be associated with following a Recommendation/ Good Practice Point. State clearly if information on feasibility is lacking.

Feasibility
GPP16.1 There may be human resource requirements to develop the sampling plan. GPP16.2, GPP16.3, GPP16.4, GPP16.5, GPP16.6 There may be financial implications due to material and human resource requirements to perform sampling.

16.9 Expert Opinion

Summarise the expert opinion used in creating the Recommendation/ Good Practice Point; if none were involved, state “none”. Translating evidence into action often

involves expert opinion where evidence is insufficient. Clearly outlining expert opinion helps users understand their influence on interpreting objective evidence. Expert opinion may also be required where there is no evidence available.

Expert opinion

GPP16.1 ARHAI Scotland support extant expert opinion guidance (from the British Standards Institution and UK) that a sampling plan should be established. Therefore, a good practice point has been developed.

GPP16.2 ARHAI Scotland support extant expert opinion guidance (from the Republic of Ireland HPSC, Scotland and UK) that sampling should ensure that areas identified as 'high risk' both in terms of supporting microorganism growth (i.e. cooler parts of the hot water system, warmer parts of the cold water system) and patient susceptibility (i.e. high-risk units), are represented. [101, 114-116, 124, 127, 132]

GPP16.3 ARHAI Scotland support extant expert opinion guidance (from the SHTM 04-01 part B) that samples should be taken from the proximal and distal ends of each water system with an agreed number of sampling points in between, as a minimum.[101] Therefore, a good practice point has been developed.

GPP16.4 ARHAI Scotland support extant expert opinion guidance (from the Republic of Ireland HPSC and British Standards Institution) that the exact number of samples required for each area/outlet type should be sufficient in number to be fully representative of the distribution system.[115, 124]

GPP16.5 Outlets within clinical facilities are not covered in the identified guidance documents, but these outlets are also at risk for contamination with healthcare water system-associated organisms. It is ARHAI Scotland opinion that sampling of these outlets should be rotated at each sampling round to provide a wider sampling coverage, unless a decision has been made to sample all outlets. Therefore, a good practice point has been developed.

GPP16.6 Regarding outlets within common shared facilities (such as staff kitchen, domestic services room (DSR), treatment room, preparation room), ARHAI Scotland opinion is that these should be tested at every sampling round. Contamination at the outlets within these areas have greater potential for wider

Expert opinion
transmission of infection to patients throughout a care area either directly or indirectly via staff use.

16.10 Value judgements

Summarise value judgements used by the Working Group in creating the Recommendation/ Good Practice Point; if none were involved, state “none”. Translating evidence into action often involves value judgements, which include guiding principles, ethical considerations, or other beliefs and priorities. Stating them clearly helps users understand their influence on interpreting objective evidence.

Value judgements
None.

16.11 Intentional vagueness

State reasons for any intentional vagueness in the Recommendation/ Good Practice Point; if none was intended, state “none”. Recommendations/ Good Practice Points should be clear and specific, but if there is a decision to be vague, acknowledging the reasoning clearly promotes transparency. Reasons for vagueness may include inadequate evidence; inability to achieve consensus regarding evidence quality, anticipated benefits/harms, or interpretation of evidence; legal considerations; economic reasons; ethical/ religious reasons.

Intentional vagueness
GPP16.4 It is currently unknown which number of samples is fully representative of the water distribution system as there is no evidence in the literature to determine this. Therefore, the statement of ‘sufficient’ is intentionally vague.

16.12 Exceptions

List situations or circumstances in which the Recommendation/ Good Practice Point should not be applied.

Exceptions
None.

16.13 Recommendations for research

List any aspects of the question that require further research.

Recommendations for research
GPP16.4 There is currently no evidence in the literature to determine which amount/percentage of sampling points is sufficient to be fully representative of the water distribution system. Research that will determine this would be valuable.

Research question 17: When should water samples from further back in the system be taken?

Part A: Quality of evidence

17.1 How reliable is the body of evidence? (see SIGN50, section 5.3.1, 5.3.4)

Comment here on the quantity of evidence available on this topic and its methodological quality. Please include citations and evidence levels.

If there is insufficient evidence to answer the key question, go to section B.

Comments	Evidence level
Insufficient evidence was found in relation to this research question. In total, only one outbreak study was identified to be relevant: • 1 outbreak study (SIGN50 level 3)[15]	1x SIGN50 level 3

17.2 Is the evidence consistent in its conclusions? (see SIGN50, section 5.3.2)

Comment here on the degree of consistency demonstrated by the evidence. Where there are conflicting results, indicate how the group formed a judgement as to the overall direction of the evidence.

Comments
Very limited evidence, so it is not possible to comment on the degree of consistency. The single study, specific to *Pseudomonas aeruginosa*, suggested that when positive tests reoccur after remedial action at the outlet, it could indicate that this was not the actual source and that there remains a reservoir or source further down (distal) the pipes.[15] This would seem a logical route of investigation.

17.3 Is the evidence applicable to Scottish health and care settings? (see SIGN50, section 5.3.3)

For example, do the studies include interventions, comparators or outcomes that are common to Scottish health and care settings?

Comments
The outbreak study took place in Sweden and is applicable to Scotland.[15]

17.4 Are the studies generalisable to the target population?

Comment here on sample size and methods of sample selection. Is the sample representative of the specific population/group of interest? Generalisability is only relevant to primary research studies.

Comments
The study is focused *P. aeruginosa* and thus the findings may not be generalisable to other healthcare water system-associated organisms.

17.5 Are there concerns about publication bias? (see SIGN50, section 5.3.5)

Comment here on whether there is a risk in the evidence base that studies have been selectively published based on their results (and thus a risk that results from published studies are systematically different from unpublished evidence).

Comments
N/A due to limited evidence.

Part B: Evidence to decision

17.6 Recommendations

What Recommendations(s) or good practice point(s) does the Working Group agree are appropriate based on this evidence?

Note the following terminology:

- **“must”** implies that the health and care setting must implement the recommended approach and is used where a recommendation has been directly lifted from legislation or mandatory guidance
- **“should”** implies that the health and care setting “should” implement the recommended approach unless a clear and compelling rationale for an alternative approach is present
- **“should consider”** implies that the health and care setting should consider implementing the recommended approach

Recommendation	Grading
GPP17.1 Taking water samples further back in the system could be beneficial when positive tests reoccur following remedial intervention at the outlet(s).	Good Practice Point
GPP17.2 Positive pre- and post-flush sample test results might indicate an issue beyond the outlet and testing further back in the system could be beneficial.	Good Practice Point

17.7 Balancing benefits and harms

Comment here on the potential impact of the Recommendation/Good Practice Point on service users, visitors and staff. Benefits and harms include considerations beyond IPC.

Benefits

List the favourable changes in outcome that would likely occur if the Recommendation/ Good Practice Point were followed correctly. Be explicit, clear about pros.

Benefits
• GPP17.1, GPP17.2 Providing information to assist with problem solving until resolution of water associated infection risk.

Benefits
• GPP17.1, GPP17.2 Potential increase of service user safety.

Risks and Harms

List the adverse events or other unfavourable outcomes that may occur if the Recommendation/ Good Practice Point were followed correctly. Be explicit, clear about cons.

Risks/Harms
No risks or harms identified.

Benefit-Harm assessment

Classify as “benefits outweigh harms” (or vice versa) or a “balance of benefit and harm.” Description of this balance can be from the individual patient/staff/visitor perspective, the societal perspective, or both. Recommendations/ Good Practice Points are possible when clear benefit is not offset by important harms, costs or adverse events (or vice versa).

Benefit-Harm assessment
Only benefits identified.

17.8 Feasibility

Is the Recommendation/ Good Practice Point implementable in the Scottish context? Describe (if applicable) financial implications, opportunity costs, material or human resource requirements, facility needs, sustainability issues, human factors etc., that may be associated with following a Recommendation/ Good Practice Point. State clearly if information on feasibility is lacking.

Feasibility
GPP17.1, GPP17.2 There may be financial implications due to material and human resource requirements to perform additional sampling. GPP17.2 Planning and coordination will be required to facilitate pre-flush sampling in an occupied ward – this may have to occur early in the morning or at another time of lower water outlet usage.

17.9 Expert Opinion

Summarise the expert opinion used in creating the Recommendation/ Good Practice Point; if none were involved, state “none”. Translating evidence into action often involves expert opinion where evidence is insufficient. Clearly outlining expert opinion helps users understand their influence on interpreting objective evidence. Expert opinion may also be required where there is no evidence available.

Expert opinion
GPP17.1 One outbreak study, specific to *Pseudomonas aeruginosa*, suggests that a reservoir or source might remain further down (distal) the pipes when positive tests reoccur after remedial action at the outlet.[15] This evidence is not sufficient for developing a recommendation. However, it is ARHAI Scotland opinion that testing further back in the system could be beneficial in this situation and therefore a good practice point has been developed. GPP17.2 It is ARHAI Scotland opinion that testing further back in the system could also be beneficial when pre- and post-flush samples both test positive. This might lead to finding the potential source of contamination.

17.10 Value judgements

Summarise value judgements used by the Working Group in creating the Recommendation/ Good Practice Point; if none were involved, state “none”. Translating evidence into action often involves value judgements, which include guiding principles, ethical considerations, or other beliefs and priorities. Stating them clearly helps users understand their influence on interpreting objective evidence.

Value judgements
None.

17.11 Intentional vagueness

State reasons for any intentional vagueness in the Recommendation/ Good Practice Point; if none was intended, state “none”. Recommendations/ Good Practice Points should be clear and specific, but if there is a decision to be vague, acknowledging the reasoning clearly promotes transparency. Reasons for vagueness may include inadequate evidence; inability to achieve consensus regarding evidence quality, anticipated benefits/harms, or interpretation of evidence; legal considerations; economic reasons; ethical/ religious reasons.

Intentional vagueness
None.

17.12 Exceptions

List situations or circumstances in which the Recommendation/ Good Practice Point should not be applied.

Exceptions
None.

17.13 Recommendations for research

List any aspects of the question that require further research.

Recommendations for research
There is a lack of evidence regarding sampling further back in the system, more research and/or outbreak studies describing this would be valuable.

Research question 18: Who should water test results be reported to?

Part A: Quality of evidence

18.1 How reliable is the body of evidence? (see SIGN50, section 5.3.1, 5.3.4)

Comment here on the quantity of evidence available on this topic and its methodological quality. Please include citations and evidence levels.

If there is insufficient evidence to answer the key question, go to section B.

Comments	Evidence level
There is limited evidence to inform recommendations regarding the reporting of water sample test results, especially who to report to. In total, seven pieces of evidence were identified which includes: • 3 Scottish guidance documents (SIGN50 level 4),[101, 117, 123] • 2 British standards (SIGN50 level 4),[121, 132] • 2 English guidance documents (SIGN50 level 4).[125, 131] All seven pieces of evidence were deemed to be expert opinions due to the lack of a rigorous search and/or methodology in developing the guidance. The small amount of evidence and lack of high-quality evidence is a limiting factor and makes it challenging to answer this research question.	7x SIGN50 level 4

18.2 Is the evidence consistent in its conclusions? (see SIGN50, section 5.3.2)

Comment here on the degree of consistency demonstrated by the evidence. Where there are conflicting results, indicate how the group formed a judgement as to the overall direction of the evidence.

Comments
There is limited evidence available, the evidence found (seven guidance documents) is consistent on the fact that test results need to be recorded and reported to the WSG. [101, 117, 123, 125, 131]

18.3 Is the evidence applicable to Scottish health and care settings? (see SIGN50, section 5.3.3)

For example, do the studies include interventions, comparators or outcomes that are common to Scottish health and care settings?

Comments
Three guidance documents are Scottish Health Technical Memorandums (SHTM 04-01). [101, 117, 123] The two British standards are good practice for Scotland. [121, 132] Two other guidance documents are derived from England. [125, 131] Therefore, all evidence is applicable to Scotland.

18.4 Are the studies generalisable to the target population?

Comment here on sample size and methods of sample selection. Is the sample representative of the specific population/group of interest? Generalisability is only relevant to primary research studies.

Comments
N/A – no primary studies were identified for this research question.

18.5 Are there concerns about publication bias? (see SIGN50, section 5.3.5)

Comment here on whether there is a risk in the evidence base that studies have been selectively published based on their results (and thus a risk that results from published studies are systematically different from unpublished evidence).

Comments
No concerns.

Part B: Evidence to decision

18.6 Recommendations

What Recommendations(s) or good practice point(s) does the Working Group agree are appropriate based on this evidence?

Note the following terminology:

- **"must"** implies that the health and care setting must implement the recommended approach and is used where a recommendation has been directly lifted from legislation or mandatory guidance
- **"should"** implies that the health and care setting "should" implement the recommended approach unless a clear and compelling rationale for an alternative approach is present
- **"should consider"** implies that the health and care setting should consider implementing the recommended approach

Recommendation	Grading
GPP18.1 During commissioning of new builds, the contractor should provide a full set of the water sample analysis results to the project manager (or equivalent) for approval by the WSG (including IPC team) before the system is put into clinical use.	Good Practice Point

Recommendation	Grading
GPP18.2 After replacement/remedial activities, water sample analysis results should be approved by the IMT/ WSG or agreed local process.	Good Practice Point
GPP18.3 Each NHS board must have processes in place to describe reporting and dissemination of results which includes as a minimum: • Exceptions are tabled at WSG meetings, • Exceptions are recorded and rapidly disseminated to all WSG members and local IPC team, • A record should be kept of distribution lists for reporting, • Clear responsibilities are defined for interpretation and actions of results (see GPP19.3, GPP36.1 and GPP36.2).	Good Practice Point

18.7 Balancing benefits and harms

Comment here on the potential impact of the Recommendation/Good Practice Point on service users, visitors and staff. Benefits and harms include considerations beyond IPC.

Benefits

List the favourable changes in outcome that would likely occur if the Recommendation/ Good Practice Point were followed correctly. Be explicit, clear about pros.

Benefits
• GPP18.1, GPP18.2 Organisational awareness of and public confidence in water quality.

Benefits
• GPP18.1, GPP18.2, GPP18.3 Timely communication of water test results that are outwith microbiological limits ensuring prompt and appropriate response. • GPP18.3 Improved audit trail of water test results. • GPP18.1, GPP18.2, GPP18.3 Historical knowledge of system performance. • GPP18.1, GPP18.2, GPP18.3 Demonstrable governance arrangements.

Risks and Harms

List the adverse events or other unfavourable outcomes that may occur if the Recommendation/ Good Practice Point were followed correctly. Be explicit, clear about cons.

Risks/Harms
No risks or harms identified.

Benefit-Harm assessment

Classify as “benefits outweigh harms” (or vice versa) or a “balance of benefit and harm.” Description of this balance can be from the individual patient/ staff/ visitor perspective, the societal perspective, or both. Recommendations/ Good Practice Points are possible when clear benefit is not offset by important harms, costs or adverse events (or vice versa).

Benefit-Harm assessment
Only benefits identified.

18.8 Feasibility

Is the Recommendation/ Good Practice Point implementable in the Scottish context? Describe (if applicable) financial implications, opportunity costs, material or human resource requirements, facility needs, sustainability issues, human factors etc., that may be associated with following a Recommendation/ Good Practice Point. State clearly if information on feasibility is lacking.

Feasibility
GPP18.3 Additional human resource requirements might be needed, including IT support.

18.9 Expert Opinion

Summarise the expert opinion used in creating the Recommendation/Good Practice Point; if none were involved, state “none”. Translating evidence into action often involves expert opinion where evidence is insufficient. Clearly outlining expert opinion helps users understand their influence on interpreting objective evidence. Expert opinion may also be required where there is no evidence available.

Expert opinion
GPP18.1 ARHAI Scotland support extant expert opinion guidance (SHTM 04-01 part E) regarding *Legionella* that the contractor supplies a full set of the water sample analysis to the site supervisor for approval before the system is put into use (in new builds).[117] The water sample analysis should be cascaded by the site supervisor to other relevant stakeholders such as the WSG members. It is ARHAI Scotland expert opinion that this extends to all organisms and is not limited to *Legionella* spp. Therefore, a good practice point has been developed. GPP18.2 The above GPP covers new builds, but this may not be the case for commissioning of small-scale projects or remedial activities. It is ARHAI Scotland expert opinion that after replacement/remedial activities, water sample analysis results should be approved by the IMT/WSG and a good practice point has been developed to cover this. GPP18.3 Evidence is limited, but consistent in the fact that results need to be recorded and reported to the WSG. ARHAI Scotland expert opinion is that not

Expert opinion
enough detail is provided in the current guidance, but it is important that the board has processes in place for the recording and reporting. It is important that records are kept of results and its distribution, decisions are made promptly and that exceptions are tabled at the WSG meetings. This will aide in the reduction of water–associated infection risks and improves service user safety and confidence.

18.10 Value judgements

Summarise value judgements used by the Working Group in creating the Recommendation/ Good Practice Point; if none were involved, state “none”. Translating evidence into action often involves value judgements, which include guiding principles, ethical considerations, or other beliefs and priorities. Stating them clearly helps users understand their influence on interpreting objective evidence.

Value judgements
None.

18.11 Intentional vagueness

State reasons for any intentional vagueness in the Recommendation/Good Practice Point; if none was intended, state “none”. Recommendations/Good Practice Points should be clear and specific, but if there is a decision to be vague, acknowledging the reasoning clearly promotes transparency. Reasons for vagueness may include inadequate evidence; inability to achieve consensus regarding evidence quality, anticipated benefits/harms, or interpretation of evidence; legal considerations; economic reasons; ethical/religious reasons.

Intentional vagueness
None.

18.12 Exceptions

List situations or circumstances in which the Recommendation/Good Practice Point should not be applied.

Exceptions
None.

18.13 Recommendations for research

List any aspects of the question that require further research.

Recommendations for research
None.

Research question 19: How should routine water test results be interpreted?

Part A: Quality of evidence

19.1 How reliable is the body of evidence? (see SIGN50, section 5.3.1, 5.3.4)

Comment here on the quantity of evidence available on this topic and its methodological quality. Please include citations and evidence levels.

If there is insufficient evidence to answer the key question, go to section B.

Comments	Evidence level
In total, 8 pieces of evidence were identified in relation to this research question which includes: • 3 British standards,[114, 121, 132] • 3 English guidance documents,[115, 125, 127] • 1 guidance from the Republic of Ireland,[124] • 1 guidance published by the WHO.[102] All eight pieces of evidence were deemed to be expert opinions (SIGN50 level 4) due to the lack of a rigorous search and/or methodology in developing the guidance.	8x SIGN50 level 4

19.2 Is the evidence consistent in its conclusions? (see SIGN50, section 5.3.2)

Comment here on the degree of consistency demonstrated by the evidence. Where there are conflicting results, indicate how the group formed a judgement as to the overall direction of the evidence.

Comments
Consideration of multiple factors:

Comments

- There is consistency in four guidance documents that interpretation of water test results can be challenging and multiple factors need to be considered.[102, 121, 125, 132]
    - Examples of these are mentioned in the British Standards (BS 8680:2020 and BS8554:2015) for example water temperature, pH, residual disinfectant, water softeners, water turnover.[121, 132]
    - Three guidance documents (The two British Standards as well as the WHO) mention that it is good practice to record these values to aide interpretation of results and allow for trend analysis.[102, 121, 132]
- BS8554:2015 further adds that multiple samples are required to provide confidence in the interpretation of the condition of the system as a whole, but this is not written in other guidance.[132]

Local versus systemic contamination:

- Two guidance documents (BS7592:2022 and Republic of Ireland guidance) advise that positive pre-flush sample may indicate a local water outlet problem whereas a positive post-flush sample may indicate a systemic contamination.[114, 124]

Interpretation of results:

- Two guidance documents recommend that water test results should be interpreted by a competent person. It is not fully explained what competent entails other than having knowledge of the healthcare environment.[125, 127]

19.3 Is the evidence applicable to Scottish health and care settings? (see SIGN50, section 5.3.3)

For example, do the studies include interventions, comparators or outcomes that are common to Scottish health and care settings?

Comments

There are four guidance documents that are deemed UK codes of practice which are good practice within Scotland.[114, 121, 125, 132] Other guidance documents are

Comments
derived from England, Republic of Ireland and WHO.[102, 115, 124, 125, 127] All are applicable to Scottish health and care settings.

19.4 Are the studies generalisable to the target population?

Comment here on sample size and methods of sample selection. Is the sample representative of the specific population/group of interest? Generalisability is only relevant to primary research studies.

Comments
N/A - no primary studies were identified for this research question.

19.5 Are there concerns about publication bias? (see SIGN50, section 5.3.5)

Comment here on whether there is a risk in the evidence base that studies have been selectively published based on their results (and thus a risk that results from published studies are systematically different from unpublished evidence).

Comments
No concerns.

Part B: Evidence to decision

19.6 Recommendations

What recommendations(s) or good practice point(s) does the Working Group agree are appropriate based on this evidence?

Note the following terminology:

- **"must"** implies that the health and care setting must implement the recommended approach and is used where a recommendation has been directly lifted from legislation or mandatory guidance
- **"should"** implies that the health and care setting "should" implement the recommended approach unless a clear and compelling rationale for an alternative approach is present

- **“should consider”** implies that the health and care setting should consider implementing the recommended approach

Recommendation	Grading
GPP19.1 If water test results are above microbiological limitations, known quantifiable environmental factors (for example water temperature, pH, residual disinfectant, water softeners, water turnover) should be reviewed to aide interpretation of water test results and reviewed along with the water system’s schematic diagram.	Good Practice Point
GPP19.2 Routine water test results should be interpreted as a series of trends (over time) and with an awareness of the systems schematic and current condition.	Good Practice Point
GPP19.3 To ensure prompt decision making, interpretation of water test results that are above microbiological limits should be led by the Infection Prevention and Control Doctor and Consultant Microbiologist.	Good Practice Point
GPP19.4 When interpreting results, the clinical risk associated with the location should be taken into account.	Good Practice Point

19.7 Balancing benefits and harms

Comment here on the potential impact of the Recommendation/Good Practice Point on service users, visitors and staff. Benefits and harms include considerations beyond IPC.

Benefits

List the favourable changes in outcome that would likely occur if the Recommendation/ Good Practice Point were followed correctly. Be explicit, clear about pros.

Benefits
• GPP19.1, GPP19.2, GPP19.4 Awareness of risk can enable control measures to be implemented with the aim of reducing the risk of nosocomial infection which potentially increases service user safety. • GPP19.1, GPP19.2 History of environmental quantifiable factors and routine water test results aides in the interpretation of results, improves knowledge of the water system, potentially provides a timeline of events, and assists in the identification of trends and the interpretation of risk. • GPP19.3 Demonstrates oversight, assurance and accountability for water associated infection control risk management. Together with timely decisions this contributes to a reduction in water–associated infection risks.

Risks and Harms

List the adverse events or other unfavourable outcomes that may occur if the Recommendation/ Good Practice Point were followed correctly. Be explicit, clear about cons.

Risks/Harms
No risks or harms identified.

Benefit-Harm assessment

Classify as “benefits outweigh harms” (or vice versa) or a “balance of benefit and harm.” Description of this balance can be from the individual patient/ staff/ visitor perspective, the societal perspective, or both. Recommendations/ Good Practice Points are possible when clear benefit is not offset by important harms, costs or adverse events (or vice versa).

Benefit-Harm assessment
Only benefits identified.

19.8 Feasibility

Is the Recommendation/ Good Practice Point implementable in the Scottish context? Describe (if applicable) financial implications, opportunity costs, material or human resource requirements, facility needs, sustainability issues, human factors etc., that may be associated with following a Recommendation/ Good Practice Point. State clearly if information on feasibility is lacking.

Feasibility
GPP19.1, GPP19.2, GPP19.4 There may be additional human resource requirements to develop SOPs with actions to be taken. GPP19.2 There may be a requirement to discuss water results with an Authorising Engineer to aide interpretation. GPP19.3 There may be additional education requirements on how to interpret routine water test results for IPC staff. There may be additional human resource requirements for IPC staff to interpret results promptly.

19.9 Expert Opinion

Summarise the expert opinion used in creating the Recommendation/ Good Practice Point; if none were involved, state “none”. Translating evidence into action often involves expert opinion where evidence is insufficient. Clearly outlining expert opinion helps users understand their influence on interpreting objective evidence. Expert opinion may also be required where there is no evidence available.

Expert opinion
GPP19.1 ARHAI Scotland support extant expert opinion guidance (from the British Standards Institution, WHO and UK) that interpretation of water test results can be challenging and multiple factors need to be considered.[102, 121, 125, 132] Examples of

Expert opinion
these are mentioned in the British Standards (BS 8680:2020 and BS8554:2015).[121, 132] Therefore, a good practice point has been developed. GPP19.2 ARHAI Scotland support extant expert opinion guidance (from the British Standards Institution and WHO) that it is good practice to record these values to aide interpretation of results and allow for trend analysis.[102, 121, 132] Therefore, a good practice point has been developed. GPP19.3 During the consultation period of the literature review, comments were received regarding the need for a multidisciplinary team to interpret results. It is ARHAI Scotland opinion that it cannot be the responsibility of the WSG as test results need to be interpretated promptly to avoid any clinical consequences and therefore the responsibility should lie with the IPC team. GPP19.4 It is ARHAI Scotland opinion that when interpreting water test results, the clinical risk associated with the location should be taken into consideration to assist in the evaluation of risk and to implement targeted control measures.

19.10 Value judgements

Summarise value judgements used by the Working Group in creating the Recommendation/Good Practice Point; if none were involved, state “none”. Translating evidence into action often involves value judgements, which include guiding principles, ethical considerations, or other beliefs and priorities. Stating them clearly helps users understand their influence on interpreting objective evidence.

Value judgements
None.

19.11 Intentional vagueness

State reasons for any intentional vagueness in the Recommendation/Good Practice Point; if none was intended, state “none”. Recommendations/Good Practice Points should be clear and specific, but if there is a decision to be vague, acknowledging the reasoning clearly promotes transparency. Reasons for vagueness may include inadequate evidence; inability to achieve consensus regarding evidence quality,

anticipated benefits/harms, or interpretation of evidence; legal considerations; economic reasons; ethical/ religious reasons.

Intentional vagueness
GPP19.1, GPP19.2, GPP19.3 There are challenges in interpreting results owing to the recognised limitations associated with test methods. Regarding *Legionella* spp. testing, this could be poor recovery of *L. pneumophila* due to for example residual disinfectant, heat treatment to repress growth of other non-*Legionella* bacteria and addition of antibiotics to culture medium. For other organisms, there may not be standard UKAS-accredited tests and advice for the interpretation of results. Therefore, good practice points are formed to aide in the interpretation of the water test results and it is recommended that an experienced multidisciplinary team should interpret the water test results.

19.12 Exceptions

List situations or circumstances in which the Recommendation/ Good Practice Point should not be applied.

Exceptions
None.

19.13 Recommendations for research

List any aspects of the question that require further research.

Recommendations for research
It would be beneficial if SOPs/standardised UKAS accredited tests are developed for other healthcare water system-associated organisms. Published peer-reviewed articles that detail interpretation of results will be helpful.

Research question 20: What are the water testing requirements following a positive water test result (in the absence of clinical cases)?

Part A: Quality of evidence

20.1 How reliable is the body of evidence? (see SIGN50, section 5.3.1, 5.3.4)

Comment here on the quantity of evidence available on this topic and its methodological quality. Please include citations and evidence levels.

If there is insufficient evidence to answer the key question, go to section B.

Comments	Evidence level
In total, 8 pieces of evidence were identified in relation to this research question which includes: • 2 Scottish guidance documents,[101, 116] • 2 guidance documents published by the British Standards Institution,[114, 115] • 3 English guidance documents,[126, 127, 131] • 1 guidance document from Republic of Ireland.[124] All eight pieces of evidence were deemed to be expert opinions (SIGN50 level 4) due to the lack of a rigorous search and/or methodology in developing the guidance.	8x SIGN50 level 4

20.2 Is the evidence consistent in its conclusions? (see SIGN50, section 5.3.2)

Comment here on the degree of consistency demonstrated by the evidence. Where there are conflicting results, indicate how the group formed a judgement as to the overall direction of the evidence.

Comments
Resampling:

Comments
There is consistency in six guidance documents that resampling needs to be done after disinfection/remedial actions have taken place to assure that it is/ has been effective/ that the system is not contaminated.[101, 115, 116, 124, 127, 131] Local and systemic contamination: There is an updated guidance of the BSI that does not take into account the cfu/litre, but says that following a positive pre flush sample, a disinfected outlet post flush sample may help differentiate between local and systemic contamination.[114] As mentioned in the previous research question, a positive pre-flush sample may indicate a local water outlet problem whereas a positive post-flush sample may indicate a systemic contamination – this is mentioned in three guidance documents: BS7592:2022, English and Republic of Ireland guidance.[114, 124, 126]

20.3 Is the evidence applicable to Scottish health and care settings? (see SIGN50, section 5.3.3)

For example, do the studies include interventions, comparators or outcomes that are common to Scottish health and care settings?

Comments
Two pieces of evidence are derived from Scotland[101, 116] one is a code of practice within the UK.[114] The other four guidance documents, which are labelled as expert opinion, are derived from the UK (England, Republic of Ireland).[115, 124, 126, 127, 131] Therefore, all are applicable to Scottish health and care settings.

20.4 Are the studies generalisable to the target population?

Comment here on sample size and methods of sample selection. Is the sample representative of the specific population/group of interest? Generalisability is only relevant to primary research studies.

Comments
N/A - no primary studies were identified for this research question.

20.5 Are there concerns about publication bias? (see SIGN50, section 5.3.5)

Comment here on whether there is a risk in the evidence base that studies have been selectively published based on their results (and thus a risk that results from published studies are systematically different from unpublished evidence).

Comments
No concerns.

Part B: Evidence to decision

20.6 Recommendations

What recommendations(s) or good practice point(s) does the Working Group agree are appropriate based on this evidence?

Note the following terminology:

- **"must"** implies that the health and care setting must implement the recommended approach and is used where a recommendation has been directly lifted from legislation or mandatory guidance
- **"should"** implies that the health and care setting "should" implement the recommended approach unless a clear and compelling rationale for an alternative approach is present
- **"should consider"** implies that the health and care setting should consider implementing the recommended approach

Recommendation	Grading
GPP20.1 If coliforms are identified in a water sample, a repeat sample should be collected and tested to rule out a false positive.	Good Practice Point
GPP20.2 Whenever pre-flush sample results remain above the microbiological limits, pre- and post-flush samples should be collected to	Good Practice Point

Recommendation	Grading
ascertain if there is a local or systemic contamination. Where post-flush samples remain above microbiological limits, it may indicate systemic contamination. Negative/low post-flush samples may indicate a local contamination (outlet and/or associated pipework and/or fittings near the outlet).	
GPP20.3 The water system/outlet should be resampled when disinfection/remedial actions have taken place following a positive water test result to ensure the actions undertaken have been effective.	Good Practice Point

20.7 Balancing benefits and harms

Comment here on the potential impact of the Recommendation/Good Practice Point on service users, visitors and staff. Benefits and harms include considerations beyond IPC.

Benefits

List the favourable changes in outcome that would likely occur if the Recommendation/ Good Practice Point were followed correctly. Be explicit, clear about pros.

Benefits
• GPP20.1, GPP20.2, GPP20.3 Resampling could help rule out false positive results when a minority of sampling points test positive and contain a low level of microbial counts. • GPP20.2, GPP20.3 Helps to manage the risk of water system-associated nosocomial infections and will therefore potentially increase service user safety.

Benefits
• GPP20.2 Knowledge that the contamination is likely to be systemic or local enhances the ability to target remedial actions and resolve the water associated infection risk.

Risks and Harms

List the adverse events or other unfavourable outcomes that may occur if the Recommendation/ Good Practice Point were followed correctly. Be explicit, clear about cons.

Risks/Harms
No risks or harms identified.

Benefit-Harm assessment

Classify as “benefits outweigh harms” (or vice versa) or a “balance of benefit and harm.” Description of this balance can be from the individual patient/staff/visitor perspective, the societal perspective, or both. Recommendations/Good Practice Points are possible when clear benefit is not offset by important harms, costs or adverse events (or vice versa).

Benefit-Harm assessment
Only benefits are identified.

20.8 Feasibility

Is the Recommendation/ Good Practice Point implementable in the Scottish context? Describe (if applicable) financial implications, opportunity costs, material or human resource requirements, facility needs, sustainability issues, human factors etc., that may be associated with following a Recommendation/ Good Practice Point. State clearly if information on feasibility is lacking.

Feasibility
• GPP20.1, GPP20.2, GPP20.3 There may be additional material and human resource requirements to perform resampling which will also have financial implications. • GPP20.1, GPP20.2, GPP20.3 Capacity within NHS boards is needed to undertake testing or there may be additional finance required to outsource testing externally if needed.

20.9 Expert Opinion

Summarise the expert opinion used in creating the Recommendation/ Good Practice Point; if none were involved, state “none”. Translating evidence into action often involves expert opinion where evidence is insufficient. Clearly outlining expert opinion helps users understand their influence on interpreting objective evidence. Expert opinion may also be required where there is no evidence available.

Expert opinion
GPP20.1 It is ARHAI Scotland expert opinion that repeat sampling should be undertaken when any water samples identify coliforms. Therefore, a good practice point has been developed advising that when coliforms are identified from a water sample, a repeat sample should be collected and tested to rule out a false positive. This is because coliforms are faecal organisms so it would be unusual to find them in hospital water. In the absence of a potential linked clinical case, it is more likely that the sample has been contaminated either through poor sampling practice or poor hygiene. GPP20.2 ARHAI Scotland support extant expert opinion guidance (from the British Standards Institution, Republic of Ireland HPSC and UK) that a positive pre-flush sample may indicate a local water outlet problem whereas a positive post-flush sample may indicate a systemic contamination – this is mentioned in three guidance documents: BS7592:2022, English and Republic of Ireland guidance.[114, 124, 126] GPP20.3 ARHAI Scotland support extant expert opinion guidance (from the British Standards Institution, Scotland and UK) that resampling needs to be done after

Expert opinion
disinfection/remedial actions have been taken place to assure that it is/ has been effective/ that the system is not contaminated.[101, 115, 116, 124, 127, 131] Therefore, a good practice point has been developed.

20.10 Value judgements

Summarise value judgements used by the Working Group in creating the Recommendation/Good Practice Point; if none were involved, state “none”. Translating evidence into action often involves value judgements, which include guiding principles, ethical considerations, or other beliefs and priorities. Stating them clearly helps users understand their influence on interpreting objective evidence.

Value judgements
None

20.11 Intentional vagueness

State reasons for any intentional vagueness in the Recommendation/Good Practice Point; if none was intended, state “none”. Recommendations/Good Practice Points should be clear and specific, but if there is a decision to be vague, acknowledging the reasoning clearly promotes transparency. Reasons for vagueness may include inadequate evidence; inability to achieve consensus regarding evidence quality, anticipated benefits/harms, or interpretation of evidence; legal considerations; economic reasons; ethical/religious reasons.

Intentional vagueness
None

20.12 Exceptions

List situations or circumstances in which the Recommendation/Good Practice Point should not be applied.

Exceptions
None.

20.13 Recommendations for research

List any aspects of the question that require further research.

Recommendations for research
None.

Research question 21: What action(s) (remedial and/or clinical) should be taken following a positive water test result (in the absence of clinical cases)?

Part A: Quality of evidence

21.1 How reliable is the body of evidence? (see SIGN50, section 5.3.1, 5.3.4)

Comment here on the quantity of evidence available on this topic and its methodological quality. Please include citations and evidence levels.

If there is insufficient evidence to answer the key question, go to section B.

Comments	Evidence level
In total, 10 pieces of evidence were identified in relation to this research question which includes: • 6 expert opinion guidance documents (SIGN50 level 4),[101,125-127, 131,124] • 2 guidance documents published by the British Standards Institution (SIGN50 level 4),[115, 122] • 2 international guidelines (CDC and WHO) (SIGN50 level 4).[95,141] All 10 guidance documents were deemed to be expert opinions and in accordance with SIGN50 methodology are graded level 4 evidence.[95, 101, 115, 122, 124-127, 131, 134]	10x SIGN50 level 4

21.2 Is the evidence consistent in its conclusions? (see SIGN50, section 5.3.2)

Comment here on the degree of consistency demonstrated by the evidence. Where there are conflicting results, indicate how the group formed a judgement as to the overall direction of the evidence.

Comments
All UK guidance mention that disinfection should be considered, but that an immediate review of control measures and risk assessment should be carried out to identify any other remedial action required.[101, 115, 122,125-127, 131] Only a couple guidance documents mention examples of remedial actions which do have consistency in disinfection or removal of the system/outlet, but they mention slightly different examples such as flushing of outlets.[122, 134]

21.3 Is the evidence applicable to Scottish health and care settings? (see SIGN50, section 5.3.3)

For example, do the studies include interventions, comparators or outcomes that are common to Scottish health and care settings?

Comments
Two pieces are code of practice within the UK.[122, 125] Six other guidance, which are also labelled as expert opinion, are derived from Scotland and countries with similar practice (England and Republic of Ireland).[101,126, 127, 131,124] Two international guidelines are from WHO and the US (SIGN50 level 4).[95, 134] All are applicable to Scottish health and care settings.

21.4 Are the studies generalisable to the target population?

Comment here on sample size and methods of sample selection. Is the sample representative of the specific population/group of interest? Generalisability is only relevant to primary research studies.

Comments
N/A - no primary studies were identified for this research question.

21.5 Are there concerns about publication bias? (see SIGN50, section 5.3.5)

Comment here on whether there is a risk in the evidence base that studies have been selectively published based on their results (and thus a risk that results from published studies are systematically different from unpublished evidence).

Comments
No concerns.

Part B: Evidence to decision

21.6 Recommendations

What recommendations(s) or good practice point(s) does the Working Group agree are appropriate based on this evidence?

Note the following terminology:

- **"must"** implies that the health and care setting must implement the recommended approach and is used where a recommendation has been directly lifted from legislation or mandatory guidance
- **"should"** implies that the health and care setting "should" implement the recommended approach unless a clear and compelling rationale for an alternative approach is present
- **"should consider"** implies that the health and care setting should consider implementing the recommended approach

Recommendation	Grading
GPP21.1 Following a positive water test result, an immediate review of existing control measures and risk assessment by the IPC team and estates team should be carried out to identify additional remedial/clinical actions required.	Good Practice Point
GPP21.2 Remedial actions should be determined based on consideration of the water test results in context with the water system as a whole, for instance considering routine control measures (for example temperature control, pressure control, flushing, disinfection) as well as chemical and potability analysis results.	Good Practice Point

21.7 Balancing benefits and harms

Comment here on the potential impact of the Recommendation/Good Practice Point on service users, visitors and staff. Benefits and harms include considerations beyond IPC.

Benefits

List the favourable changes in outcome that would likely occur if the Recommendation/ Good Practice Point were followed correctly. Be explicit, clear about pros.

Benefits
GPP21.1, GPP21.2 Awareness of risk and consideration of water results allows the remedial actions to be identified and appropriate action can be undertaken with the aim of reducing the risk of nosocomial infection and increase the safety of service users. GPP21.1, GPP21.2 Demonstrates organisational response, assurance and accountability for water associated infection control risk management.

Risks and Harms

List the adverse events or other unfavourable outcomes that may occur if the Recommendation/ Good Practice Point were followed correctly. Be explicit, clear about cons.

Risks/Harms
GPP21.2 Some control measures (for example if major engineering modifications are required) might impact or disrupt healthcare provision and impact patients and/or services.

Benefit-Harm assessment

Classify as “benefits outweigh harms” (or vice versa) or a “balance of benefit and harm.” Description of this balance can be from the individual patient/ staff/ visitor perspective, the societal perspective, or both. Recommendations/ Good Practice

Points are possible when clear benefit is not offset by important harms, costs or adverse events (or vice versa).

Benefit-Harm assessment
Benefits outweigh harms.

21.8 Feasibility

Is the Recommendation/ Good Practice Point implementable in the Scottish context? Describe (if applicable) financial implications, opportunity costs, material or human resource requirements, facility needs, sustainability issues, human factors etc., that may be associated with following a Recommendation/ Good Practice Point. State clearly if information on feasibility is lacking.

Feasibility
GPP21.1, GPP21.2 There may be financial implications due to material and human resource requirements to undertake the remedial and/or clinical actions that are identified. GPP21.1 There may be additional human resource requirements to carry out the review of control measures/risk assessment, it may be challenging to do this in busy boards.

21.9 Expert Opinion

Summarise the expert opinion used in creating the Recommendation/ Good Practice Point; if none were involved, state “none”. Translating evidence into action often involves expert opinion where evidence is insufficient. Clearly outlining expert opinion helps users understand their influence on interpreting objective evidence. Expert opinion may also be required where there is no evidence available.

Expert opinion
GPP21.1 ARHAI Scotland support extant expert opinion guidance (from the UK) that following a positive water test result, an immediate review of control measures

Expert opinion
and risk assessment should be carried out to identify any other remedial action required.[101, 115, 122,125-127, 131] GPP21.2 It is ARHAI Scotland opinion that remedial actions should be determined based on consideration of the water test results in context with the water system as a whole and also chemical and potability analysis results for the reason that microbial growth and survival are dependent on a number of environmental factors. Therefore, a good practice point has been developed.

21.10 Value judgements

Summarise value judgements used by the Working Group in creating the Recommendation/Good Practice Point; if none were involved, state “none”. Translating evidence into action often involves value judgements, which include guiding principles, ethical considerations, or other beliefs and priorities. Stating them clearly helps users understand their influence on interpreting objective evidence.

Value judgements
None.

21.11 Intentional vagueness

State reasons for any intentional vagueness in the Recommendation/ Good Practice Point; if none was intended, state “none”. Recommendations/Good Practice Points should be clear and specific, but if there is a decision to be vague, acknowledging the reasoning clearly promotes transparency. Reasons for vagueness may include inadequate evidence; inability to achieve consensus regarding evidence quality, anticipated benefits/harms, or interpretation of evidence; legal considerations; economic reasons; ethical/ religious reasons.

Intentional vagueness
Evidence is not specific towards remedial/clinical actions, some guidance documents provide actions to consider. This is because the remedial actions taken should be dependent on the organism identified, contamination level, patient group, clinical activities undertaken and sample location as well as being specific to the

Intentional vagueness
water system installed. Examples of remedial actions typically include measures to ensure the water system is functioning within the intended parameters and may include improvements to ensure intended water temperatures and water flow are maintained, such as removal of dead legs and identification of little used outlets.

21.12 Exceptions

List situations or circumstances in which the Recommendation/ Good Practice Point should not be applied.

Exceptions
None.

21.13 Recommendations for research

List any aspects of the question that require further research.

Recommendations for research
None.

Research question 22: Is routine environmental testing for healthcare water system-associated organisms recommended?

Part A: Quality of evidence

22.1 How reliable is the body of evidence? (see SIGN50, section 5.3.1, 5.3.4)

Comment here on the quantity of evidence available on this topic and its methodological quality. Please include citations and evidence levels.

If there is insufficient evidence to answer the key question, go to section B.

Comments	Evidence level
In total, 5 pieces of evidence were identified in relation to this research question which includes: • 3 expert opinion guidance documents (SIGN50 level 4),[112, 127, 131] • 1 guidance document published by the British Standards Institution (SIGN50 level 4),[122] • 1 international guidelines (CDC) (AGREE 'Recommend').[95] There are some limitations to the evidence as it all low quality (SIGN50 level 4). The included guidance documents that were deemed expert opinion lack a rigorous search and/or methodology while developing the guidance and often refer to the same reference source. The CDC guidelines are mostly based on studies published pre-2000 which is a limitation as it might not reflect current IPC practices.	5x SIGN50 level 4

22.2 Is the evidence consistent in its conclusions? (see SIGN50, section 5.3.2)

Comment here on the degree of consistency demonstrated by the evidence. Where there are conflicting results, indicate how the group formed a judgement as to the overall direction of the evidence.

Comments
There is consistency amongst the four expert opinions and the international guideline that environmental routine testing has to be decided per risk assessment.[95, 112, 122, 127, 131] None of the guidance documents are specific towards recommending routine environmental surface testing, but routine air sampling is recommended fortnightly for cardiac HCUs as this is a known reservoir of healthcare water system-associated organisms dispersed in aerosols which can indirectly infect patients undergoing cardiac surgery. [112] As demonstrated in the section “What are the causes/sources of environmental contamination with healthcare water system-associated organisms?", environmental reservoirs exist for these organisms and these reservoirs are not routinely cleaned (examples being sink and shower drains). In this regard, there is currently inconsistency between extant guidance (currently no recommendation for environmental testing) and the primary scientific literature; outbreak studies consistently demonstrate that healthcare water fittings and fixtures can be environmental reservoirs for water system-associated organisms and may persist as reservoirs if the contamination is not appropriately managed.

22.3 Is the evidence applicable to Scottish health and care settings? (see SIGN50, section 5.3.3)

For example, do the studies include interventions, comparators or outcomes that are common to Scottish health and care settings?

Comments
One guidance document is Scottish[112] and one is code of practice within the UK.[122] Other guidance are derived from England,[127, 131] and the US.[95] All are applicable to Scotland.

22.4 Are the studies generalisable to the target population?

Comment here on sample size and methods of sample selection. Is the sample representative of the specific population/group of interest? Generalisability is only relevant to primary research studies.

Comments
N/A - no primary studies were identified for this research question.

22.5 Are there concerns about publication bias? (see SIGN50, section 5.3.5)

Comment here on whether there is a risk in the evidence base that studies have been selectively published based on their results (and thus a risk that results from published studies are systematically different from unpublished evidence).

Comments
No concerns.

Part B: Evidence to decision

22.6 Recommendations

What recommendations(s) or good practice point(s) does the Working Group agree are appropriate based on this evidence?

Note the following terminology:

- **"must"** implies that the health and care setting must implement the recommended approach and is used where a recommendation has been directly lifted from legislation or mandatory guidance

- **"should"** implies that the health and care setting "should" implement the recommended approach unless a clear and compelling rationale for an alternative approach is present
- **"should consider"** implies that the health and care setting should consider implementing the recommended approach

Recommendation	Grading
GPP22.1 The need for routine environmental sampling (surface swabbing) for healthcare water system-associated organisms and its frequency should be based on a risk assessment taking into account prior incident/outbreak information and should be part of an overall management strategy. Risk assessment may include (but is not limited to): sampling history (clinical and environmental), system design, system materials, temperature control, water use, retrograde contamination risks, patient group/clinical risks and building use and should be designed to assure a safe environment for at-risk patient groups and to consider effectiveness of any decontamination methods in use.	Good Practice Point
GPP22.2 Routine air sampling is recommended fortnightly for cardiac heater cooler units (HCUs).	Good Practice Point

22.7 Balancing benefits and harms

Comment here on the potential impact of the Recommendation/Good Practice Point on service users, visitors and staff. Benefits and harms include considerations beyond IPC.

Benefits

List the favourable changes in outcome that would likely occur if the Recommendation/ Good Practice Point were followed correctly. Be explicit, clear about pros.

Benefits
• GPP22.1 History of routine environmental test results could improve knowledge of the water system, provide a timeline of contamination events, and could assist in the identification of trends and the interpretation of risk. • GPP22.2 Regular air sampling of cardiac heater cooler units enables identification of developing safety risks. • GPP22.1, GPP22.2 Awareness of risk enables control measures to be implemented with the aim of reducing the risk of nosocomial transmission and increases the safety of service users.

Risks and Harms

List the adverse events or other unfavourable outcomes that may occur if the Recommendation/ Good Practice Point were followed correctly. Be explicit, clear about cons.

Risks/Harms
No risks or harms identified.

Benefit-Harm assessment

Classify as “benefits outweigh harms” (or vice versa) or a “balance of benefit and harm.” Description of this balance can be from the individual patient/ staff/ visitor perspective, the societal perspective, or both. Recommendations/ Good Practice Points are possible when clear benefit is not offset by important harms, costs or adverse events (or vice versa).

Benefit-Harm assessment
Only benefits identified.

22.8 Feasibility

Is the Recommendation/ Good Practice Point implementable in the Scottish context? Describe (if applicable) financial implications, opportunity costs, material or human resource requirements, facility needs, sustainability issues, human factors etc., that may be associated with following a Recommendation/ Good Practice Point. State clearly if information on feasibility is lacking.

Feasibility
• GPP22.1, GPP22.2 There may be financial implications due to material and human resource requirements to perform sampling and testing. • GPP22.1, GPP22.2 There may be resource and financial implications in relation to staff education and training on how to perform sampling and its interpretation. • GPP22.1, GPP22.2 There may not be standard UKAS-accredited tests available for all organisms.

22.9 Expert Opinion

Summarise the expert opinion used in creating the Recommendation/ Good Practice Point; if none were involved, state “none”. Translating evidence into action often involves expert opinion where evidence is insufficient. Clearly outlining expert opinion helps users understand their influence on interpreting objective evidence. Expert opinion may also be required where there is no evidence available.

Expert opinion
GPP22.1 ARHAI Scotland support extant guidance (expert opinion) that environmental routine testing has to be decided per risk assessment.[95, 112, 122, 127, 131] It is ARHAI Scotland opinion that it is important to take prior incident and outbreak information into account when deciding on the need and frequency for routine environmental sampling. Past incidents or outbreaks may help identify specific locations within the healthcare facility where water system-associated organisms were previously detected or where infections occurred. This information allows for targeted and focused sampling in areas that pose a higher risk of contamination. Analysing historical data also provides insights into patterns and

Expert opinion
trends related to the occurrence of environmental reservoirs of water system-associated organisms. Knowledge of environmental sources can support development of measures to break the chain of transmission from those sources to patients. GPP22.2 ARHAI Scotland support extant guidance (expert opinion and international guidelines) that routine air sampling is recommended fortnightly for cardiac HCUs as this is a known reservoir of healthcare water system-associated organisms dispersed in aerosols which can indirectly infect patients undergoing cardiac surgery.[112] Therefore, a good practice point has been developed.

22.10 Value judgements

Summarise value judgements used by the Working Group in creating the Recommendation/ Good Practice Point; if none were involved, state “none”. Translating evidence into action often involves value judgements, which include guiding principles, ethical considerations, or other beliefs and priorities. Stating them clearly helps users understand their influence on interpreting objective evidence.

Value judgements
None.

22.11 Intentional vagueness

State reasons for any intentional vagueness in the Recommendation/ Good Practice Point; if none was intended, state “none”. Recommendations/ Good Practice Points should be clear and specific, but if there is a decision to be vague, acknowledging the reasoning clearly promotes transparency. Reasons for vagueness may include inadequate evidence; inability to achieve consensus regarding evidence quality, anticipated benefits/harms, or interpretation of evidence; legal considerations; economic reasons; ethical/ religious reasons.

Intentional vagueness
A risk assessment, rather than specific environmental locations, has been advised in GPP22.1. Advising a risk assessment allows boards to assess the specifics of

Intentional vagueness
the local system and develop a plan for environmental sampling that will support a safe environment. As evidenced in research question 3 ('What are the causes/sources…'), sixty reports describe microbial proliferation/contamination of the plumbing infrastructure mainly at distal outlets and/or drains. As a minimum, environmental sampling should be considered where there is a history of clinical cases involving environmental organisms but water samples have remained compliant.

22.12 Exceptions

List situations or circumstances in which the Recommendation/ Good Practice Point should not be applied.

Exceptions
None.

22.13 Recommendations for research

List any aspects of the question that require further research.

Recommendations for research
Studies that provide evidence regarding long-term environmental sampling and its potential benefits would be helpful.

Research question 23: Are there any specific actions required if an outlet tests positive pre-flush but negative post-flush?

Part A: Quality of evidence

23.1 How reliable is the body of evidence? (see SIGN50, section 5.3.1, 5.3.4)

Comment here on the quantity of evidence available on this topic and its methodological quality. Please include citations and evidence levels.

If there is insufficient evidence to answer the key question, go to section B.

Comments	Evidence level
Four pieces of evidence were identified to inform this research question including: • 2 guidance documents published by the British Standards Institution,[114, 115] • 1 English guidance document,[126] • 1 guidance document from the Republic of Ireland.[124] All four pieces of evidence were deemed to be expert opinions due to the lack of a rigorous search and/or methodology in developing the guidance.[114, 115, 124, 126] In accordance with SIGN50 methodology, these four expert opinions are graded level 4 evidence.[114, 115, 124, 126] The small amount and low quality of evidence identified is a limitation for this question.	4x SIGN50 level 4

23.2 Is the evidence consistent in its conclusions? (see SIGN50, section 5.3.2)

Comment here on the degree of consistency demonstrated by the evidence. Where there are conflicting results, indicate how the group formed a judgement as to the overall direction of the evidence.

Comments
There is a limited amount of evidence that specifically mentions positive pre-flush but negative post-flush, but there is consensus amongst the four identified guidance documents that contamination is likely to be local in the case of a positive pre-flush and negative post-flush.[114, 115, 124, 126] The guidance documents published by the British Standards Institution also mention the possibility of false negatives and how to prevent this.[114, 115]

23.3 Is the evidence applicable to Scottish health and care settings? (see SIGN50, section 5.3.3)

For example, do the studies include interventions, comparators or outcomes that are common to Scottish health and care settings?

Comments
One guidance is a code of practice within the UK[114] and the other guidance, which are also labelled as expert opinion, are derived from countries with similar practice (England[115, 126] and Republic of Ireland[124]). All are applicable to Scottish health and care settings.

23.4 Are the studies generalisable to the target population?

Comment here on sample size and methods of sample selection. Is the sample representative of the specific population/group of interest? Generalisability is only relevant to primary research studies.

Comments
N/A - no primary studies were identified for this research question.

23.5 Are there concerns about publication bias? (see SIGN50, section 5.3.5)

Comment here on whether there is a risk in the evidence base that studies have been selectively published based on their results (and thus a risk that results from published studies are systematically different from unpublished evidence).

Comments
No concerns.

Part B: Evidence to decision

23.6 Recommendations

What recommendations(s) or good practice point(s) does the Working Group agree are appropriate based on this evidence?

Note the following terminology:

- **"must"** implies that the health and care setting must implement the recommended approach and is used where a recommendation has been directly lifted from legislation or mandatory guidance
- **"should"** implies that the health and care setting "should" implement the recommended approach unless a clear and compelling rationale for an alternative approach is present
- **"should consider"** implies that the health and care setting should consider implementing the recommended approach

Recommendation	Grading
GPP23.1 Remedial measures should be directed towards the outlet (and associated pipework and fittings) when post-flush samples are negative or have low counts as this indicates a local contamination.	Good Practice Point

23.7 Balancing benefits and harms

Comment here on the potential impact of the Recommendation/Good Practice Point on service users, visitors and staff. Benefits and harms include considerations beyond IPC.

Benefits

List the favourable changes in outcome that would likely occur if the Recommendation/ Good Practice Point were followed correctly. Be explicit, clear about pros.

Benefits
• GPP23.1 Targeted actions based on the water test results may provide a more efficient approach to resolving any identified issues. • GPP23.1 Targeted actions might reduce risk of water system-associated nosocomial infections which potentially leads to increased service user safety.

Risks and Harms

List the adverse events or other unfavourable outcomes that may occur if the Recommendation/ Good Practice Point were followed correctly. Be explicit, clear about cons.

Risks/Harms
GPP23.1 The sampler needs to be aware of the possibility that the post-remedial action test can fail to detect the organisms and/or contaminated water outlets can be missed due to the continued action of biocides after sample collection (repeat sampling to exclude false negatives may be required). The results are representing the taken samples and not the entire water system. The results should not be interpreted in isolation and further sampling may be required and taken in the context of the entire water system.

Benefit-Harm assessment

Classify as “benefits outweigh harms” (or vice versa) or a “balance of benefit and harm.” Description of this balance can be from the individual patient/ staff/ visitor perspective, the societal perspective, or both. Recommendations/ Good Practice Points are possible when clear benefit is not offset by important harms, costs or adverse events (or vice versa).

Benefit-Harm assessment
Benefits outweigh harms.

23.8 Feasibility

Is the Recommendation/ Good Practice Point implementable in the Scottish context? Describe (if applicable) financial implications, opportunity costs, material or human resource requirements, facility needs, sustainability issues, human factors etc., that may be associated with following a Recommendation/Good Practice Point. State clearly if information on feasibility is lacking.

Feasibility
• GPP23.1 There may be financial implications due to material and human resource requirements to perform sampling and testing. • GPP23.1 There may be resource and financial implications in relation to staff education and training on how to perform sampling and its interpretation. • GPP23.1 There may not be standard UKAS-accredited tests available for all organisms.

23.9 Expert Opinion

Summarise the expert opinion used in creating the Recommendation/ Good Practice Point; if none were involved, state “none”. Translating evidence into action often involves expert opinion where evidence is insufficient. Clearly outlining expert opinion helps users understand their influence on interpreting objective evidence. Expert opinion may also be required where there is no evidence available.

Expert opinion
GPP23.1 ARHAI Scotland support extant expert opinion guidance (from the Republic of Ireland HPSC and UK) that contamination is likely to be local in the case of a positive pre-flush and negative post-flush and therefore a good practice point has been developed.[114, 115, 124, 126]

23.10 Value judgements

Summarise value judgements used by the Working Group in creating the Recommendation/ Good Practice Point; if none were involved, state “none”. Translating evidence into action often involves value judgements, which include guiding principles, ethical considerations, or other beliefs and priorities. Stating them clearly helps users understand their influence on interpreting objective evidence.

Value judgements
None.

23.11 Intentional vagueness

State reasons for any intentional vagueness in the Recommendation/ Good Practice Point; if none was intended, state “none”. Recommendations/ Good Practice Points should be clear and specific, but if there is a decision to be vague, acknowledging the reasoning clearly promotes transparency. Reasons for vagueness may include inadequate evidence; inability to achieve consensus regarding evidence quality, anticipated benefits/harms, or interpretation of evidence; legal considerations; economic reasons; ethical/ religious reasons.

Intentional vagueness
None.

23.12 Exceptions

List situations or circumstances in which the Recommendation/Good Practice Point should not be applied.

Exceptions
None.

23.13 Recommendations for research

List any aspects of the question that require further research.

Recommendations for research
None.

Research question 24: Are there any recommended methods for the removal of healthcare water system contamination?

Part A: Quality of evidence

24.1 How reliable is the body of evidence? (see SIGN50, section 5.3.1, 5.3.4)

Comment here on the quantity of evidence available on this topic and its methodological quality. Please include citations and evidence levels.

If there is insufficient evidence to answer the key question, go to section B.

Comments	Evidence level
In total, 48 pieces of evidence were identified in relation to this research question which includes: • 41 outbreak studies (SIGN50 level 3),[8, 9, 13-17, 19, 21, 22, 26, 27, 29-43, 45-47, 50, 51, 55, 57, 58, 63-65, 67, 79, 87] • 2 case reports (SIGN50 level 3),[92, 98] • 2 intervention studies (SIGN50 level 3),[56, 90] • 3 expert opinion guidance documents (SIGN50 level 4).[95, 124, 136] Of the primary scientific evidence included, the majority (n=41) consists of outbreak studies where more than one method of removal was implemented often at the same time (or as a result of the first attempt having failed), and removal methods implemented at the same time as other IPC remedial measures. The two intervention studies are observational therefore were graded SIGN50 level 3. Consequently, this body of evidence is considered low quality.	45 x SIGN50 level 3 3x SIGN50 level 4

Comments	Evidence level
Three guidance documents[95,124, 136] are assessed as expert opinion due to lack of a systematic and rigorous underlying evidence base.	

24.2 Is the evidence consistent in its conclusions? (see SIGN50, section 5.3.2)

Comment here on the degree of consistency demonstrated by the evidence. Where there are conflicting results, indicate how the group formed a judgement as to the overall direction of the evidence.

Comments
This research question is not concerned with the routine management of healthcare water systems to maintain safe water however it is acknowledged that in response to an infection incident or outbreak, efforts may focus on improvements to routine management (for example where noncompliance or failure of routine processes has been identified). Generally, the methods for removal of contamination described in the literature can be categorised as chemical disinfection, heat treatment or physical removal/replacement of parts/systems: • Chemical disinfection either of the outlet(s) or the water system itself was described in 29 studies.[8, 9, 13-17, 19, 22, 27, 29, 30, 33, 35, 42, 43, 46, 47, 50, 55, 63, 65, 87, 92, 95, 98, 124, 136] • Heat treatment was described in 10 studies, solely or in combination with chemical disinfection.[13, 15, 36, 42, 56, 63, 65, 90, 92, 98] • Physical removal/replacement of sinks, pipes, taps and associated fittings was described in 37 studies.[8, 9, 13, 15-17, 19, 21, 22, 26, 27, 29, 31-35, 37-43, 45, 50, 51, 55-58, 64, 65, 79, 90, 92, 98, 137] For emergency disinfection in response to infection incidents and outbreaks, literature was unable to demonstrate a superior or universal disinfection method (or bundle of methods). This is in part due to the limitations of the evidence base, as most outbreak studies fail to appropriately evaluate the success of

Comments
interventions. It must also be acknowledged that disinfection methods work at their optimal performance within different parameters, and this variation in parameters is high across the settings described in the included studies. This limits the ability for comparison. Extant guidance (SHTM 04-01 Part D; Republic of Ireland HPSC guidance; CDC guidance) is mainly focused on routine disinfection of water systems for the control of *Legionella* spp. There is limited information in guidance both on emergency disinfection in response to outbreaks involving microorganisms other than *Legionella* spp., and on disinfection of distal outlets and drains. In summary, it was not possible to conclude a superior disinfection method or bundle of disinfection methods for the removal of microbial contamination. Therefore, good practice points rather than recommendations have been developed for this research question.

24.3 Is the evidence applicable to Scottish health and care settings? (see SIGN50, section 5.3.3)

For example, do the studies include interventions, comparators or outcomes that are common to Scottish health and care settings?

Comments
One guidance document is derived from Scotland,[136] one from Ireland,[124] and one from the US.[95] Other evidence is derived from developed countries which is fairly applicable but there might be some differences in IPC interventions between the different countries.

24.4 Are the studies generalisable to the target population?

Comment here on sample size and methods of sample selection. Is the sample representative of the specific population/group of interest? Generalisability is only relevant to primary research studies.

Comments
Not applicable. All evidence was observational (uncontrolled).

24.5 Are there concerns about publication bias? (see SIGN50, section 5.3.5)

Comment here on whether there is a risk in the evidence base that studies have been selectively published based on their results (and thus a risk that results from published studies are systematically different from unpublished evidence).

Comments
Yes - there is a possibility of publication bias as not all outbreaks/infection incidents are published in scientific journals and the methods of controlling the outbreak are not always mentioned. A formal assessment of publication bias was not conducted.

Part B: Evidence to decision

24.6 Recommendations

What recommendations(s) or good practice point(s) does the Working Group agree are appropriate based on this evidence?

Note the following terminology:

- **"must"** implies that the health and care setting must implement the recommended approach and is used where a recommendation has been directly lifted from legislation or mandatory guidance
- **"should"** implies that the health and care setting "should" implement the recommended approach unless a clear and compelling rationale for an alternative approach is present
- **"should consider"** implies that the health and care setting should consider implementing the recommended approach

Recommendation	Grading
GPP24.1 If there is a clinical need to retain the outlet, the following methods (acknowledging that more than one method may be required) should be considered by the water safety group (WSG) and/or incident	Good Practice Point

Recommendation	Grading
management team (IMT) when attempting to remove or reduce microbial contamination at the outlet (inclusive of the drain); disinfection (chemical and/or heat treatment), physical replacement of parts of the outlet or the entire outlet.	
GPP24.2 Whole system water disinfection may be appropriate if contamination is suspected to extend beyond the outlet (further back in the system).	Good Practice Point
GPP24.3 When considering the most suitable method of whole water system disinfection (of the entire system or isolated loops), the advantages and disadvantages should be considered as outlined in (SHTM) 04-01 part D 'Disinfection of Domestic Water Systems'.	Good Practice Point
GPP24.4 Where possible, assessment of the success of a removal method or combined removal methods should be undertaken by carrying out environmental sampling pre- and post- intervention.	Good Practice Point

24.7 Balancing benefits and harms

Comment here on the potential impact of the Recommendation/Good Practice Point on service users, visitors and staff. Benefits and harms include considerations beyond IPC.

Benefits

List the favourable changes in outcome that would likely occur if the Recommendation/ Good Practice Point were followed correctly. Be explicit, clear about pros.

Benefits
GPP24.1, GPP24.3, and GPP 24.4 highlight that multiple methods may be required to achieve removal or reduction of contamination and that the success of removal methods should be assessed. If this is applied, it will provide assurance that water outlets or the water system are safe for use.

Risks and Harms

List the adverse events or other unfavourable outcomes that may occur if the Recommendation/ Good Practice Point were followed correctly. Be explicit, clear about cons.

Risks/ Harms
There may be specific adverse events related to the type or method of disinfection implemented. For example, damage to the materials of fixtures and fittings caused by biocides, risk of scalding with certain heat treatments. These are feasibility issues that, when considered, may result in a different disinfection/removal method being pursued.

Benefit-Harm assessment

Classify as “benefits outweigh harms” (or vice versa) or a “balance of benefit and harm.” Description of this balance can be from the individual patient/ staff/ visitor perspective, the societal perspective, or both. Recommendations/ Good Practice Points are possible when clear benefit is not offset by important harms, costs or adverse events (or vice versa).

Benefit-Harm assessment
It is anticipated that benefits will outweigh harms.

24.8 Feasibility

Is the Recommendation/ Good Practice Point implementable in the Scottish context? Describe (if applicable) financial implications, opportunity costs, material or human resource requirements, facility needs, sustainability issues, human factors etc., that

may be associated with following a Recommendation/Good Practice Point. State clearly if information on feasibility is lacking.

Feasibility
• GPP24.1, GPP24.2, GPP24.3 There will be a need for experienced staff to consider the various removal methods available. • GPP24.1 There may be challenges with the removal of outlets in Private Finance Initiative (PFI) / private buildings. • GPP24.1, GPP24.2, GPP24.3 There may be financial implications due to material and human resource requirements to perform the remedial actions. • GPP24.1, GPP24.2, GPP24.3 There may be an impact on service delivery if the water system is temporarily out of commission; there may be a need to provide alternative sources of water or to decant patients to another care area. • GPP24.1, GPP24.2, GPP24.3 There is a possibility that in some scenarios, it may not be feasible to maintain a contamination-free outlet indefinitely and repeated attempts at disinfection may be required to reduce the risk of onwards transmission. • GPP24.4 There will be costs and resources associated with undertaking additional water sampling and/or environmental swabbing pre and post intervention. This is dependent also on access to laboratory support and having experienced staff to undertake the sampling and to interpret the results.

24.9 Expert Opinion

Summarise the expert opinion used in creating the Recommendation/ Good Practice Point; if none were involved, state “none”. Translating evidence into action often involves expert opinion where evidence is insufficient. Clearly outlining expert opinion helps users understand their influence on interpreting objective evidence. Expert opinion may also be required where there is no evidence available.

Expert opinion
ARHAI Scotland acknowledge that there is an absence of available evidence to inform emergency remedial actions for the removal or reduction of contamination at outlets and within water systems. Consequently, good practice points have been developed to highlight the need for NHS boards to consider the various disinfection/removal methods available that will be appropriate for the specific water system and clinical setting in question. Where this knowledge is not currently available in boards, there will be a need for NHS Scotland Assure to support boards in identifying options and making decisions. For GPP24.4: In some circumstances, it may not be possible to undertake pre-intervention environmental sampling, especially if there is a need to move swiftly to rectify a contamination issue. In these cases, it is ARHAI Scotland opinion that post-intervention sampling should still be undertaken to assess whether the outlet or water system still poses a risk.

24.10 Value judgements

Summarise value judgements used by the Working Group in creating the Recommendation/ Good Practice Point; if none were involved, state “none”. Translating evidence into action often involves value judgements, which include guiding principles, ethical considerations, or other beliefs and priorities. Stating them clearly helps users understand their influence on interpreting objective evidence.

Value judgements
None.

24.11 Intentional vagueness

State reasons for any intentional vagueness in the Recommendation/Good Practice Point; if none was intended, state “none”. Recommendations/Good Practice Points should be clear and specific, but if there is a decision to be vague, acknowledging the reasoning clearly promotes transparency. Reasons for vagueness may include inadequate evidence; inability to achieve consensus regarding evidence quality,

anticipated benefits/harms, or interpretation of evidence; legal considerations; economic reasons; ethical/ religious reasons.

Intentional vagueness
Consistency across specific disinfection methods is not feasible as they all work at their optimal performance within different parameters and thus no universal approach to disinfection can be recommended. Consequently, the good practice points suggest that a range of methods are assessed for appropriateness, but boards will have to determine the most appropriate and suitable approach depending on local parameters, with support from NHS Scotland Assure.

24.12 Exceptions

List situations or circumstances in which the Recommendation/ Good Practice Point should not be applied.

Exceptions
None.

24.13 Recommendations for research

List any aspects of the question that require further research.

Recommendations for research
When considering the most appropriate method(s) for the removal of healthcare water associated organisms, it might be beneficial to review the materials and/or the design of the outlet as some materials/designs are more prone to contamination whereas others are designed to reduce contamination/biofilm (outwith the remit of this review). More research and guidance on drain decontamination is required, as well as prospective studies to inform guidance on disinfection methods at the outlet and in response to infection incidents and outbreaks.

Research question 25: What flushing regimes are recommended for healthcare settings?

Part A: Quality of evidence

25.1 How reliable is the body of evidence? (see SIGN50, section 5.3.1, 5.3.4)

Comment here on the quantity of evidence available on this topic and its methodological quality. Please include citations and evidence levels.

If there is insufficient evidence to answer the key question, go to section B.

Comments	Evidence level
In total, 8 pieces of evidence were identified to inform recommendations on this subject which includes: • 2 Scottish guidance documents,[101, 138] • 2 guidance documents published by the British Standards Institution,[115, 122] • 2 English guidance documents,[125, 139] • 1 guidance document from the Republic of Ireland,[124] • 1 environmental surveillance study.[140] All included guidance were deemed to be expert opinions and in accordance with SIGN50 methodology are graded level 4 evidence.[101, 115, 122, 124, 125, 138, 139] The environmental surveillance study was graded level 3 evidence using the SIGN50 methodology.[140]	1x SIGN50 level 3 7x SIGN50 level 4

25.2 Is the evidence consistent in its conclusions? (see SIGN50, section 5.3.2)

Comment here on the degree of consistency demonstrated by the evidence. Where there are conflicting results, indicate how the group formed a judgement as to the overall direction of the evidence.

Comments
Flushing in high-risk settings: • All seven guidance documents are consistent in recommending daily flushing for outlets in high-risk areas.[101, 115, 122, 124, 125, 138, 139] Flushing outwith high-risk settings: • Six guidance documents recommend a twice-weekly flushing regime in areas outwith high-risk settings[101, 115, 122, 125, 138, 139] except for the guidance document from the Republic of Ireland that recommends weekly as a minimum. However, this document does recognise that there are variances within healthcare facilities and that a risk assessment should be performed, taking into account the specific water pressure and contamination levels.[124] • There is inconsistency regarding the duration of flushing outwith high-risk areas. The HSE code of practice mention a flush duration of 'several minutes' and Republic of Ireland guidance mention '3 minutes'. [124] In addition, one guidance document (The Department of Health, Health Technical Memorandum (HTM) 04-01 series on water safety) recommends that if the outlet is fitted with a POU filter, the filter should not be removed in order to flush the tap unless the manufacturer's instructions advise otherwise.[118]

25.3 Is the evidence applicable to Scottish health and care settings? (see SIGN50, section 5.3.3)

For example, do the studies include interventions, comparators or outcomes that are common to Scottish health and care settings?

Comments
Two guidance documents are derived from Scotland,[101, 138] four others are from within the UK[115, 122, 125, 139] (of which two are codes of practice for the UK)[122, 125] and one guidance document is derived from the Republic of Ireland.[124] All have similar health and care practices as Scotland and therefore are applicable to Scottish health and care settings.

25.4 Are the studies generalisable to the target population?

Comment here on sample size and methods of sample selection. Is the sample representative of the specific population/group of interest? Generalisability is only relevant to primary research studies.

Comments
N/A – the one primary study included is not relating to a specific target population but to the organism (*Legionella* spp.) and its survival in water systems.[140]

25.5 Are there concerns about publication bias? (see SIGN50, section 5.3.5)

Comment here on whether there is a risk in the evidence base that studies have been selectively published based on their results (and thus a risk that results from published studies are systematically different from unpublished evidence).

Comments
No concerns.

Part B: Evidence to decision

25.6 Recommendations

What recommendations(s) or good practice point(s) does the Working Group agree are appropriate based on this evidence?

Note the following terminology:

- **“must”** implies that the health and care setting must implement the recommended approach and is used where a recommendation has been directly lifted from legislation or mandatory guidance
- **“should”** implies that the health and care setting “should” implement the recommended approach unless a clear and compelling rationale for an alternative approach is present
- **“should consider”** implies that the health and care setting should consider implementing the recommended approach

Recommendation	Grading
GPP25.1 In high-risk settings, all outlets should be flushed at least daily for a minimum of one minute and a record should be kept of when they were flushed.	Good Practice Point
GPP25.2 Outwith high-risk settings, flushing of all outlets is recommended twice weekly as a minimum for at least three minutes in occupied buildings and should be based on local risk assessment taking into account the local water pressure, temperature and flow rate.	Good Practice Point
GPP25.3 If an outlet is fitted with a POU filter, the filter should not be removed in order to flush the tap unless the manufacturer’s instructions advise otherwise.	Good Practice Point
GPP25.4 Records should be maintained to demonstrate that flushing has been undertaken and for the appropriate duration.	Good Practice Point

25.7 Balancing benefits and harms

Comment here on the potential impact of the Recommendation/Good Practice Point on service users, visitors and staff. Benefits and harms include considerations beyond IPC.

Benefits

List the favourable changes in outcome that would likely occur if the Recommendation/ Good Practice Point were followed correctly. Be explicit, clear about pros.

Benefits
• GPP25.1, GPP25.2, GPP25.3 Increased service user safety. • GPP25.1, GPP25.2 Minimising water stagnation subsequently results in reduced risk of contamination of water system and outlets and thus potentially reducing the risk of water system-associated nosocomial infection. • GPP25.4 Demonstrates organisational response, assurance and accountability for water associated IC risk management.

Risks and Harms

List the adverse events or other unfavourable outcomes that may occur if the Recommendation/ Good Practice Point were followed correctly. Be explicit, clear about cons.

Risks/Harms
• GPP25.1, GPP25.2 Flushing might give a false assurance and this could potentially result in reduced compliance with other IPC measures and/or failure to address/improve potential poor design(s). • GPP25.1, GPP25.2 Potential splash risks to surrounding surfaces when flow rates are too high.

Benefit-Harm assessment

Classify as “benefits outweigh harms” (or vice versa) or a “balance of benefit and harm.” Description of this balance can be from the individual patient/ staff/ visitor perspective, the societal perspective, or both. Recommendations/ Good Practice

Points are possible when clear benefit is not offset by important harms, costs or adverse events (or vice versa).

Benefit-Harm assessment
Benefits outweigh harms.

25.8 Feasibility

Is the Recommendation/ Good Practice Point implementable in the Scottish context? Describe (if applicable) financial implications, opportunity costs, material or human resource requirements, facility needs, sustainability issues, human factors etc., that may be associated with following a Recommendation/Good Practice Point. State clearly if information on feasibility is lacking.

Feasibility
• GPP25.1, GPP25.2, GPP25.4 There will be human resource requirements to perform and document flushing. • GPP25.1, GPP25.2 There will be a need to ensure access to outlets to undertake flushing (for example when rooms are being used for storage or access to a sink is blocked by equipment).

25.9 Expert Opinion

Summarise the expert opinion used in creating the Recommendation/ Good Practice Point; if none were involved, state “none”. Translating evidence into action often involves expert opinion where evidence is insufficient. Clearly outlining expert opinion helps users understand their influence on interpreting objective evidence. Expert opinion may also be required where there is no evidence available.

Expert opinion
GPP25.1 ARHAI Scotland support extant expert opinion guidance (from Scotland and UK) that outlets should be flushed for a minimum of one minute daily in high-risk settings.[101, 115, 122, 124, 125, 138, 139] It is not feasible for the person doing the flushing to know whether the temperature has stabilised or whether all potentially

Expert opinion

stagnant water has been flushed, therefore it is more appropriate to provide a timeframe.

GPP25.2 The inconsistency in literature regarding flush duration outwith high-risk settings ('several minutes' versus '3 minutes') was discussed with ARHAI Scotland and Health Facilities Scotland colleagues. The consensus was that a set time is needed to be able to measure/comply with and thus a minimum of 3 minutes was proposed. It is ARHAI Scotland opinion that it does depend on the design and situation and that the flow rate is important. Therefore, a good practice point has been developed. It is ARHAI Scotland opinion that this GPP should be specific for occupied buildings.

Twice-weekly flushing in areas outwith high-risk settings has been mentioned in a number of guidance documents[101, 115, 122, 125, 138, 139] and the Republic of Ireland recommends weekly as a minimum.[124] It is mentioned in guidance and supported by ARHAI Scotland that there are variances within healthcare facilities and that a risk assessment should be performed, taking into account the specific water pressure and contamination levels however twice weekly flushing should occur. A good practice point has been developed which details this.

GPP25.3 In addition, one guidance document (The Department of Health, Health Technical Memorandum (HTM) 04-01 series on water safety) recommends that if the outlet is fitted with a POU filter, the filter should not be removed in order to flush the tap unless the manufacturer's instructions advise otherwise.[118]

GPP25.4 The importance of record keeping has been mentioned in extant guidance (Scottish and UK) regarding flushing in high-risk areas.[101, 115, 122, 124, 125, 138, 139] It is ARHAI Scotland opinion that this should extend to all settings and inclusive of the duration of flushing.

25.10 Value judgements

Summarise value judgements used by the Working Group in creating the Recommendation/ Good Practice Point; if none were involved, state "none". Translating evidence into action often involves value judgements, which include

guiding principles, ethical considerations, or other beliefs and priorities. Stating them clearly helps users understand their influence on interpreting objective evidence.

Value judgements
None.

25.11 Intentional vagueness

State reasons for any intentional vagueness in the Recommendation/Good Practice Point; if none was intended, state “none”. Recommendations/Good Practice Points should be clear and specific, but if there is a decision to be vague, acknowledging the reasoning clearly promotes transparency. Reasons for vagueness may include inadequate evidence; inability to achieve consensus regarding evidence quality, anticipated benefits/harms, or interpretation of evidence; legal considerations; economic reasons; ethical/ religious reasons.

Intentional vagueness
The literature is not consistent in recommending a specific time for flushing and thus the GPP25.2 mentions a minimum of 3 minutes. As it also depends on various local factors, it has been added that a local risk assessment should be performed while considering the local water pressure and flow rate.

25.12 Exceptions

List situations or circumstances in which the Recommendation/Good Practice Point should not be applied.

Exceptions
Flushing needs to be more frequent in non-high-risk care settings when occupied by high-risk patients.

25.13 Recommendations for research

List any aspects of the question that require further research.

Recommendations for research
More research to inform optimal flushing times will be valuable.

Research question 26: Who should be responsible for flushing?

Part A: Quality of evidence

26.1 How reliable is the body of evidence? (see SIGN50, section 5.3.1, 5.3.4)

Comment here on the quantity of evidence available on this topic and its methodological quality. Please include citations and evidence levels.

If there is insufficient evidence to answer the key question, go to section B.

Comments	Evidence level
A limited amount of evidence is available in relation to this research question. In total, 4 pieces of evidence were identified which includes: • 2 Scottish guidance documents,[101, 138] • 1 British Standard,[122] • 1 guidance document from the Republic of Ireland.[124] All included guidance documents were deemed to be expert opinions (SIGN50 level 4).	4x SIGN50 level 4

26.2 Is the evidence consistent in its conclusions? (see SIGN50, section 5.3.2)

Comment here on the degree of consistency demonstrated by the evidence. Where there are conflicting results, indicate how the group formed a judgement as to the overall direction of the evidence.

Comments
As there is limited evidence available, a high degree of consistency cannot be achieved.

Comments
However, all four included guidance documents are consistent in stating that the senior charge nurse (or equivalent departmental lead) should be responsible.[101, 122, 124, 138] Some guidance have added information on who should be excluded from the flushing procedures and the general oversight of the water safety group.[101, 138]

26.3 Is the evidence applicable to Scottish health and care settings? (see SIGN50, section 5.3.3)

For example, do the studies include interventions, comparators or outcomes that are common to Scottish health and care settings?

Comments
Two guidance documents are derived from Scotland[101, 138] and the British Standard is code of practice within the UK.[122] The other guidance is derived from the Republic of Ireland.[124] All have similar health and care practices as Scotland and therefore are applicable to Scottish health and care settings.

26.4 Are the studies generalisable to the target population?

Comment here on sample size and methods of sample selection. Is the sample representative of the specific population/group of interest? Generalisability is only relevant to primary research studies.

Comments
N/A - no primary studies were identified for this research question.

26.5 Are there concerns about publication bias? (see SIGN50, section 5.3.5)

Comment here on whether there is a risk in the evidence base that studies have been selectively published based on their results (and thus a risk that results from published studies are systematically different from unpublished evidence).

Comments
No concerns.

Part B: Evidence to decision

26.6 Recommendations

What Recommendations(s) or good practice point(s) does the Working Group agree are appropriate based on this evidence?

Note the following terminology:

- **"must"** implies that the health and care setting must implement the recommended approach and is used where a recommendation has been directly lifted from legislation or mandatory guidance
- **"should"** implies that the health and care setting "should" implement the recommended approach unless a clear and compelling rationale for an alternative approach is present
- **"should consider"** implies that the health and care setting should consider implementing the recommended approach

Recommendation	Grading
GPP26.1 All departments should identify a responsible person to ensure that flushing of all outlets is being performed in that area(s) as specified, in practice this may be the Senior Charge Nurse, Clinical Lead or domestic manager.	Good Practice Point
GPP26.2 The water safety group (WSG) should have oversight and provide an assurance to the NHS board on compliance with requirements including flushing including in unused areas or outlets.	Good Practice Point
GPP26.3 Flushing could be incorporated into the local domestic cleaning schedule and associated training of all relevant staff.	Good Practice Point

26.7 Balancing benefits and harms

Comment here on the potential impact of the Recommendation/Good Practice Point on service users, visitors and staff. Benefits and harms include considerations beyond IPC.

Benefits

List the favourable changes in outcome that would likely occur if the Recommendation/ Good Practice Point were followed correctly. Be explicit, clear about pros.

Benefits
• GPP26.1 Clarification of flushing responsibility. • GPP26.2 Demonstrable assurance of flushing compliance. • GPP26.1, GPP26.2, GPP26.3 Increased service user safety.

Risks and Harms

List the adverse events or other unfavourable outcomes that may occur if the Recommendation/ Good Practice Point were followed correctly. Be explicit, clear about cons.

Risks/Harms
None identified.

Benefit-Harm assessment

Classify as “benefits outweigh harms” (or vice versa) or a “balance of benefit and harm.” Description of this balance can be from the individual patient/ staff/ visitor perspective, the societal perspective, or both. Recommendations/ Good Practice Points are possible when clear benefit is not offset by important harms, costs or adverse events (or vice versa).

Benefit-Harm assessment
Only benefits identified.

26.8 Feasibility

Is the Recommendation/ Good Practice Point implementable in the Scottish context? Describe (if applicable) financial implications, opportunity costs, material or human resource requirements, facility needs, sustainability issues, human factors etc., that may be associated with following a Recommendation/ Good Practice Point. State clearly if information on feasibility is lacking.

Feasibility
• GPP26.1 There will be human resource requirements to oversee/ensure flushing is being performed. • GPP26.3 Additional education and training might be required regarding flushing and this training might have associated financial and time implications. • There is a sustainability element with regards to water usage to undertake flushing.

26.9 Expert Opinion

Summarise the expert opinion used in creating the Recommendation/ Good Practice Point; if none were involved, state “none”. Translating evidence into action often involves expert opinion where evidence is insufficient. Clearly outlining expert opinion helps users understand their influence on interpreting objective evidence. Expert opinion may also be required where there is no evidence available.

Expert opinion
GPP26.1 Extant guidance state that the senior charge nurse (or equivalent departmental lead) should be responsible to ensure flushing is being performed.[101, 122, 124, 138] It is ARHAI Scotland opinion that it is up to each department to identify a responsible person and this has been reflected in a good practice point.

Expert opinion
GPP26.2 ARHAI Scotland support extant expert opinion guidance (from the Scottish Government and Health Facilities Scotland) that the WSG should have general oversight (inclusive of flushing).[101, 138] GPP26.3 ARHAI Scotland support extant expert opinion guidance (from the British Standards Institution) that flushing could be incorporated into the local cleaning schedule and its associated training.[122]

26.10 Value judgements

Summarise value judgements used by the Working Group in creating the Recommendation/Good Practice Point; if none were involved, state “none”. Translating evidence into action often involves value judgements, which include guiding principles, ethical considerations, or other beliefs and priorities. Stating them clearly helps users understand their influence on interpreting objective evidence.

Value judgements
None.

26.11 Intentional vagueness

State reasons for any intentional vagueness in the Recommendation/ Good Practice Point; if none was intended, state “none”. Recommendations/ Good Practice Points should be clear and specific, but if there is a decision to be vague, acknowledging the reasoning clearly promotes transparency. Reasons for vagueness may include inadequate evidence; inability to achieve consensus regarding evidence quality, anticipated benefits/harms, or interpretation of evidence; legal considerations; economic reasons; ethical/ religious reasons.

Intentional vagueness
None.

26.12 Exceptions

List situations or circumstances in which the Recommendation/Good Practice Point should not be applied.

Exceptions
None.

26.13 Recommendations for research

List any aspects of the question that require further research.

Recommendations for research
None.

Research question 27: What actions can be undertaken to reduce the risk of infection/colonisation associated with direct water usage?

Part A: Quality of evidence

27. 1 How reliable is the body of evidence? (see SIGN 50, section 5.3.1, 5.3.4)

Comment here on the quantity of evidence available on this topic and its methodological quality. Please include citations and evidence levels.

If there is insufficient evidence to answer the key question, go to section B.

Comments	Evidence level
In total, 34 pieces of evidence were identified in relation to this research question. The evidence base on this subject consists of: • 19 outbreak studies (SIGN50 level 3),[4, 31, 32, 35, 38, 40, 46, 51, 52, 59, 61, 63, 65, 76, 108, 141-143 144] • 3 before and after studies (SIGN50 level 3),[90, 145, 146] • 4 Scottish guidance documents (SIGN50 level 4),[101, 116, 147, 148] • 4 other guidance documents (SIGN50 level 4),[124, 139, 149, 150] • 2 letters to the editor (SIGN50 level 4),[45, 151] • 1 British Standard (SIGN50 level 4),[122] • 1 international guidelines (SIGN50 level 4).[95] In general, the evidence identified for this research question is low quality, from observational outbreak reports, non-controlled intervention studies (mostly retrospective) and guidance documents (mostly with no	22x SIGN50 level 3 12x SIGN50 level 4

Comments	Evidence level
accompanying evidence therefore graded as expert opinion level 4 evidence).	

27.2 Is the evidence consistent in its conclusions? (see SIGN 50, section 5.3.2)

Comment here on the degree of consistency demonstrated by the evidence. Where there are conflicting results, indicate how the group formed a judgement as to the overall direction of the evidence.

Comments
• There was consistency in four outbreak reports (SIGN50 level 3) that described inappropriate use of clinical wash hand sinks (inappropriate disposal of waste items into sinks).[51, 61, 63, 141] UK and Republic of Ireland guidance (SIGN50 level 4) advises that clinical wash hand basins should be used solely for the purpose of hand washing.[124, 139] • Complete unit-wide avoidance of tap water for patient care (ICU; neonatal ICU; transplant post-op patients) combined with or without removal of sinks as a preventative measure was described in three studies (SIGN50 level 3), demonstrating an overall benefit (reduction in patient colonisation associated with the interventions).[108, 145, 146] • Removal of water outlets where they are not required is discussed in three expert opinion documents (SIGN50 level 4).[101, 124, 139] SHTM 04-01 Part B and Republic of Irish guidance (HPSC) specifically discusses removal of showers aimed at prevention of *Legionella* infection. HTM 04-01 Part C recommends the permanent removal of existing outlets (for example showers and sinks) in settings where they are not being used. One expert opinion piece (SIGN50 level 4) highlighted the daily non-use of showers in certain ward types in Scottish hospitals.[151] • There was inconsistency in extant guidance regarding which patient groups should have tap water replaced with sterile water for drinking, oral care and washing.[95, 124] The CDC (SIGN50 level 4) advises that tap water should be

Comments
avoided for severely immunocompromised patients (haematopoietic stem cell transplantation or solid organ transplant patients) but this is specific to *Legionella* spp. only.[95] For neonatal units, Republic of Ireland guidance (SIGN50 level 4) advise that sterile water or saline should be used for washing non-intact or fragile skin of neonates, including nappy changes; tap water can be used for bathing other high-risk infants with intact skin and that do not require placement in a humidified incubator. HTM 04-01 part C (SIGN50 level 4) advises that unless water testing has shown absence of *P. aeruginosa* in high-risk units, water should either be sterile or should be supplied through a POU filter.[139] • In two reports (SIGN50 level 3), ice used for treatment purposes (bronchoalveolar lavage, bronchoscopy) was linked to pseudo-outbreaks in immunocompromised patients (specific conditions unspecified).[143, 144] In UK expert opinion guidance (SIGN50 level 4), HTM 04-01 Part C advises that where ice is used for treatment purposes in high-risk settings, it should be made using water obtained through a microbiological POU filter or boiling water in sterile ice trays or single-use ice bags placed in a freezer.[139] • In one study, ice used for consumption by HIV-infected patients was linked to a pseudo-outbreak.[76] HBN 00-09 'Infection Control in the Built Environment' advises that ice for consumption by immunocompromised patients should be made by putting drinking water into single-use ice-making bags and into a conventional freezer.[150] Republic of Ireland HPSC guidance (SIGN50 level 4) does not make specific recommendations regarding the production of ice based on the intended use.[124] It advises that an automatic dispenser (ice machine) should be used to make ice and that the use of open chest freezer storage compartments should be avoided. • UK and Republic of Ireland guidance (2 x SIGN50 level 4) are consistent in stating that tap water should not be used in neonatal units for the process of defrosting frozen breast milk.[124, 139] • One outbreak study (SIGN50 level 3) evidenced the benefit of installation of point of use (POU) filters as a preventative measure to reduce the risk of

Comments

exposure to organisms present in tap water.[35] HTM 04-01 part C (SIGN50 level 4) advises that unless water testing has shown absence of *P. aeruginosa* in high-risk units, water should either be sterile or should be supplied through a POU filter which suggests long-term use of POU filters where water quality cannot be maintained.[139]

- One outbreak study described ensuring that sink basins are deep enough to allow hand hygiene to be performed without making contact with the basin or taps.[31]
- Three outbreak studies (SIGN50 level 3) described the risk of splashing from water outlets, and ensuring that water from the tap does not create contact splashing with the drain, to prevent contamination of surrounding surfaces.[35, 40, 63]
- Consideration of use of hand rub after hand washing as an additional preventative measure was described in two outbreak reports (both involving *Pseudomonas aeruginosa*, both in ICU (one neonatal)).[35, 45]
- Education of staff, patients and their care givers on how to minimise the risk of HAI from water sources was specifically mentioned in guidance[124] (SIGN50 level 4) and one outbreak study (SIGN50 level 3).[4] Most outbreak reports do not comment on whether education is continued outwith outbreak situations.
- Two guidance documents (SIGN50 level 4) mention the importance of ensuring that clinical wash hand sinks are routinely cleaned in a manner that minimises the risk of contamination of the tap from organisms in the basin trap/drain, however neither describe a method for how to do this.[124, 139] The NHS Scotland National Cleaning Specification advises that new clean disposable cloths are used for separately cleaning the tap and the basin, however there are no instructions for cleaning taps fitted with point of use filters.[147] Two outbreak studies (SIGN50 level 3) highlight the risk of transmission via cleaning and cleaning equipment from contaminated outlets.[46, 63]

Comments
• British Standard 8580-2:2022 Part 2: 'Risk assessments for Pseudomonas aeruginosa and other waterborne pathogens — Code of practice' advises that soap dispensers should not be placed directly above the sink to prevent soap drips on the sink surfaces that may encourage bacterial growth.[122]

27.3 Is the evidence applicable to Scottish health and care settings? (see SIGN 50, section 5.3.3)

For example, do the studies include interventions, comparators or outcomes that are common to Scottish health and care settings?

Comments
The outbreak studies are from Korea,[40, 61] Japan,[32] US,[4, 35, 76, 143, 144] Netherlands,[65] Australia,[63, 108] Austria,[59] Belgium,[51] Germany,[46, 52] France,[31, 38, 141] and Norway.[142] The intervention studies (before and after studies) are from the UK,[90] The Netherlands,[146] the US.[145] The guidance documents are from the Republic of Ireland,[124] UK (3),[139, 149, 122] Scotland (4),[101, 116, 147, 148] and US.[95] The letters to the editor are from the UK[45] and Scotland.[151] Applicable as these countries have similar health systems.

27.4 Are the studies generalisable to the target population?

Comment here on sample size and methods of sample selection. Is the sample representative of the specific population/group of interest? Generalisability is only relevant to primary research studies.

Comments
None of the primary evidence studies had control over samples size therefore generalisability is not applicable.

27.5 Are there concerns about publication bias? (see SIGN 50, section 5.3.5)

Comment here on whether there is a risk in the evidence base that studies have been selectively published based on their results (and thus a risk that results from published studies are systematically different from unpublished evidence).

Comments
Since numerous studies included (19 out of 34) are outbreak studies, there is a possibility of publication bias as not all outbreaks/infection incidents are published in scientific journals. A formal assessment of publication bias was not conducted.

Part B: Evidence to decision

27.6 Recommendations

What Recommendations(s) or good practice point(s) does the Working Group agree are appropriate based on this evidence?

Note the following terminology:

- **"must"** implies that the health and care setting must implement the recommended approach and is used where a recommendation has been directly lifted from legislation or mandatory guidance
- **"should"** implies that the health and care setting "should" implement the recommended approach unless a clear and compelling rationale for an alternative approach is present
- **"should consider"** implies that the health and care setting should consider implementing the recommended approach

Recommendation	Grading
R27.1 Clinical wash hand basins should only be used for the purpose of performing hand hygiene.	Recommendation

Recommendation	Grading
R27.2 Clinical wash hand basins and patient sinks should not be used for disposal of food and drink items, clinical waste, body fluids, or medicines.	Recommendation
GPP27.1 Consideration should be given to minimising patient contact with tap water in immunocompromised patients (haematology and oncology patients, cardiac surgery patients, bone marrow and stem cell transplant patients, neonatal, paediatric and adult ICU patients, transplant patients).	Good Practice Point
GPP27.2 Consideration should be given to removing outlets including sinks and showers where they are used infrequently or not at all, provided there is not a clinical need to retain the outlet.	Good Practice Point
GPP27.3 For extremely immunosuppressed patients (for example allogeneic stem cell transplant patients – until engraftment) sterile water should be considered for drinking, oral care and washing.	Good Practice Point
GPP27.4 Sterile water should be considered for washing babies within neonatal settings specifically babies that are under 28 weeks gestation, those that do not have intact skin, have invasive line access and those being cared for in humidified incubators.	Good Practice Point
GPP27.5 Ice for consumption by immunocompromised patients (haematology and oncology, cardiac surgery, bone marrow and stem cell transplant, neonatal, paediatric and adult ICU patients, transplant patients) should not be made using ice-making machines. Where ice is required for consumption in these patient groups, it should be made by putting drinking water into single-use ice-making bags and frozen in a	Good Practice Point

Recommendation	Grading
conventional freezer. Alternatively, iced water may be provided by freezing single bottles of commercially available spring water and allowing patients to drink that ice water as it melts.	
GPP27.6 Where ice is required for treatment purposes in immunocompromised patients (haematology and oncology, cardiac surgery, bone marrow and stem cell transplant, neonatal, paediatric and adult ICU patients, transplant patients), it should not be made using an ice machine. It should be made using water obtained through a microbiological point of use (POU) filter, sterile water, or boiled water in single-use ice-making bags and frozen in a conventional freezer.	Good Practice Point
GPP27.7 Conventional freezers used in healthcare should be maintained and cleaned in line with manufacturer's instructions with an agreed cleaning, maintenance and audit schedule in place.	Good Practice Point
GPP27.8 Installation of ice machines should be by approval of the Water Safety Group (WSG). Local teams should have an agreed process for installation (acknowledging any manufacturer instructions) and an agreed cleaning, maintenance and audit schedule in place.	Good Practice Point
GPP27.9 Frozen breast milk should be defrosted using a water-free warming device, by defrosting in a designated fridge, or at room temperature. Once infant feeding is completed, any unused milk should be discarded in accordance with local waste policy.	Good Practice Point

Recommendation	Grading
GPP27.10 Powdered infant formula should be prepared using boiled water according to manufacturer's instructions.	Good Practice Point
GPP27.11 Installation of point of use (POU) filters may be considered in settings where the following patient groups are treated (haematology and oncology, cardiac surgery, bone marrow and stem cell transplant, neonatal, paediatric and adult ICU patients, transplant patients) where there is clinical risk identified associated with the water and/or historical water sampling results that demonstrate ongoing issues with water quality.	Good Practice Point
GPP27.12 Sink basins in health and care settings should be deep enough to allow hand hygiene to be performed without making contact with the basin sides or fixtures and fittings (for example, taps), even when point of use (POU) filters are installed.	Good Practice Point
GPP27.13 Water flow from taps should not create any splashing onto surrounding areas.	Good Practice Point
GPP27.14 The flow of water from the tap should not directly hit the drain (so to avoid any splash back from the drain).	Good Practice Point
GPP27.15 Where there is a need to perform hand hygiene with soap and water, use of hand rub as a follow up should be considered where there is an ongoing water quality issue.	Good Practice Point
GPP27.16 Health and care staff should be made aware of the HAI risks associated with healthcare water.	Good Practice Point

Recommendation	Grading
GPP27.17 Patients and care givers should be educated about what they can do to help minimise the risk of infection from water.	Good Practice Point
GPP27.18 Patients should be discouraged from storing personal items (for example toothpaste, cosmetics) on the patient sink as this can prevent access for environmental cleaning and puts these items at risk of contamination.	Good Practice Point
GPP27.19 The NHS Scotland National Cleaning Specification should be followed for the routine cleaning and disinfection of sinks and associated fittings (for example taps).	Good Practice Point
GPP27.20 Hand hygiene product dispensers should be placed so that the contents cannot leak or spill into/onto clinical wash hand basins.	Good Practice Point

27.7 Balancing benefits and harms

Comment here on the potential impact of the Recommendation/Good Practice Point on service users, visitors and staff. Benefits and harms include considerations beyond IPC.

Benefits

List the favourable changes in outcome that would likely occur if the Recommendation/ Good Practice Point were followed correctly. Be explicit, clear about pros.

Benefits
R27.1 and R27.2 It is anticipated that using clinical wash hand basins only for the purpose of performing hand hygiene and not for the disposal of waste items will reduce the risk of biofilms forming within the localised drain and wider plumbing

Benefits
system. Localised biofilm formation risks dispersal of microorganisms into the environment during use of the outlet. GPP27.1 Minimising patient contact with tap water in immunocompromised patients (haematology and oncology patients, cardiac surgery patients, bone marrow and stem cell transplant patients, neonatal, paediatric and adult ICU patients, transplant patients) may interrupt or prevent the mode of transmission (water to patient) and therefore reduce the risk of transmission associated with tap water. GPP27.2 Removal of outlets including sinks and showers where they are used infrequently or not at all (provided there is not a clinical need to retain the outlet) may reduce water stagnation and the build-up of biofilm, and will remove splash risks and the need to flush those outlets. GPP27.3 Avoidance of tap water for drinking, oral care and washing (and use of sterile water instead) in extremely immunosuppressed patients (for example allogeneic stem cell transplant patients – until engraftment) will prevent transmission from those uses of tap water. GPP27.4 Use of sterile water instead of tap water for washing babies that are under 28 weeks gestation, those that do not have intact skin, have invasive line access and those being cared for in humidified incubators, may reduce the risk of transmission from tap water. GPP27.5 Making ice for consumption by putting drinking water into single-use ice-making bags or by freezing single bottles of commercially available spring water and allowing patients to drink that ice water as it melts, and not using ice machines, will prevent transmission from contaminated ice machines. GPP27.6 Avoiding the use of ice making machines for making ice for treatment purposes, will reduce the risk of transmission from contaminated ice machines. GPP27.7 Ensuring that conventional freezers used in healthcare are maintained and cleaned in line with manufacturer’s instructions with an agreed cleaning, maintenance and audit schedule in place, will reduce the risk of equipment contamination and subsequent transmission to patients.

Benefits
GPP27.8 Installation of ice machines by approval of the WSG and local teams having an agreed process for installation (acknowledging any manufacturer instructions) and an agreed cleaning, maintenance and audit schedule in place, will reduce the risk of ice machines become contaminated and being potential reservoirs for transmission to patients. GPP27.9 and GPP27.10 Avoidance of tap water use for the preparation of frozen breast milk, and use of boiled water for preparing infant formula will reduce the risk of transmission through direct ingestion. GPP27.11 Installation of point of use (POU) filters where there is clinical risk identified associated with the water and/or historical water sampling results that demonstrate ongoing issues with water quality, will ensure that water leaving the tap is microbiologically safe. GPP27.12 Provision of sink basins that are deep enough to allow hand hygiene to be performed without making contact with the basin sides or fixtures and fittings is anticipated to reduce the risk of hand contamination and onwards transmission. GPP27.13 and GPP27.15 Reduction of splashing from taps and drains onto surrounding areas will reduce the risk of environmental contamination. GPP27.15 Using hand rub as a follow up to soap and water hand hygiene where there is an ongoing water quality issue will reduce the risk of transmission from potential contamination of the hands from the water. GPP27.16 Health and care staff being aware of the HAI risks associated with healthcare water will support good clinical practice and help reduce the risk of water-associated HAI. GPP27.17 Education for carers and patients may help reduce the transmission risk associated with water, for example being aware of the negative impact of disposing of waste items into sinks. GPP27.18 Keeping patient sinks free from clutter will help domestic staff access the sink for cleaning, this will ensure that routine cleaning is undertaken as intended. Keeping personal items away from the sink will also prevent contamination of those items from water splashing.

Benefits
GPP27.19 Adhering to the NHS Scotland National Cleaning Specification will ensure best practice guidance is followed for the routine cleaning and decontamination of sinks and associated fittings. GPP27.20 If the liquid hand soap/hand gel is able to drip into/onto water outlets such as sinks, it can encourage bacterial growth and biofilm formation. Also, if the liquid hand soap is contaminated and able to drip into the sink, it could then contaminate the water outlet. Ensuring that dispensers are appropriately placed should prevent these occurrences.

Risks and Harms

List the adverse events or other unfavourable outcomes that may occur if the Recommendation/ Good Practice Point were followed correctly. Be explicit, clear about cons.

Risks/Harms
R27.1, R27.2 – there are no harms associated with using clinical wash hand basins only for the purpose of performing hand hygiene and not for the disposal of waste items. GPP27.1 Depending on the method used to minimise tap water contact, there may be unintended harms, hence the need for consideration. For example, contaminated water-based patient hygiene products (used instead of washing with tap water) have been linked to HAI transmission. Patient discomfort could occur if avoidance of tap water contact prevents desired frequency and method of showering or bathing. GPP27.2 No harm is anticipated with the removal of outlets including sinks and showers where they are used infrequently or not at all, provided there is not a clinical need to retain the outlet. GPP27.3 and GPP27.4 There are no anticipated harms associated with using sterile water for drinking, oral care and washing in these patient groups (extremely immunosuppressed patients (for example allogeneic stem cell transplant patients

Risks/Harms
– until engraftment), and babies that are under 28 weeks gestation, those that do not have intact skin, have invasive line access and those being cared for in humidified incubators. GPP27.5 and GPP27.6 There are no anticipated harms associated with avoiding ice machines for making ice for consumption by immunocompromised patients, and for making ice for treatment. Commercially available spring water could theoretically pose an infection risk if there is a batch contamination issue. GPP27.7 There are no anticipated harms associated with ensuring that conventional freezers used in healthcare are maintained and cleaned in line with manufacturer's instructions with an agreed cleaning, maintenance and audit schedule in place. GPP27.8 There are no anticipated harms associated with the installation of ice machines by approval of the Water Safety Group (WSG) and with local teams having an agreed process for installation (acknowledging any manufacturer instructions) and an agreed cleaning, maintenance and audit schedule in place. GPP27.9 There are no anticipated harms associated with defrosting frozen breast milk by using a water-free warming device, by defrosting in a designated fridge, or at room temperature. GPP27.10 There may be a risk of scalding associated with using boiled water to prepare powdered infant formula. GPP27.11 A possible unintended harm associated with the installation of POU filters is that they may be inappropriately viewed as a complete solution and other potential solutions overlooked where there are water quality issues. GPP27.12 There are no anticipated harms associated with ensuring that sink basins in health and care settings are deep enough to allow hand hygiene to be performed without making contact with the basin sides or fixtures and fittings (for example, taps), even when point of use (POU) filters are installed. GPP27.13 and GPP27.14 There are no anticipated harms associated with ensuring that the running of water from taps does not result in splash-back.

Risks/Harms
GPP27.15 There are no anticipated harms associated with using hand rub as a follow up to soap and water hand hygiene, provided that hands are thoroughly dried prior to application of the hand rub. GPP27.16 There are no anticipated harms associated with educating health and care staff on the HAI risks associated with healthcare water. GPP27.17 Educating patients and care givers about what they can do to help minimise the risk of infection from water may cause anxiety in these groups, education will need to be provided appropriately to minimise this risk. GPP27.18 There are no anticipated harms associated with ensuring that patient sinks remain free from personal items (clutter). GPP27.19 There are no anticipated harms associated with following the NHS Scotland National Cleaning Specification for the routine cleaning and decontamination of sinks and associated fittings. GPP27.20 There are no anticipated harms associated with careful placement of hand hygiene product dispensers to prevent dripping onto water outlets.

Benefit-Harm assessment

Classify as “benefits outweigh harms” (or vice versa) or a “balance of benefit and harm.” Description of this balance can be from the individual patient/ staff/ visitor perspective, the societal perspective, or both. Recommendations/ Good Practice Points are possible when clear benefit is not offset by important harms, costs or adverse events (or vice versa).

Benefit-Harm assessment
R27.1, R27.2 Only benefits associated with using clinical wash hand basins only for the purpose of performing hand hygiene and not for the disposal of waste items. GPP27.1 If sufficient consideration is given to the potential risks and benefits associated with methods of minimising patient contact with tap water, it is anticipated that benefits will outweigh harms.

Benefit-Harm assessment
GPP27.2 Only benefits are associated with the removal of outlets where they are used infrequently or not at all, provided there is not a clinical need to retain the outlet. GPP27.3 and GPP27.4 Only benefits are identified in using sterile water in these patient groups. GPP27.5 Whilst there is the possibility of a batch contamination event with commercially available spring water, there is a greater possibility of maintenance/cleaning failures with ice machines, therefore the benefits of avoidance of ice from ice machines is considered to outweigh the risks. GPP27.6 Only benefits are associated with the avoidance of ice making machines for making ice for treatment purposes in immunocompromised patients. GPP27.7 Only benefits are associated with ensuring that conventional freezers used in healthcare are maintained and cleaned in line with manufacturer's instructions with an agreed cleaning, maintenance and audit schedule in place. GPP27.8 Only benefits are associated with the installation of ice machines by approval of the Water Safety Group (WSG) and with local teams having an agreed process for installation (acknowledging any manufacturer instructions) and an agreed cleaning, maintenance and audit schedule in place. GPP27.9 Only benefits associated with defrosting frozen breast milk by using a water-free warming device, by defrosting in a designated fridge, or at room temperature. GPP27.10 The benefits of using boiled water to prepare powdered infant formula outweigh the potential risk of scalding. GPP27.11 Only benefits associated with the installation of point of use (POU) filters, provided they are installed and maintained appropriately. GPP27.12 Only benefits associated with ensuring that sink basins in health and care settings are deep enough to allow hand hygiene to be performed without making contact with the basin sides or fixtures and fittings (for example, taps), even when point of use (POU) filters are installed.

Benefit-Harm assessment
GPP27.13 and GPP27.14 Only benefits associated with ensuring that the running of water from taps does not result in splash-back. GPP27.15 The benefits of using hand rub as a follow up to soap and water hand hygiene, outweigh the potential risk of skin irritation (which may result if hands are not thoroughly dried prior to application of the hand rub). GPP27.16 Only benefits associated with staff being aware of the HAI risks associated with healthcare water. GPP27.17 Although patients and care givers may feel some anxiety as a result of being educated about what they can do to help minimise the risk of infection from water, this benefit of having this knowledge is anticipated to outweigh the harm. GPP27.18 There are only benefits associated with keeping patient sinks free from clutter. GPP27.19 There are only benefits associated with following the NHS Scotland National Cleaning Specification. GPP27.20 There are only benefits associated with safe placement of hand hygiene product dispensers to prevent dripping into/onto water outlets.

27.8 Feasibility

Is the Recommendation/ Good Practice Point implementable in the Scottish context?

Describe (if applicable) financial implications, opportunity costs, material or human resource requirements, facility needs, sustainability issues, human factors etc., that may be associated with following a Recommendation/ Good Practice Point. State clearly if information on feasibility is lacking.

Feasibility
R27.1, R27.2: there may be a requirement to provide alternative waste management solutions for disposal of fluids, and staff, patient and visitor education to support the prevention of waste disposal into hand wash sinks.

Feasibility
GPP27.1 There will be a requirement for staff experience and knowledge to undertake an assessment of the risks, benefits and feasibility of minimising patient contact with tap water, inclusive of patient preference and patient comfort. GPP27.2 Removal of outlets including sinks and showers where they are used infrequently or not at all, provided there is not a clinical need to retain the outlet, will require staff resource to assess the usage of the outlet. Estates and facilities staff will have to assess the ability to remove the outlet and this may require engineering modifications. There may be financial costs associated with this as well as disruption to patient placement. There may be challenges with removing outlets in Private Finance Initiative (PFI) buildings or privately-owned buildings. GPP27.3 and GPP27.4 There will be a requirement for procurement and storage of sterile water for drinking, oral care and washing for these patient groups (extremely immunosuppressed patients (for example allogeneic stem cell transplant patients – until engraftment), and babies that are under 28 weeks gestation, those that do not have intact skin, have invasive line access and those being cared for in humidified incubators. GPP27.5 and GPP27.6 There will be a requirement to procure single-use ice-making bags (or bottled spring water) and access to a conventional freezer. Staff resource and time will be required to make the ice and collect it from the freezer. There may be costs associated with removal of existing ice machines where this is necessary. GPP27.7 Staff resource and time will be required to ensure that conventional freezers used in healthcare are maintained and cleaned in line with manufacturer's instructions with an agreed cleaning, maintenance and audit schedule in place. Staff education may be required. GPP27.8 The Water Safety Group (WSG) will need to assess and agree the suitability of installation of ice machines. Local teams will be required to ensure that ice machines are installed in accordance with manufacturer instructions, with an agreed cleaning, maintenance and audit schedule in place. A system of recording cleaning and maintenance for audit purposes may need to be developed.

Feasibility
GPP27.9 There may be financial costs associated with purchasing and maintaining water-free warming devices for defrosting frozen breast milk. Access to a fridge may be required if the frozen breast milk is defrosted by placing in a fridge and there should be cleaning regimes in place for warming devices. GPP27.10 There will be a requirement for access to boiled water to prepare powdered infant formula. GPP27.11 There are financial costs associated with the installation and ongoing maintenance of point of use (POU) filters, and staff education and training may be required to support. GPP27.12 There may be financial costs related to redesigning sinks in health and care settings to ensure they are deep enough to allow hand hygiene to be performed without making contact with the basin sides or fixtures and fittings (for example, taps), even when point of use (POU) filters are installed. Estates and facilities staff and/or outside contractors may be required to refurbish and install. There may be a requirement to decant patients while the remedial work is undertaken. GPP27.13 and GPP27.14 It may be challenging to ensure that the running of water from taps does not result in splash-back. There may be financial costs related to redesigning water outlets and estates and facilities staff and/or outside contractors may be required to refurbish or install. There may be a requirement to decant patients while the remedial work is undertaken. GPP27.15 There may be financial costs associated with the provision of additional hand rub dispensers (if these were not already fitted), where hand rub is used as a follow up to soap and water hand hygiene. Staff education may be required to support compliance. GPP27.16 There may be a requirement for staff education and training to ensure they are aware of the HAI risks associated with healthcare water. ARHAI Scotland will be working with NHS Education for Scotland to develop supporting tools.

Feasibility
GPP27.17 Staff resource and time may be required to support educating patients and care givers about what they can do to help minimise the risk of infection from water. Supportive materials (for example leaflets, posters) may be required. GPP27.18 There may be a requirement to provide storage facilities for patients to keep their personal items away from sinks. Education to staff, visitors, and patients will be required and staff may need to encourage patients to adhere to this requirement. GPP27.19 There is a requirement for staff education and training to ensure adherence to the NHS Scotland National Cleaning Specification. GPP27.20 There may be a need to re-locate hand hygiene product dispensers which will require staff resource and may incur costs.

27.9 Expert Opinion

Summarise the expert opinion used in creating the Recommendation/Good Practice Point; if none were involved, state “none”. Translating evidence into action often involves expert opinion where evidence is insufficient. Clearly outlining expert opinion helps users understand their influence on interpreting objective evidence. Expert opinion may also be required where there is no evidence available.

Expert opinion
R27.1, R27.2 – The evidence is sufficient to support these recommendations, no expert opinion to note. GPP27.1 It is ARHAI Scotland expert opinion that minimising patient contact with tap water may have the most significant impact in reducing the risk of transmission from environmental sources. This is supported by evidence from three studies that demonstrated reduction in colonisation rates when tap water use was avoided, however these were specific patient groups (neonatal ICU, ICU, post-operative patients) that are likely to have been bed-bound. Therefore, a good practice point has been developed to allow consideration at local level of the methods for reducing tap water contact and their suitability and safety.

Expert opinion

GPP27.2 Although extant Scottish engineering guidance (SHTM 04-01) only refers to removal of sinks in relation to *Legionella* prevention, it is ARHAI Scotland expert opinion that this should be extended to all outlet types (sinks and showers), provided there is not a clinical need to retain the outlet.

GPP27.3 Extant guidance is specific to use of sterile water in immunocompromised patients for the prevention of *Legionella* infection. It is ARHAI Scotland expert opinion that sterile water should be considered for drinking, oral care and washing of specifically extremely immunosuppressed patients (for example allogeneic stem cell transplant patients – until engraftment) as these patients are high-risk for infection.

GPP27.4 ARHAI Scotland support extant expert opinion guidance from the Irish HPSC that sterile water should be considered for washing babies that are under 28 weeks gestation, those that do not have intact skin, have invasive line access and those being cared for in humidified incubators.

GPP27.5 In one study, ice used for consumption by HIV-infected patients was linked to a pseudo-outbreak.[76] HBN 00-09 'Infection Control in the Built Environment' advises that ice for consumption by immunocompromised patients should be made by putting drinking water into single-use ice-making bags and into a conventional freezer.[150] This evidence was considered insufficient for the development of a recommendation. ARHAI Scotland expert opinion is in agreement with HBN 00-09 for the method for making ice for immunocompromised patients. A good practice point has been developed that provides a list of immunocompromised patient types (haematology and oncology, cardiac surgery, bone marrow and stem cell transplant, neonatal, paediatric and adult ICU patients, transplant patients) which is based on evidence from research question 4. Whilst there is the possibility of a batch contamination event with commercially available spring water, it is ARHAI Scotland opinion that there is a greater possibility of maintenance/cleaning failures with ice machines.

GPP27.6 Extant UK guidance (HTM 04-01 Part A) advises avoidance of ice machines for making ice for treatment purposes in high-risk settings. Two pseudo-

Expert opinion

outbreaks support this.[143, 144] A good practice point has been developed to highlight the risk in immunocompromised patients.

GPP27.7 It is ARHAI Scotland expert opinion that conventional freezers used in healthcare should be maintained and cleaned in line with manufacturer's instructions with an agreed cleaning, maintenance and audit schedule in place.

GPP27.8 It is ARHAI Scotland expert opinion that installation of ice machines should be by approval of the Water Safety Group (WSG) and local teams should have an agreed process for installation (acknowledging any manufacturer instructions) and an agreed cleaning, maintenance and audit schedule in place.

GPP27.9 ARHAI Scotland support extant expert opinion guidance (from the Irish HPSC and UK) that tap water should not be used in neonatal units for the process of defrosting frozen breast milk. Therefore, a good practice point has been developed.

GPP27.10 ARHAI Scotland expert opinion is that use of boiled water for preparing infant formula will reduce the risk of transmission through direct ingestion. This is in line with manufacturer instructions for preparing infant formula.

GPP27.11 One outbreak study (SIGN50 level 3) evidenced the benefit of installation of POU filters as a preventative measure to reduce the risk of exposure to organisms present in tap water.[35] HTM 04-01 part C (SIGN50 level 4) advises that unless water testing has shown absence of *P. aeruginosa* in high-risk units, water should either be sterile or should be supplied through a POU filter which suggests long-term use of POU filters where water quality cannot be maintained. This evidence was not sufficient for the development of a recommendation. However, it is ARHAI Scotland opinion that a good practice point be developed to support the consideration of installation of POU filters in settings where the following patients at highest risk of water-associated HAI are treated (haematology and oncology, cardiac surgery, bone marrow and stem cell transplant, neonatal, paediatric and adult ICU patients, transplant patients), where there is clinical risk identified associated with the water and/or historical water sampling results that demonstrate ongoing issues with water quality.

Expert opinion

GPP27.12 One outbreak study described ensuring that sink basins are deep enough to allow hand hygiene to be performed without making contact with the basin or taps.[31] This evidence is not sufficient for the development of a recommendation. However, it is ARHAI Scotland expert opinion that ensuring sink basins are deep enough to allow safe hand hygiene should be standard practice and therefore a good practice point has been developed.

GPP27.13 and GPP27.14 Three outbreak studies (SIGN50 level 3) described the risk of splashing from water outlets, and ensuring that water from the tap does not create contact splashing with the drain, to prevent contamination of surrounding surfaces.[35, 40, 63] This evidence was considered insufficient for the development of a recommendation. However, it is ARHAI Scotland opinion that the avoidance of splashing is critical to the prevention of contamination of surrounding surfaces and equipment, and therefore a good practice point has been developed.

GPP27.15 Consideration of use of alcohol-based hand rub (ABHR) after hand washing as an additional preventative measure was described in two outbreak reports (both involving *Pseudomonas aeruginosa*, both in ICU (one neonatal)).[35, 45] This evidence was considered insufficient for the development of a recommendation. It is ARHAI Scotland expert opinion that use of hand rub may provide an addition means of reducing hand contamination and therefore should be considered where there is an ongoing water quality issue, consequently a good practice point has been developed.

GPP27.16 and GPP27.17 Education of staff, patients and their care givers on how to minimise the risk of HAI from water sources was specifically mentioned in guidance[124] (SIGN50 level 4) and one outbreak study (SIGN50 level 3).[4] This evidence was considered insufficient for the development of a recommendation. It is ARHAI Scotland expert opinion that education is critical to support good practice around water use and therefore a good practice point has been developed.

GPP27.18 It is ARHAI Scotland expert opinion that clutter on patient sinks is likely to prevent domestic staff from gaining access to the sink surfaces during cleaning. Clutter may prevent adequate cleaning and may lead to reduced frequency of cleaning. Personal hygiene items on sinks may be at risk of contamination from the

Expert opinion
plumbing system if exposed to splashing and spraying of water. A good practice point has been developed to highlight this expert opinion. GPP27.19 It is ARHAI Scotland expert opinion that the NHS Scotland National Cleaning Specification should be followed for the routine cleaning of sinks and associated fittings. There may be an opportunity to include instructions for the cleaning of taps fitted with point of use (POU) filters when the National Cleaning Specification is next updated. GPP27.20 ARHAI Scotland support extant guidance provided in BS 8580-2:2022[122] that states soap dispensers should not be placed directly above the sink as it can lead to soap drips on the sink surfaces that may support bacterial growth.

27.10 Value judgements

Summarise value judgements used by the Working Group in creating the Recommendation/ Good Practice Point; if none were involved, state “none”. Translating evidence into action often involves value judgements, which include guiding principles, ethical considerations, or other beliefs and priorities. Stating them clearly helps users understand their influence on interpreting objective evidence.

Value judgements
None.

27.11 Intentional vagueness

State reasons for any intentional vagueness in the Recommendation/ Good Practice Point; if none was intended, state “none”. Recommendations/ Good Practice Points should be clear and specific, but if there is a decision to be vague, acknowledging the reasoning clearly promotes transparency. Reasons for vagueness may include inadequate evidence; inability to achieve consensus regarding evidence quality, anticipated benefits/harms, or interpretation of evidence; legal considerations; economic reasons; ethical/ religious reasons.

Intentional vagueness
GPP27.1 This good practice point states that ‘consideration should be given to minimising tap water contact in immunocompromised patients’. The specific ways in which tap water may be avoided are not detailed, this is because it will require assessment at local level, with consideration of potential harms and feasibility.

27.12 Exceptions

List situations or circumstances in which the Recommendation/ Good Practice Point should not be applied.

Exceptions
GPP27.2 Water outlets (sinks and showers) should not be removed if there is a clinical need to retain the outlet.

27.13 Recommendations for research

List any aspects of the question that require further research.

Recommendations for research
As most of the recommendations and good practice points have been informed by low quality evidence (guidance documents with little to no reference base), some primary research to evaluate the effectiveness of actions would add rigour to the evidence base. For example, pre and post intervention studies, controlled trials (where feasible). It would be beneficial to undertake a trial in Scotland to evaluate water-free/ water reduced care.

Research question 28: What actions can be undertaken to reduce the risk of infection/colonisation associated with indirect water usage?

Part A: Quality of evidence

28.1 How reliable is the body of evidence? (see SIGN 50, section 5.3.1, 5.3.4)

Comment here on the quantity of evidence available on this topic and its methodological quality. Please include citations and evidence levels.

If there is insufficient evidence to answer the key question, go to section B.

Comments	Evidence level
In total, 15 pieces of evidence were identified in relation to this research question which includes: • 1 international guideline published by the CDC (SIGN50 level 4),[95] • 7 guidance documents that were deemed expert opinion (including two Scottish[112, 113] and one British standard[122]) (SIGN50 level 4),[94, 112, 113, 122, 124, 139, 152] • 6 outbreak studies (SIGN50 level 3),[2, 55, 74, 77, 81, 87] • 1 case-control study (SIGN50 level 2).[153]	1x SIGN50 level 2 6x SIGN50 level 3 8x SIGN50 level 4

28.2 Is the evidence consistent in its conclusions? (see SIGN 50, section 5.3.2)

Comment here on the degree of consistency demonstrated by the evidence. Where there are conflicting results, indicate how the group formed a judgement as to the overall direction of the evidence.

Comments

- One evidence source, Republic of Ireland HPSC guidance (SIGN50 level 4) advises that where infants require therapeutic cooling, sterile water should be used in a closed system (to avoid direct contact between the infant and the water). Ice or ice packs must not be used for passive or therapeutic cooling.
- There is consistency in UK guidance[139] and the British Standards Institute[122] (all SIGN50 level 4 evidence) that preparation areas for aseptic procedures and drug preparation and any associated sterile equipment should not be located where they are at risk of splash contamination from water outlets. Further, it is advised that all surfaces on which aseptic procedures are to be performed are decontaminated prior to commencing a procedure.
- As outlined in "What are the known transmission routes of water system-associated organisms in healthcare settings?", indirect transmission can occur from contaminated patient equipment. HPSC Republic of Ireland guidance (SIGN50 level 4) specifically recommends that medical equipment and patient care equipment should not be placed in, or washed in, clinical wash hand basins.[124]
- CDC guidance (SIGN50 level 4) advises of the contamination risk of refillable fluid containers (for example spray bottles used for cleaning) in high-risk settings.[95] They advise that making sufficient fresh cleaning solution for daily cleaning, discarding any remaining solution, and drying out the container will help to minimise bacterial contamination. One outbreak study (SIGN50 level 3) in a paediatric haemato-oncology unit, details transmission of *P. aeruginosa* and *P. putida* from contaminated refillable disinfectant-detergent spray bottles.[55] There was no evidence identified that demonstrated infection incidents associated with use of refillable bottles in care homes.
- Inappropriate decontamination of neonatal incubators was detailed in an outbreak study (SIGN50 level 3) where *Klebsiella pneumoniae* in a French NNU was linked to contaminated incubators and incubator mattresses; steam cleaning of the mattresses resulted in residual moisture which is

Comments

likely to have supported ongoing contamination.[81] Republic of Ireland guidance[124] and UKHSA guidance[152] (both SIGN50 level 4) provide advice regarding management of humidified and non-humidified incubators. These guidance are consistent in recommendations with a focus on ensuring the thorough drying of all parts of the incubator and mattress before use.

- Republic of Ireland guidance (SIGN50 level 4) advises that sterile water must be used for humidifiers in ventilator circuits and continuous positive airway pressure (CPAP) units,[124] and both Republic of Ireland and UKHSA guidance (SIGN50 level 4) advise sterile water in humidified neonatal incubators.[152]
- Three outbreak reports and one case-control study (all graded SIGN50 level 3) were consistent in demonstrating the risk from poor management of endoscopes (bronchoscopes, duodenoscopes) and automatic endoscope reprocessors (AERs).[2, 74, 87, 153] Extant Scottish guidance (SIGN50 level 4) is available for the interpretation and clinical management of endoscopy final rinse water.[113]
- Reseach question 9 demonstrated the risk of transmisison from cardiac heater cooler units. Scottish guidance is available for the management of cardiac heater cooler units.[112]
- One outbreak study (SIGN50 level 3) described contamination of a domestic washing machine used to wash neonatal clothing which led to transmission of *Klebsiella oxytoca* to new-borns; the washing machine parts (detergent drawer, rubber sealant) were contaminated.[77]

28.3 Is the evidence applicable to Scottish health and care settings? (see SIGN 50, section 5.3.3)

For example, do the studies include interventions, comparators or outcomes that are common to Scottish health and care settings?

Comments
Outbreak studies are derived from Germany,[77] Spain,[2] US,[74] France (3),[55, 81, 87] Turkey.[153] The guidance documents are from Scotland (2),[112, 113] the UK (4),[94, 122, 139, 152] Republic of Ireland,[124] and US.[95] All are applicable to Scottish health and care settings as the countries have similar health systems.

28.4 Are the studies generalisable to the target population?

Comment here on sample size and methods of sample selection. Is the sample representative of the specific population/group of interest? Generalisability is only relevant to primary research studies.

Comments
The case-control study was conducted in Turkey and assessed risk factors for infection with *Pseudomonas aeruginosa* in a gastroenterology department and endoscopic retrograde cholangiopancreatography (ECRP) unit.[153] Case patients were compared to 56 randomly chosen patients who were hospitalized in the department during the same period. This study may not be representative outwith patients undergoing endoscopy.

28.5 Are there concerns about publication bias? (see SIGN 50, section 5.3.5)

Comment here on whether there is a risk in the evidence base that studies have been selectively published based on their results (and thus a risk that results from published studies are systematically different from unpublished evidence).

Comments
Some (6 of the 15) studies included are outbreak studies and so there is a possibility of publication bias as not all outbreaks/infection incidents are published in scientific journals.

Part B: Evidence to decision

28.6 Recommendations

What recommendations(s) or good practice point(s) does the Working Group agree are appropriate based on this evidence?

Note the following terminology:

- **"must"** implies that the health and care setting must implement the recommended approach and is used where a recommendation has been directly lifted from legislation or mandatory guidance
- **"should"** implies that the health and care setting "should" implement the recommended approach unless a clear and compelling rationale for an alternative approach is present
- **"should consider"** implies that the health and care setting should consider implementing the recommended approach

Recommendation	Grading
GPP28.1 Drug preparation, aseptic procedures and other clinical procedures should not be carried out close to sinks or other water outlets where the potential for contamination due to splashing and/or spraying from mains water is possible. Where relocation or reconfiguration is not possible, physical barriers should be considered in such instances.	Good Practice Point
GPP28.2 Medical equipment and patient care equipment should not be placed in, or washed in, clinical wash hand basins or patient sinks, showers or baths.	Good Practice Point
GPP28.3 As refillable bottles are difficult to adequately decontaminate and can act as a reservoir for water associated microorganisms they should not be used in settings where immunocompromised	Good Practice Point

Recommendation	Grading
patients are treated (haematology and oncology, cardiac surgery, bone marrow and stem cell transplant, neonatal, paediatric and adult ICU, transplant units).	
GPP28.4 When investigating infection incidents where there is suspicion of an environmental link to water, potential involvement of refillable bottles should be considered.	Good Practice Point
GPP28.5 Sterile water, and not tap water, should be used in humidified neonatal incubators.	Good Practice Point
GPP28.6 Neonatal incubators (including mattresses) should be completely dismantled, cleaned, decontaminated and thoroughly dried between patients (or every 7 days when used continuously by the same patient), using cleaning products that are compatible with the equipment and in accordance with manufacturer's instructions. The re-usable reservoirs of humidified incubators should be cleaned and sterilised between uses in a central decontamination unit, if manufacturer guidance allows.	Good Practice Point
GPP28.7 Health and care settings should refer to NHSScotland Guidance for the interpretation and clinical management of endoscopy final rinse water and NHSScotland Guidance for Decontamination and testing of Cardiac Heater Cooler Units (HCUs).	Good Practice Point

28.7 Balancing benefits and harms

Comment here on the potential impact of the Recommendation/Good Practice Point on service users, visitors and staff. Benefits and harms include considerations beyond IPC.

Benefits

List the favourable changes in outcome that would likely occur if the Recommendation/ Good Practice Point were followed correctly. Be explicit, clear about pros.

Benefits
GPP28.1 It is anticipated that avoidance of splashing and/or spraying of tap water in the vicinity of the space in which drug preparation and other clinical and aseptic procedures are undertaken, will reduce the risk of transmission from water to patients via these routes. GPP28.2 Ensuring that medical and care equipment is not placed or washed in clinical wash hand basins and patient sinks will reduce the risk of transfer of infectious agents from said equipment to the fixtures and fittings and therefore prevent transmission to hands and formation of biofilms within the localised plumbing system. GPP28.3 It is anticipated that avoidance of the use of refillable bottles in high-risk settings will reduce the risk of transmission of infectious agents from contaminated bottles to the environment. GPP28.4 Considering the potential involvement of refillable bottles when investigating infection incidents where there is suspicion of an environmental link to water, may result in positive identification or will assist in ruling out a potential source. GPP28.5 It is anticipated that adhering to manufacturers' instructions for the operation and maintenance of humidified incubators will reduce the risk of contamination of the equipment and cross transmission between patients.

Benefits
GPP28.6 It is anticipated that good practice in the cleaning and decontamination of neonatal incubators will reduce the risk of HAI transmission via the incubators when used by subsequent patients. GPP28.7 It is anticipated that adherence to best practice guidance for the clinical management of endoscopy final rinse water and decontamination and testing of cardiac heater cooler units will reduce the risk of transmission of HAIs.

Risks and Harms

List the adverse events or other unfavourable outcomes that may occur if the Recommendation/ Good Practice Point were followed correctly. Be explicit, clear about cons.

Risks/Harms
GPP28.1 There are no anticipated harms as a result of ensuring that drug preparation, aseptic procedures and other clinical procedures are not carried out close to sinks or other water outlets where the potential for contamination due to splashing and/or spraying from water is possible. There are no anticipated harms associated with the erection of physical barriers where sites cannot be relocated or reconfigured. GPP28.2 There are no anticipated harms as a result of not placing or washing medical equipment and patient care equipment in clinical wash hand basins or patient sinks, showers or baths. GPP28.3 There are no anticipated harms associated with not using refillable bottles in settings where immunocompromised patients are treated (haematology and oncology, cardiac surgery, bone marrow and stem cell transplant, neonatal, paediatric and adult ICU, transplant units). GPP28.4 There are no anticipated harms associated with considering the potential involvement of refillable bottles when investigating infection incidents where there is suspicion of an environmental link to water.

Risks/Harms
GPP28.5 There are no anticipated harms associated with using sterile water, and not tap water, in humidified incubators. GPP28.6 There are no anticipated harms associated with the cleaning and decontamination of neonatal incubators. GPP28.7 There are no anticipated harms associated with referring health and care settings to NHSScotland Guidance for the interpretation and clinical management of endoscopy final rinse water and NHSScotland Guidance for Decontamination and testing of Cardiac Heater Cooler Units (HCUs).

Benefit-Harm assessment

Classify as “benefits outweigh harms” (or vice versa) or a “balance of benefit and harm.” Description of this balance can be from the individual patient/ staff/ visitor perspective, the societal perspective, or both. Recommendations/ Good Practice Points are possible when clear benefit is not offset by important harms, costs or adverse events (or vice versa).

Benefit-Harm assessment
Benefits outweigh harms for all good practice points.

28.8 Feasibility

Is the Recommendation/ Good Practice Point implementable in the Scottish context?

Describe (if applicable) financial implications, opportunity costs, material or human resource requirements, facility needs, sustainability issues, human factors etc., that may be associated with following a Recommendation/ Good Practice Point. State clearly if information on feasibility is lacking.

Feasibility
GPP28.1 There may be financial costs associated with reconfiguring a clinical department to minimise splash risk from water outlets. Access to other water

Feasibility
sources may be required while remedial works are being undertaken. There will be a requirement to include physical barriers in cleaning schedules. GPP28.2 There may be a need to train and educate staff to ensure that medical equipment and patient care equipment are not placed in, or washed in, clinical wash hand basins or patient sinks, showers or baths. Appropriate areas for equipment cleaning and decontamination will have to be accessible. GPP28.3 There may be financial implications related to replacement of refillable bottles. This may have a sustainability implication related to repurchase of ready-filled or pre-mixed cleaning and disinfectant bottles. GPP28.4 Staff investigating infection incidents may require training. Depending on the degree of suspicion, there may be a need to sample the bottles, which will require microbiology and laboratory resource. GPP28.5 The use of sterile water, and not tap water, in humidified incubators, will require the procurement and storage of sterile water. GPP28.6 Staff training and education may be required to support compliance with safe cleaning and decontamination of neonatal incubators. For weekly cleaning of incubators used continuously by the same neonate, sufficient incubators will be required to allow for the decant of the neonate into a clean incubator whilst the previous one is being decontaminated. This may incur a financial cost. GPP28.7 No resource needs identified.

28.9 Expert Opinion

Summarise the expert opinion used in creating the Recommendation/ Good Practice Point; if none were involved, state “none”. Translating evidence into action often involves expert opinion where evidence is insufficient. Clearly outlining expert opinion helps users understand their influence on interpreting objective evidence. Expert opinion may also be required where there is no evidence available.

Expert opinion

GPP28.1 ARHAI Scotland expert opinion is in agreement with SIGN50 level 4 extant guidance[122, 139] that preparation areas for aseptic procedures, drug preparation and any associated sterile equipment should not be located where they are at risk of splash contamination from water outlets.

GPP28.2 ARHAI Scotland expert opinion is in agreement with SIGN50 level 4 extant guidance from HPSC Republic of Ireland guidance that medical equipment and patient care equipment should not be placed in, or washed in, clinical wash hand basins.[124]

GPP28.3 Evidence from the CDC guideline (SIGN50 level 4)[95] and one outbreak study (SIGN50 level 3)[55] highlights the risk of contaminated refillable spray bottles acting as reservoirs or vectors for transmission. This evidence is considered insufficient for the development of a recommendation as it is low in quantity and the CDC guideline does not provide specific recommendations on the topic, only a discussion in text. There was no evidence identified that demonstrated infection incidents associated with use of refillable bottles in care homes. It is ARHAI Scotland expert opinion that risk with refillable bottles specifically is likely related to the difficultly in cleaning and drying all parts. As demonstrated in research question 4, the patients most at risk of infection are immunocompromised patient groups (haematology and oncology, cardiac surgery, bone marrow and stem cell transplant, neonatal, paediatric and adult ICU, transplant units). Consequently, a good practice point has been developed acknowledging the risk of refillable bottle contamination in these settings.

GPP28.4 It is ARHAI Scotland expert opinion that those investigating infection incidents should consider the potential involvement of refillable bottles where there is suspicion of an environmental link to water. A good practice point has been developed to reflect this.

GPP28.5 ARHAI Scotland expert opinion supports extant guidance (Republic of Ireland HPSC)[124] (UKHSA guidance[152] (both SIGN50 level 4) that advise the use of sterile water in humidified neonatal incubators. A good practice point has been developed.

Expert opinion
GPP28.6 One outbreak study (SIGN50 level 3) and extant guidance (SIGN50 level 4) from the Republic of Ireland[124] and UKHSA[152] (SIGN50 level 4) highlight the risk of transmission from inadequately decontaminated neonatal incubators, where inadequate drying of parts can facilitate survival and transmission of infectious agents. This evidence was considered insufficient for the development of a recommendation. However, this evidence supports ARHAI Scotland expert opinion for the development of a good practice point, to support safe cleaning and decontamination of neonatal incubators. GPP28.7 Three outbreak reports and one case-control study (all graded SIGN50 level 3) were consistent in demonstrating the risk from poor management of endoscopes (bronchoscopes, duodenoscopes) and automatic endoscope reprocessors (AERs).[2, 74, 87, 153] Evidence did not provide detail on the prevention of transmission from this equipment, therefore is insufficent to support a recommendation. ARHAI Scotland expert opinion supports a good practice point that healthcare settings should refer to extant NHSScotland Guidance for the interpretation and clinical management of endoscopy final rinse water.[113] Further, ARHAI Scotland expert opinion also supports referral to NHSScotland guidance for the decontamination and testing of heater cooler units.[112]

28.10 Value judgements

Summarise value judgements used by the Working Group in creating the Recommendation/ Good Practice Point; if none were involved, state “none”. Translating evidence into action often involves value judgements, which include guiding principles, ethical considerations, or other beliefs and priorities. Stating them clearly helps users understand their influence on interpreting objective evidence.

Value judgements
None.

28.11 Intentional vagueness

State reasons for any intentional vagueness in the Recommendation/ Good Practice Point; if none was intended, state “none”. Recommendations/ Good Practice Points should be clear and specific, but if there is a decision to be vague, acknowledging the reasoning clearly promotes transparency. Reasons for vagueness may include inadequate evidence; inability to achieve consensus regarding evidence quality, anticipated benefits/harms, or interpretation of evidence; legal considerations; economic reasons; ethical/ religious reasons.

Intentional vagueness
None.

28.12 Exceptions

List situations or circumstances in which the Recommendation/ Good Practice Point should not be applied.

Exceptions
None.

28.13 Recommendations for research

List any aspects of the question that require further research.

Recommendations for research
It would be beneficial if there was more evidence available to better define the splash risk/splash zone surrounding water outlets in health and care settings and the factors that impact this. It would be beneficial if more detail were provided in published outbreak reports regarding the control measures employed and analysis of their effectiveness.

Research question 29: What actions can be undertaken to facilitate the earliest possible detection and preparedness for clinical cases of water-associated colonisation or infection?

Part A: Quality of evidence

29.1 How reliable is the body of evidence? (see SIGN50, section 5.3.1, 5.3.4)

Comment here on the quantity of evidence available on this topic and its methodological quality. Please include citations and evidence levels.

If there is insufficient evidence to answer the key question, go to.

Comments	Evidence level
There is limited evidence available regarding actions that can be undertaken to facilitate earliest possible detection and preparedness for clinical cases of water-associated colonisation or infection. In total, six pieces of evidence were identified which includes: • 3 guidance documents [124, 127] (including 1 Scottish) (SIGN50 level 4),[123] • 1 outbreak study (SIGN50 level 3),[48] • 1 surveillance study (SIGN50 level 3),[83] • 1 British Standard (SIGN50 level 4).[122]	2x SIGN50 level 3 4x SIGN50 level 4

29.2 Is the evidence consistent in its conclusions? (see SIGN50, section 5.3.2)

Comment here on the degree of consistency demonstrated by the evidence. Where there are conflicting results, indicate how the group formed a judgement as to the overall direction of the evidence.

Comments
As there is limited evidence available, a high degree of consistency cannot be achieved. English and Scottish guidance are consistent on the fact that changes in monitored levels could provide early identification of water contamination.[123, 124, 127] Clinical surveillance is also mentioned. Scottish guidance adds a few more things that can facilitate early detection and preparedness which has not been mentioned elsewhere.[123] The review has not looked at the evidence on effectiveness (and associated benefits or harms) of prospective/active surveillance (for example admission screening) for early identification of cases of infection; therefore, no recommendation could be made.

29.3 Is the evidence applicable to Scottish health and care settings? (see SIGN50, section 5.3.3)

For example, do the studies include interventions, comparators or outcomes that are common to Scottish health and care settings?

Comments
All guidance documents are derived from Scotland or countries with a similar health system (1x Scottish guidance,[123] 1x Republic of Ireland guidance,[124] 1x UK guidance[122] and 1x English guidance[127]) and therefore are applicable to Scottish health and care settings. The outbreak study is derived from Australia[48] and the surveillance study is from China.[83]

29.4 Are the studies generalisable to the target population?

Comment here on sample size and methods of sample selection. Is the sample representative of the specific population/group of interest? Generalisability is only relevant to primary research studies.

Comments
No primary research studies were included.

29.5 Are there concerns about publication bias? (see SIGN50, section 5.3.5)

Comment here on whether there is a risk in the evidence base that studies have been selectively published based on their results (and thus a risk that results from published studies are systematically different from unpublished evidence).

Comments
No concerns.

Part B: Evidence to decision

29.6 Recommendations

What recommendations(s) or good practice point(s) does the Working Group agree are appropriate based on this evidence?

Note the following terminology:

- **"must"** implies that the health and care setting must implement the recommended approach and is used where a recommendation has been directly lifted from legislation or mandatory guidance
- **"should"** implies that the health and care setting "should" implement the recommended approach unless a clear and compelling rationale for an alternative approach is present
- **"should consider"** implies that the health and care setting should consider implementing the recommended approach

Recommendation	Grading
R29.1 All high-risk settings should have a setting-specific alert organism list for healthcare water system associated organisms which can be isolated from clinical samples, which should be informed by the known historical epidemiology of that setting. As a minimum, this alert organism list should include *Acinetobacter* spp., *Burkholderia* spp., *Chryseomonas*	Recommendation

Recommendation	Grading
indologenes, *Cupriavidus pauculus*, *Legionella* spp., *Pseudomonas* spp., non-tuberculous Mycobacteria (NTM), *Serratia marcescens, Sphingomonas* spp. and *Stenotrophomonas maltophilia.*	
GPP29.1 All care settings should have a water safety plan inclusive of a business continuity/contingency arrangement in preparation for the event that a water source (for example mains water, system water, tap water) cannot be used.	Good Practice Point

29.7 Balancing benefits and harms

Comment here on the potential impact of the Recommendation/Good Practice Point on service users, visitors and staff. Benefits and harms include considerations beyond IPC.

Benefits

List the favourable changes in outcome that would likely occur if the Recommendation/ Good Practice Point were followed correctly. Be explicit, clear about pros.

Benefits
• R29.1 An alert organism list will trigger investigations and the enactment of control measures to prevent the risk of onward transmission from the known case and potential environmental source. • GPP29.1 Having a water safety plan (inclusive of a business continuity/contingency arrangement) demonstrates a system for organisational preparedness to respond to water associated infection risks.

Risks and Harms

List the adverse events or other unfavourable outcomes that may occur if the Recommendation/ Good Practice Point were followed correctly. Be explicit, clear about cons.

Risks/Harms
An alert organism list (R29.1) will trigger investigations which has potential impact on services and the ability to deliver clinical care. However, this should be mitigated by having a business continuity/contingency arrangement within the water safety plan (GPP29.1).

Benefit-Harm assessment

Classify as “benefit outweigh harm” (or vice versa) or a “balance of benefit and harm.” Description of this balance can be from the individual patient/ staff/ visitor perspective, the societal perspective, or both. Recommendations/ Good Practice Points are possible when clear benefit is not offset by important harms, costs or adverse events (or vice versa).

Benefit-Harm assessment
Benefit outweighs harm.

29.8 Feasibility

Is the Recommendation/ Good Practice Point implementable in the Scottish context?

Describe (if applicable) financial implications, opportunity costs, material or human resource requirements, facility needs, sustainability issues, human factors etc., that may be associated with following a Recommendation/Good Practice Point. State clearly if information on feasibility is lacking.

Feasibility
R29.1 Depending on the organisms that are on the setting-specific alert organism list, there may be resource and financial requirements associated with setting up

Feasibility
alerts/ surveillance and laboratory processes. Some organisms may be difficult to detect and/or expensive to process in the laboratory.

29.9 Expert Opinion

Summarise the expert opinion used in creating the Recommendation/ Good Practice Point; if none were involved, state “none”. Translating evidence into action often involves expert opinion where evidence is insufficient. Clearly outlining expert opinion helps users understand their influence on interpreting objective evidence. Expert opinion may also be required where there is no evidence available.

Expert opinion
R29.1 The list of organisms is informed by research question 1 which provided sufficient evidence for a recommendation on which organisms are associated with healthcare water system-associated incidents. Alert organism lists are intended to support patient safety and trigger investigation which may then indicate whether further reporting to ARHAI Scotland is required. It is not considered appropriate to add Enterobacteriaceae to an alert organism list as humans can be naturally colonised with these organisms. This list is not exhaustive and IPC Teams should remain vigilant for rarer and emerging waterborne pathogens. Therefore, ‘as a minimum’ has been added. GPP29.1 Although no specific evidence was identified regarding contingency planning, ARHAI Scotland opinion is that all care settings should have a contingency plan for when a water source cannot be used due to an infection incident.

29.9 Value judgements

Summarise value judgements used by the Working Group in creating the Recommendation/ Good Practice Point; if none were involved, state “none”. Translating evidence into action often involves value judgements, which include guiding principles, ethical considerations, or other beliefs and priorities. Stating them clearly helps users understand their influence on interpreting objective evidence.

Value judgements
None.

29.10 Intentional vagueness

State reasons for any intentional vagueness in the Recommendation/Good Practice Point; if none was intended, state “none”. Recommendations/Good Practice Points should be clear and specific, but if there is a decision to be vague, acknowledging the reasoning clearly promotes transparency. Reasons for vagueness may include inadequate evidence; inability to achieve consensus regarding evidence quality, anticipated benefits/harms, or interpretation of evidence; legal considerations; economic reasons; ethical/ religious reasons.

Intentional vagueness
GPP29.1 states that a contingency plan should be in place but does not state what that plan should include. This is because business continuity and contingency arrangements are likely to vary within different organisations due to multiple factors such as the ability to relocate a department or service and continue to provide its intended clinical functionality. This is beyond the scope and purpose of this literature review.

29.12 Exceptions

List situations or circumstances in which the Recommendation/ Good Practice Point should not be applied.

Exceptions
None.

29.13 Recommendations for research

List any aspects of the question that require further research.

Recommendations for research
This review has not looked into the benefits, risks and harms regarding admission screening and it would be helpful to explore evidence on the effectiveness of

Recommendations for research
admission screening with regards to preparedness for clinical cases (for example, if patients test negative for the healthcare water system associated alert organisms at admission it could direct investigations towards environmental reservoirs within the ward when an infection/colonisation is acquired during their stay). It could also rule out the healthcare water system if a patient tests positive for any of the healthcare water system associated alert organisms on admission.

Research question 30: How should water-associated incidents be assessed and reported locally and nationally?

Part A: Quality of evidence

30.1 How reliable is the body of evidence? (see SIGN50, section 5.3.1, 5.3.4)

Comment here on the quantity of evidence available on this topic and its methodological quality. Please include citations and evidence levels.

If there is insufficient evidence to answer the key question, go to section B.

Comments	Evidence level
Limited evidence is available. In total, two pieces of evidence were included, one is a guidance document categorised as expert opinion (SIGN50 level 4),[154] the other is an independent report, graded SIGN50 level 4.[155]	2x SIGN50 level 4

30.2 Is the evidence consistent in its conclusions? (see SIGN50, section 5.3.2)

Comment here on the degree of consistency demonstrated by the evidence. Where there are conflicting results, indicate how the group formed a judgement as to the overall direction of the evidence.

Comments
There was insufficient evidence to comment on consistency. Only two evidence sources were included, a Scottish guidance document and an independent report from Northern Ireland.[154, 155] The “Management of Public Health Incidents: Guidance on the Roles and Responsibilities of NHS Led Incident Management Teams” which is applicable to Scotland advises that following detection/recognition of an incident, the IPC team or HPT team should undertake an initial risk assessment. Limited detail of this risk assessment is provided. The Northern Ireland independent report, which was specific to neonatal cases of *P. aeruginosa* colonisation or infection in neonatal intensive care and high

Comments
dependency units concluded that because Irish trusts had different approaches to the declaration of outbreaks, it may have led to a delay in putting control measures in place when cases of infection occurred. The report recommended that an agreed approach for reporting should be established across all trusts.

30.3 Is the evidence applicable to Scottish health and care settings? (see SIGN50, section 5.3.3)

For example, do the studies include similar target populations, interventions, comparators or outcomes as those common to Scottish health and care settings?

Comments
Yes, it is applicable.

30.4 Are the studies generalisable to the target population?

Comment here on sample size and methods of sample selection. For example, if all the studies include adults only, their findings may not be generalisable to neonates.

Comments
N/A - no primary studies were identified for this research question.

30.5 Are there concerns about publication bias? (see SIGN50, section 5.3.5)

Comment here on whether there is a risk in the evidence base that studies have been selectively published based on their results (and thus a risk that results from published studies are systematically different from unpublished evidence).

Comments
No concerns.

Part B: Evidence to decision

30.6 Recommendations

What recommendations(s) or good practice point(s) does the Working Group agree are appropriate based on this evidence?

Note the following terminology:

- **"must"** implies that the health and care setting must implement the recommended approach and is used where a recommendation has been directly lifted from legislation or mandatory guidance
- **"should"** implies that the health and care setting "should" implement the recommended approach unless a clear and compelling rationale for an alternative approach is present
- **"should consider"** implies that the health and care setting should consider implementing the recommended approach

Recommendation	Grading
GPP30.1 Where a transmission event associated with the healthcare water system is suspected or confirmed it should be assessed using the NIPCM Healthcare Infection Incident Assessment Tool (HIIAT).	Good Practice Point

30.7 Balancing benefits and harms

Comment here on the potential impact of the Recommendation/Good Practice Point on service users, visitors and staff. Benefits and harms include considerations beyond IPC.

Benefits

List the favourable changes in outcome that would likely occur if the Recommendation/ Good Practice Point were followed correctly. Be explicit, clear about pros.

Benefits
GPP30.1 Using the HIIAT tool ensures appropriate communication including national reporting to ARHAI Scotland which is beneficial for supporting national surveillance and the national assessment of incident management. This also ensures a national collation of lessons learned, facilitates shared learning and contributes to the development of guidance.

Risks and Harms

List the adverse events or other unfavourable outcomes that may occur if the Recommendation/ Good Practice Point were followed correctly. Be explicit, clear about cons.

Risks/Harms
No risks or harms identified.

Benefit-Harm assessment

Classify as “benefits outweigh harms” (or vice versa) or a “balance of benefit and harm.” Description of this balance can be from the individual patient/staff/visitor perspective, the societal perspective, or both. Recommendations/Good Practice Points are possible when clear benefit is not offset by important harms, costs or adverse events (or vice versa).

Benefit-Harm assessment
Only benefits identified.

30.8 Feasibility

Is the Recommendation/Good Practice Point implementable in the Scottish context? Describe (if applicable) financial implications, opportunity costs, material or human resource requirements, facility needs, sustainability issues, human factors etc., that

may be associated with following a Recommendation/ Good Practice Point. State clearly if information on feasibility is lacking.

Feasibility
GPP30.1 There may be additional requirements to provide support and information to service users, family/carers while the assessment is being conducted.

30.9 Expert Opinion

Summarise the expert opinion used in creating the Recommendation/Good Practice Point; if none were involved, state “none”. Translating evidence into action often involves expert opinion where evidence is insufficient. Clearly outlining expert opinion helps users understand their influence on interpreting objective evidence. Expert opinion may also be required where there is no evidence available.

Expert opinion
GPP30.1 This research question is not concerned with the determination of whether colonisation or infection in the patient(s) is potentially healthcare-related, for detail specific to that determination see RQ1 and RQ3. Once it has been decided that there may be a possible association between clinical case/s and healthcare environment, the “Management of Public Health Incidents: Guidance on the Roles and Responsibilities of NHS Led Incident Management Teams” which is applicable to Scotland advises that following detection/recognition of an incident, the IPC team or HPT team should undertake an initial risk assessment. There is limited information provided in this guidance as to what factors the risk assessment should include. The Northern Ireland independent report, although specific to neonatal cases of *P. aeruginosa*, recommended a nationally agreed approach to reporting of infection incidents. An assessment tool to undertake a risk assessment is provided within Chapter 3 of the NIPCM in the form of the Healthcare Infection Incident Assessment (HIIAT) tool and at the time of writing is under review for optimalisation. The HIIAT tool supports assessment of the impact of a healthcare infection incident/outbreak on patients, services and public health. It also indicates the national communication and reporting that is required based on the risk assessment. It is ARHAI Scotland opinion that the HIIAT

tool should be used to support the assessment and reporting of all clinical cases (in Scottish acute care settings) where involvement with the water system is suspected.

30.10 Value judgements

Summarise value judgements used by the Working Group in creating the Recommendation/Good Practice Point; if none were involved, state “none”. Translating evidence into action often involves value judgements, which include guiding principles, ethical considerations, or other beliefs and priorities. Stating them clearly helps users understand their influence on interpreting objective evidence.

Value judgements
None.

30.11 Intentional vagueness

State reasons for any intentional vagueness in the Recommendation/ Good Practice Point; if none was intended, state “none”. Recommendations/ Good Practice Points should be clear and specific, but if there is a decision to be vague, acknowledging the reasoning clearly promotes transparency. Reasons for vagueness may include inadequate evidence; inability to achieve consensus regarding evidence quality, anticipated benefits/harms, or interpretation of evidence; legal considerations; economic reasons; ethical/ religious reasons.

Intentional vagueness
None.

30.12 Exceptions

List situations or circumstances in which the Recommendation/ Good Practice Point should not be applied.

Exceptions
None.

30.13 Recommendations for research

List any aspects of the question that require further research.

Recommendations for research
None.

Research question 31: What are the water testing requirements during a water-associated incident/outbreak?

Part A: Quality of evidence

31.1 How reliable is the body of evidence? (see SIGN50, section 5.3.1, 5.3.4)

Comment here on the quantity of evidence available on this topic and its methodological quality. Please include citations and evidence levels.

If there is insufficient evidence to answer the key question, go to section B.

Comments	Evidence level
There is limited evidence available regarding water testing requirements during a water-associated incident/outbreak. Three guidance documents were identified to inform recommendations on this subject which includes: • 1 Scottish guidance document,[101] • 1 British Standard,[114] • 1 guidance document from the Republic of Ireland.[124] All were deemed to be expert opinions due to the lack of a rigorous search and/or methodology in developing the guidance and in accordance with SIGN50 methodology, were graded level 4 evidence.	3x SIGN50 level 4

31.2 Is the evidence consistent in its conclusions? (see SIGN50, section 5.3.2)

Comment here on the degree of consistency demonstrated by the evidence. Where there are conflicting results, indicate how the group formed a judgement as to the overall direction of the evidence.

Comments
As there is limited evidence available, a high degree of consistency cannot be achieved. However, the following points have been agreed by more than one guidance document: • All three guidance documents advise that in case of a water-associated outbreak, the frequency of routine water testing should be increased.[101, 114, 124] • BS7592:2022 and Republic of Ireland guidance advise that an overall investigation plan including sampling should be drawn by the IMT to identify and prioritise potential sources.[114, 124] • BS7592:2022 and Republic of Ireland guidance advise that pre-flush samples represent the water that patients are most likely to have had contact with, therefore if sampling is undertaken it should include pre-flush samples.[114, 124] In addition, SHTM 04-01 advises that sampling should occur prior to disinfection to increase the ability to identify a source or reservoir within the water system (effective disinfection may remove or temporarily mask system contamination and sample quality).[101] As demonstrated in research question 3 (what are the causes/sources of environmental contamination), water-based equipment can be the source/reservoir for transmission to patients, and therefore should be sampled if included as a potential source within the working hypothesis.

31.3 Is the evidence applicable to Scottish health and care settings? (see SIGN50, section 5.3.3)

For example, do the studies include interventions, comparators or outcomes that are common to Scottish health and care settings?

Comments
All evidence is derived from Scotland or countries with a similar health system (1x Scottish guidance,[101] 1x Republic of Ireland guidance,[124] 1x UK guidance[114]) and therefore are applicable to Scottish health and care settings.

31.4 Are the studies generalisable to the target population?

Comment here on sample size and methods of sample selection. Is the sample representative of the specific population/group of interest? Generalisability is only relevant to primary research studies.

Comments
N/A - no primary studies were identified for this research question.

31.5 Are there concerns about publication bias? (see SIGN50, section 5.3.5)

Comment here on whether there is a risk in the evidence base that studies have been selectively published based on their results (and thus a risk that results from published studies are systematically different from unpublished evidence).

Comments
No concerns.

Part B: Evidence to decision

31.6 Recommendations

What recommendations(s) or good practice point(s) does the Working Group agree are appropriate based on this evidence?

Note the following terminology:

- **"must"** implies that the health and care setting must implement the recommended approach and is used where a recommendation has been directly lifted from legislation or mandatory guidance
- **"should"** implies that the health and care setting "should" implement the recommended approach unless a clear and compelling rationale for an alternative approach is present
- **"should consider"** implies that the health and care setting should consider implementing the recommended approach

Recommendation	Grading
GPP31.1 A water sampling plan should be agreed by the incident management team (IMT) to identify and prioritise potential sources (both mains water supply and water associated equipment/procedures) taking account of the known epidemiological and historical information at the time, the geographical distribution of any infected/colonised cases throughout their entire healthcare journey, and the layout/schematics of the associated water system.	Good Practice Point
GPP31.2 Consideration should be given to taking water samples from equipment that utilises water (sterile and non-sterile) to function (both medical and non-medical) if it is a suspected source.	Good Practice Point
GPP31.3 Water samples should be taken before disinfection of the water system/equipment or before any other remedial actions are initiated.	Good Practice Point
GPP31.4 A pre-flush sample should be taken from each outlet being sampled.	Good Practice Point
GPP31.5 For sampling guidance specific to *Legionella* spp., BSI 7592:2022 'Sampling for *Legionella* bacteria in water systems – Code of practice' should be followed.	Good Practice Point

31.7 Balancing benefits and harms

Comment here on the potential impact of the Recommendation/Good Practice Point on service users, visitors and staff. Benefits and harms include considerations beyond IPC.

Benefits

List the favourable changes in outcome that would likely occur if the Recommendation/ Good Practice Point were followed correctly. Be explicit, clear about pros.

Benefits
GPP31.1, GPP31.2 & GPP31.3 Identification of potential sources can enable consideration and tailoring of controls and remedial actions which can reduce the risk of direct and/or indirect transmission from the source(s) to service users. When the potential source is identified, this might lead to earlier initiation of control measures. Equally it can also rule out potential sources.

Risks and Harms

List the adverse events or other unfavourable outcomes that may occur if the Recommendation/Good Practice Point were followed correctly. Be explicit, clear about cons.

Risks/Harms
No risks and harms identified.

Benefit-Harm assessment

Classify as “benefits outweigh harms” (or vice versa) or a “balance of benefit and harm.” Description of this balance can be from the individual patient/ staff/ visitor perspective, the societal perspective, or both. Recommendations/Good Practice Points are possible when clear benefit is not offset by important harms, costs or adverse events (or vice versa).

Benefit-Harm assessment
Only benefits identified.

31.8 Feasibility

Is the Recommendation/ Good Practice Point implementable in the Scottish context?

Describe (if applicable) financial implications, opportunity costs, material or human resource requirements, facility needs, sustainability issues, human factors etc., that may be associated with following a Recommendation/ Good Practice Point. State clearly if information on feasibility is lacking.

Feasibility
• GPP31.1, GPP31.2, GPP31.3, GPP31.4 Human resource is required to plan and undertake water sampling. • GPP31.2, GPP31.3, GPP31.4 There will be financial costs associated with sampling and testing; an external contractor may be required.

31.9 Expert Opinion

Summarise the expert opinion used in creating the Recommendation/ Good Practice Point; if none were involved, state “none”. Translating evidence into action often involves expert opinion where evidence is insufficient. Clearly outlining expert opinion helps users understand their influence on interpreting objective evidence. Expert opinion may also be required where there is no evidence available.

Expert opinion
GPP31.1 ARHAI Scotland support extant expert opinion guidance (from the British Standards Institution and Republic of Ireland HPSC) BS7592:2022 and Republic of Ireland guidance advise that an overall investigation plan including sampling should be drawn by the IMT to identify and prioritise potential sources.[114, 124] GPP31.2 It is the opinion of ARHAI Scotland that consideration should be given to taking water samples from equipment that utilises water to function if it is a suspected source. GPP31.3 SHTM 04-01 advises that sampling should occur prior to disinfection to increase the ability to identify a source or reservoir within the water system. It is

Expert opinion
ARHAI Scotland opinion that this should extend to sampling prior to other remedial actions.[101] GPP31.4 ARHAI Scotland support extant expert opinion guidance (from the British Standards Institution and Republic of Ireland HPSC) that pre-flush samples represent the water that patients are most likely to have had contact with, therefore if sampling is undertaken it should include pre-flush samples.[114, 124] GPP31.5 Sampling guidance for specific organisms are not covered by this review, but guidance (BS code of practice) is available regarding sampling for *Legionella* bacteria in water systems and therefore a good practice point has been developed to refer to this guidance.

31.10 Value judgements

Summarise value judgements used by the Working Group in creating the Recommendation/ Good Practice Point; if none were involved, state “none”. Translating evidence into action often involves value judgements, which include guiding principles, ethical considerations, or other beliefs and priorities. Stating them clearly helps users understand their influence on interpreting objective evidence.

Value judgements
None.

31.11 Intentional vagueness

State reasons for any intentional vagueness in the Recommendation/Good Practice Point; if none was intended, state “none”. Recommendations/Good Practice Points should be clear and specific, but if there is a decision to be vague, acknowledging the reasoning clearly promotes transparency. Reasons for vagueness may include inadequate evidence; inability to achieve consensus regarding evidence quality, anticipated benefits/harms, or interpretation of evidence; legal considerations; economic reasons; ethical/ religious reasons.

Intentional vagueness
It is not possible to comment on the number of samples that should be taken, as this will depend on the complexity of the incident, the location of cases, and the specific design of the water distribution system, including number and type of outlets present.

31.12 Exceptions

List situations or circumstances in which the Recommendation/ Good Practice Point should not be applied.

Exceptions
For GPP31.3 it may not be possible to take water samples prior to disinfection of the water system/equipment or before any other remedial actions are initiated if patient safety requires immediate remedial actions.

31.13 Recommendations for research

List any aspects of the question that require further research.

Recommendations for research
None.

Research question 32: What are the environmental testing requirements when investigating healthcare water system-associated incidents/outbreaks?

Part A: Quality of evidence

32.1 How reliable is the body of evidence? (see SIGN50, section 5.3.1, 5.3.4)

Comment here on the quantity of evidence available on this topic and its methodological quality. Please include citations and evidence levels.

If there is insufficient evidence to answer the key question, go to section B.

Comments	Evidence level
In total, 21 pieces of evidence were identified in relation to this research question which includes: • 14 outbreak studies (SIGN50 level 3),[17, 20, 35, 43, 49, 51, 58, 62-64, 67, 70, 71, 77] • 1 surveillance study (SIGN50 level 3),[82] • 6 guidance documents categorised as expert opinion (including one Scottish,[106] one English,[127] one from the Republic of Ireland,[124] one international guideline[95] and two British Standards),[114, 122] (SIGN50 level 4)	15x SIGN50 level 3 6x SIGN50 level 4

32.2 Is the evidence consistent in its conclusions? (see SIGN50, section 5.3.2)

Comment here on the degree of consistency demonstrated by the evidence. Where there are conflicting results, indicate how the group formed a judgement as to the overall direction of the evidence.

Comments
There is consistency in the following:

Comments

- Environmental sampling is advised by all 21 pieces of evidence when investigating the source of hospital acquired cases and/or outbreaks.[17, 20, 35, 43, 49, 51, 58, 62-64, 67, 70, 71, 77, 82, 95, 106, 114, 122, 124, 127]

- Three guidance documents (BS 7592:2022, BS 8580-2:2022 and HPSC Republic of Ireland) advise that an overall investigation plan should be drawn up by the outbreak investigation team to identify and prioritise potential sources taking account of the geographical distribution of the infected cases.[114, 122, 124]

The challenges related to genetic typing is not mentioned in all pieces of evidence as this might vary between locations due to resource among other things.

The evidence in RQ3 ‘‘What are the causes/sources of environmental contamination with healthcare water system-associated organisms?” has demonstrated that organisms can be found in environmental reservoirs including the tap and drains, sometimes in the absence of positive/non-compliant water samples. There is a small body of outbreak studies that demonstrate that identification of environmental reservoirs contributed to successful control measures and reduced the risk of subsequent transmissions.

32.3 Is the evidence applicable to Scottish health and care settings? (see SIGN50, section 5.3.3)

For example, do the studies include interventions, comparators or outcomes that are common to Scottish health and care settings?

Comments

Guidance documents are derived from the UK (Scotland,[106] Republic of Ireland[124] and England[127]) and the US.[95] The two British Standards are code of practice within the UK including Scotland.[114, 122] The surveillance study took place in the UK.[82] Most of the outbreak studies are from developed countries (1x Denmark,[58] 1x Belgium,[51] 3x US,[35, 64, 70] 2x Spain,[20, 43] 1x France,[49] 2x Germany,[17, 77] 2x UK,[62, 71] 1x China,[67] 1x Australia[63]) and thus also applicable to Scottish health and care settings.

32.4 Are the studies generalisable to the target population?

Comment here on sample size and methods of sample selection. Is the sample representative of the specific population/group of interest? Generalisability is only relevant to primary research studies.

Comments
The only study that had any control over sample size was an outbreak study with a case-control element. This was helpful in identifying potential contributing factors but demonstrated associations only.[70] The patient group in this study is representative of the population of interest. There was no evidence of any higher quality (no randomised control trials or intervention studies).

32.5 Are there concerns about publication bias? (see SIGN50, section 5.3.5)

Comment here on whether there is a risk in the evidence base that studies have been selectively published based on their results (and thus a risk that results from published studies are systematically different from unpublished evidence).

Comments
Several (14 out of the 21) studies included are outbreak studies and so there is a possibility of publication bias as not all outbreaks/infection incidents are published in scientific journals.

Part B: Evidence to decision

32.6 Recommendations

What recommendations(s) or good practice point(s) does the Working Group agree are appropriate based on this evidence?

Note the following terminology:

- **"must"** implies that the health and care setting must implement the recommended approach and is used where a recommendation has been directly lifted from legislation or mandatory guidance

- **“should”** implies that the health and care setting “should” implement the recommended approach unless a clear and compelling rationale for an alternative approach is present
- **“should consider”** implies that the health and care setting should consider implementing the recommended approach

Recommendation	Grading
GPP32.1 Environmental sampling (swabbing) should be conducted in scenarios where there is more than one hypothesis for source and an environmental source is suspected, taking account of a data exceedance (for example sporadic cases of colonisation/infection over a set time period which might be protracted over many years).	Good Practice Point
GPP32.2 An environmental sampling plan should be agreed by the incident management team (IMT) to identify and prioritise potential sources/reservoirs taking account of the known epidemiological information at the time (including historical), and the geographical distribution of the infected/colonised cases throughout their entire healthcare journey. Environmental sites may include any sites that are exposed to water for example taps and drains.	Good Practice Point
GPP32.3 Environmental samples should be taken before environmental decontamination or other environmental remedial actions are initiated.	Good Practice Point

32.7 Balancing benefits and harms

Comment here on the potential impact of the Recommendation/Good Practice Point on service users, visitors and staff. Benefits and harms include considerations beyond IPC.

Benefits

List the favourable changes in outcome that would likely occur if the Recommendation/ Good Practice Point were followed correctly. Be explicit, clear about pros.

Benefits
GPP32.1, GPP32.2, GPP32.3 Environmental sampling may identify environmental reservoirs. Identification of environmental reservoirs can enable consideration and tailoring of controls and remedial actions which can reduce the risk of direct and/or indirect transmission from these reservoirs to patients.

Risks and Harms

List the adverse events or other unfavourable outcomes that may occur if the Recommendation/ Good Practice Point were followed correctly. Be explicit, clear about cons.

Risks/Harms
GPP32.1 There might be a false sense of security when no environmental source has been identified (when samples come back negative). There is a possibility that the sample(s) has not picked up the outbreak strain due to the size of the area(s) that can potentially harbour the strain (for example an entire sink, surface or shower) or due to the presence of biofilms.

Benefit-Harm assessment

Classify as “benefits outweigh harms” (or vice versa) or a “balance of benefit and harm.” Description of this balance can be from the individual patient/ staff/ visitor perspective, the societal perspective, or both. Recommendations/ Good Practice Points are possible when clear benefit is not offset by important harms, costs or adverse events (or vice versa).

Benefit-Harm assessment
Benefits outweigh harms.

32.8 Feasibility

Is the Recommendation/Good Practice Point implementable in the Scottish context?

Describe (if applicable) financial implications, opportunity costs, material or human resource requirements, facility needs, sustainability issues, human factors etc., that may be associated with following a Recommendation/ Good Practice Point. State clearly if information on feasibility is lacking.

Feasibility
• GPP32.1, GPP32.2, GPP32.3 Human resource is required to investigate the need for environmental sampling, and then to plan, undertake, and interpret environmental sampling. • GPP32.1, GPP32.3 There may be financial costs associated with sampling. • GPP32.3 There may be human factors involved (regarding patient safety) that make sampling challenging.

32.9 Expert Opinion

Summarise the expert opinion used in creating the Recommendation/ Good Practice Point; if none were involved, state “none”. Translating evidence into action often involves expert opinion where evidence is insufficient. Clearly outlining expert opinion helps users understand their influence on interpreting objective evidence. Expert opinion may also be required where there is no evidence available.

Expert opinion
GPP32.1 Environmental sampling is advised by all 21 pieces of evidence (14 outbreak studies, one surveillance study, five expert opinion guidance documents and one international guidelines) when investigating the source of hospital acquired cases and/or outbreaks; this evidence is considered sufficient for a recommendation.[17, 20, 35, 43, 49, 51, 58, 62-64, 67, 70, 71, 77, 82, 95, 106, 114, 122, 124, 127] It is ARHAI Scotland opinion that identifying a source/reservoir provides reassurance to staff and service users and allows development of specific control measures, therefore environmental sampling should be conducted particularly in scenarios where there is more than one hypothesis for source and an environmental source is suspected.

Expert opinion
GPP32.2 ARHAI Scotland support extant expert opinion guidance (from the British Standards Institution and HPSC Republic of Ireland) that an overall investigation plan should be drawn up by the outbreak investigation team to identify and prioritise potential sources taking account of the geographical distribution of the infected cases. Therefore, a good practice point has been developed. GPP32.3 Wherever possible, sampling should be taken before environmental decontamination or other environmental remedial actions are initiated to obtain a full understanding of the incident/outbreak and so that the potential reservoir has not been (temporarily) removed.

32.10 Value judgements

Summarise value judgements used by the Working Group in creating the Recommendation/ Good Practice Point; if none were involved, state “none”. Translating evidence into action often involves value judgements, which include guiding principles, ethical considerations, or other beliefs and priorities. Stating them clearly helps users understand their influence on interpreting objective evidence.

Value judgements
None.

32.11 Intentional vagueness

State reasons for any intentional vagueness in the Recommendation/ Good Practice Point; if none was intended, state “none”. Recommendations/ Good Practice Points should be clear and specific, but if there is a decision to be vague, acknowledging the reasoning clearly promotes transparency. Reasons for vagueness may include inadequate evidence; inability to achieve consensus regarding evidence quality, anticipated benefits/harms, or interpretation of evidence; legal considerations; economic reasons; ethical/religious reasons.

Intentional vagueness
It is not possible to comment on the number of samples that should be taken, as this will depend on the complexity of the incident, the location of cases, and the specific design of the water distribution system.

32.12 Exceptions

List situations or circumstances in which the Recommendation/Good Practice Point should not be applied.

Exceptions
None.

32.13 Recommendations for research

List any aspects of the question that require further research.

Recommendations for research
Further prospective studies that assess the effectiveness of environmental sampling for both the management and prevention of infection would add rigour to this research question.

Research question 33: How and by whom should water-associated incidents be investigated?

Part A: Quality of evidence

33.1 How reliable is the body of evidence? (see SIGN50, section 5.3.1, 5.3.4)

Comment here on the quantity of evidence available on this topic and its methodological quality. Please include citations and evidence levels.

If there is insufficient evidence to answer the key question, go to section B.

Comments	Evidence level
Very limited evidence is available regarding this research question. In total, two pieces of evidence were identified and both are guidance documents categorised as expert opinion.[124, 154]	2x SIGN50 Level 4

33.2 Is the evidence consistent in its conclusions? (see SIGN50, section 5.3.2)

Comment here on the degree of consistency demonstrated by the evidence. Where there are conflicting results, indicate how the group formed a judgement as to the overall direction of the evidence.

Comments
As there is limited evidence available, a high degree of consistency cannot be achieved. The HPSC (Republic of Ireland guidelines) mention some considerations that could be useful when investigating water-related incidents and are included as considerations/examples.[124] However, as this is a national process, other evidence is not always relevant. The other expert opinion document, guidance developed by the Scottish government, is in line with Chapter 3 of the NIPCM "Healthcare Infection Incidents, Outbreaks and Data Exceedance" and outlines how a healthcare incident or outbreak should be investigated. [154]

33.3 Is the evidence applicable to Scottish health and care settings? (see SIGN50, section 5.3.3)

For example, do the studies include interventions, comparators or outcomes that are common to Scottish health and care settings?

Comments
Applicable. Both pieces of evidence derived from Scotland and/or UK (1x Scottish guidance document and 1x Republic of Ireland guidance document)

33.4 Are the studies generalisable to the target population?

Comment here on sample size and methods of sample selection. Is the sample representative of the specific population/group of interest? Generalisability is only relevant to primary research studies.

Comments
N/A - no primary studies were identified for this research question.

33.5 Are there concerns about publication bias? (see SIGN50, section 5.3.5)

Comment here on whether there is a risk in the evidence base that studies have been selectively published based on their results (and thus a risk that results from published studies are systematically different from unpublished evidence).

Comments
No concerns.

Part B: Evidence to decision

33.6 Recommendations

What recommendations(s) or good practice point(s) does the Working Group agree are appropriate based on this evidence?

Note the following terminology:

- **“must”** implies that the health and care setting must implement the recommended approach and is used where a recommendation has been directly lifted from legislation or mandatory guidance
- **“should”** implies that the health and care setting “should” implement the recommended approach unless a clear and compelling rationale for an alternative approach is present
- **“should consider”** implies that the health and care setting should consider implementing the recommended approach

Recommendation	Grading
GPP33.1 Chapter 3 NIPCM (section 3.2) should be followed when investigating any healthcare water system-associated infection incident.	Good Practice Point
GPP33.2 As per Chapter 3 of the NIPCM, an individual member of the IPC team or health protection team may undertake the initial HIIAT assessment prior to a problem assessment group (PAG) or incident management team (IMT). If a PAG or IMT is established, then further assessments should be led by the chair of the PAG/IMT.	Good Practice Point

33.7 Balancing benefits and harms

Comment here on the potential impact of the Recommendation/Good Practice Point on service users, visitors and staff. Benefits and harms include considerations beyond IPC.

Benefits

List the favourable changes in outcome that would likely occur if the Recommendation/Good Practice Point were followed correctly. Be explicit, clear about pros.

Benefits
GPP33.1 & GPP33.2 Appropriate management by responsible staff reduces risk of further transmission.

Risks and Harms

List the adverse events or other unfavourable outcomes that may occur if the Recommendation/ Good Practice Point were followed correctly. Be explicit, clear about cons.

Risks/Harms
No risks or harms identified.

Benefit-Harm assessment

Classify as “benefit outweighs harm” (or vice versa) or a “balance of benefit and harm.” Description of this balance can be from the individual patient/ staff/ visitor perspective, the societal perspective, or both. Recommendations/ Good Practice Points are possible when clear benefit is not offset by important harms, costs or adverse events (or vice versa).

Benefit-Harm assessment
Only benefits identified.

33.8 Feasibility

Is the Recommendation/ Good Practice Point implementable in the Scottish context? Describe (if applicable) financial implications, opportunity costs, material or human resource requirements, facility needs, sustainability issues, human factors etc., that may be associated with following a Recommendation/ Good Practice Point. State clearly if information on feasibility is lacking.

Feasibility
GPP33.1 & GPP33.2 Staff required to undertake the investigation.

33.9 Expert Opinion

Summarise the expert opinion used in creating the Recommendation/ Good Practice Point; if none were involved, state “none”. Translating evidence into action often involves expert opinion where evidence is insufficient. Clearly outlining expert opinion helps users understand their influence on interpreting objective evidence. Expert opinion may also be required where there is no evidence available.

Expert opinion
GPP33.1, GPP33.2 Chapter 3 of the NIPCM “Healthcare Infection Incidents, Outbreaks and Data Exceedance” outlines how a healthcare incident or outbreak should be investigated and is in line with the “Management of Public Health Incidents: Guidance on the Roles and Responsibilities of NHS Led Incident Management Teams”.[154] Detailed information on how to conduct the investigation, as well as relevant templates, checklists and other tools are available in the NIPCM Chapter 3.

33.10 Value judgements

Summarise value judgements used by the Working Group in creating the Recommendation/Good Practice Point; if none were involved, state “none”. Translating evidence into action often involves value judgements, which include guiding principles, ethical considerations, or other beliefs and priorities. Stating them clearly helps users understand their influence on interpreting objective evidence.

Value judgements
None.

33.11 Intentional vagueness

State reasons for any intentional vagueness in the Recommendation/Good Practice Point; if none was intended, state “none”. Recommendations/Good Practice Points should be clear and specific, but if there is a decision to be vague, acknowledging the reasoning clearly promotes transparency. Reasons for vagueness may include inadequate evidence; inability to achieve consensus regarding evidence quality,

anticipated benefits/harms, or interpretation of evidence; legal considerations; economic reasons; ethical/ religious reasons.

Intentional vagueness
None.

33.12 Exceptions

List situations or circumstances in which the Recommendation/Good Practice Point should not be applied.

Exceptions
None.

33.13 Recommendations for research

List any aspects of the question that require further research.

Recommendations for research
None.

Research question 34: Should point-of-use (POU) filters be fitted in response to water-associated incidents/outbreaks?

Part A: Quality of evidence

34.1 How reliable is the body of evidence? (see SIGN50, section 5.3.1, 5.3.4)

Comment here on the quantity of evidence available on this topic and its methodological quality. Please include citations and evidence levels.

If there is insufficient evidence to answer the key question, go to section B.

Comments	Evidence level
In total, 15 pieces of evidence were identified in relation to this research question which includes: • 8 guidance documents that were deemed expert opinion (including three Scottish,[101, 116, 156] three English,[125, 126, 139] one British Standard[122] and one from Republic of Ireland)[124]) (SIGN50 level 4), • 6 outbreak studies (SIGN50 level 3),[3, 9, 35, 52, 55, 78] • 1 before and after study (SIGN50 level 3).[157]	7x SIGN50 level 3 8x SIGN50 level 4

34.2 Is the evidence consistent in its conclusions? (see SIGN50, section 5.3.2)

Comment here on the degree of consistency demonstrated by the evidence. Where there are conflicting results, indicate how the group formed a judgement as to the overall direction of the evidence.

Comments
All evidence is consistent on advising the use of POU filters in response to water associated incidents and outbreaks to ensure the water can continue to be used where it is deemed essential to retain the outlet. The BS 8580-2:2022 elaborates

Comments
on the risk of using POU filters which is also mentioned in a few other guidance documents.[122, 139] There is one slight inconsistency where SHTM 04-01 Part A[116] mentions using a filter pore size of below 0.1 µm but all other guidance (including British Standard) and SIGN50 level 3 articles recommend/used 0.2 µm.

34.3 Is the evidence applicable to Scottish health and care settings? (see SIGN50, section 5.3.3)

For example, do the studies include interventions, comparators or outcomes that are common to Scottish health and care settings?

Comments
Guidance documents are derived from Scotland (3),[101, 116, 156] Republic of Ireland (1)[124] and England (4).[122, 125, 126, 139] The before and after study took place in Germany[157] and most of the outbreak studies are from developed countries (3x US,[3, 9, 35] 1x Brazil,[78] 1x Germany,[52] 1x France[55]) and thus also applicable to Scottish health and care settings.

34.4 Are the studies generalisable to the target population?

Comment here on sample size and methods of sample selection. Is the sample representative of the specific population/group of interest? Generalisability is only relevant to primary research studies.

Comments
The only studies that had any control over sample size were the outbreak studies that had conducted case-control studies;[9, 35, 157] these were helpful in assessing potential efficacy of reducing incidents/outbreaks after installation of POU filters but no quantitative analysis were performed. The patient groups in these studies are representative of the population of interest. There was no evidence of any higher quality (no randomised control trials or intervention studies).

34.5 Are there concerns about publication bias? (see SIGN50, section 5.3.5)

Comment here on whether there is a risk in the evidence base that studies have been selectively published based on their results (and thus a risk that results from published studies are systematically different from unpublished evidence).

Comments
Some (6 out of the 15) studies included are outbreak studies and so there is a possibility of publication bias as not all outbreaks/infection incidents are published in scientific journals. A formal assessment of publication bias was not conducted.

Part B: Evidence to decision

34.6 Recommendations

What recommendations(s) or good practice point(s) does the Working Group agree are appropriate based on this evidence?

Note the following terminology:

- **"must"** implies that the health and care setting must implement the recommended approach and is used where a recommendation has been directly lifted from legislation or mandatory guidance
- **"should"** implies that the health and care setting "should" implement the recommended approach unless a clear and compelling rationale for an alternative approach is present
- **"should consider"** implies that the health and care setting should consider implementing the recommended approach

Recommendation	Grading
R34.1 If it is essential for the water outlet(s) to remain in use, POU filters should be installed while	Recommendation

Recommendation	Grading
investigations are ongoing and remedial actions are being considered.	
GPP34.1 The Water Safety Group should have in place a risk assessment which establishes the process for fitting of POU filters, their ongoing maintenance and for review of their ongoing need.	Good Practice Point

34.7 Balancing benefits and harms

Comment here on the potential impact of the Recommendation/Good Practice Point on service users, visitors and staff. Benefits and harms include considerations beyond IPC.

Benefits

List the favourable changes in outcome that would likely occur if the Recommendation/ Good Practice Point were followed correctly. Be explicit, clear about pros.

Benefits
• R34.1 & GPP34.1 POU filters enable refinement of water quality when there is an identifiable water associated infection risk and water test results are out with acceptable/regulatory microbiological parameters. • R34.1 & GPP34.1 The use of POU filters can enable clinical service delivery to be maintained when a water associated infection risk has been identified. • R34.1 & GPP34.1 The use of POU filters can enable the WSG/IMT time to investigate the root causes and resolve the issue without decanting the facility. • R34.1 & GPP34.1 The fitting of POU filters provides a visible control measure which may increase staff and patient confidence in water safety during the incident's investigation & resolution phase.

Risks and Harms

List the adverse events or other unfavourable outcomes that may occur if the Recommendation/ Good Practice Point were followed correctly. Be explicit, clear about cons.

Risks/Harms
• R34.1 Risk of POU filter changing direction of water and creating splash risk. • R34.1 Risk of water flowing directly from the filter outlet into the drain. • R34.1 There might be over reliance on POU filters when installed as a control measure. This could potentially result in complacency, reduced compliance with other IPC measures and/or failure to address/improve potential poor design. • R34.1 & GPP34.1 The installed POU filter could introduce splash transmission risks by altering the water flow and direction between the outlet and drain and reducing the space between them. These risks are modifiable if care is taking during installation as per GPP34.1. • R34.1 & GPP34.1 There might be a potential contact transmission risk as the installed POU filter reduces the space available for hand washing. These risks are modifiable if addressed during installation as per GPP34.1 (for example having a bigger sink). • R34.1 & GPP34.1 Risk of retrograde contamination from contact by service users, equipment or poor cleaning techniques.

Benefit-Harm assessment

Classify as “benefit outweighs harm” (or vice versa) or a “balance of benefit and harm.” Description of this balance can be from the individual patient/ staff/ visitor perspective, the societal perspective, or both. Recommendations/ Good Practice Points are possible when clear benefit is not offset by important harms, costs or adverse events (or vice versa).

Benefit-Harm assessment
Benefit is likely to outweigh any contingent harm introduced as an unintended consequence. While risks have been identified (splash risk and contact contamination) these can be mitigated if care is taken during their installation.

34.8 Feasibility

Is the Recommendation/Good Practice Point implementable in the Scottish context?

Describe (if applicable) financial implications, opportunity costs, material or human resource requirements, facility needs, sustainability issues, human factors etc., that may be associated with following a Recommendation/Good Practice Point. State clearly if information on feasibility is lacking.

Feasibility
• R34.1 Supplemental procurement of a non-requisite item and continual procurement during incident response. • R34.1 Maintenance of stock and supply to assure replacements are readily available to enable reinstallation in accordance with manufacturer's instructions throughout the incident response. • R34.1 There may be engineering requirements if the outlet cannot facilitate a POU filter or if there is splash risk introduced as a result of installation (for example if the sink does not have the space or the tap cannot fit a filter). • GPP34.1 Increased resource demand on estates and facilities teams to undertake installation, maintenance and reinstallation throughout the incident response. • GPP34.1 If the decision is made to install POU filters, there will be ongoing costs associated with their purchase and maintenance (inclusive of cleaning). • GPP34.1 There is a need for cleaning protocol to safely clean and manage POU filters once installed. This protocol should be evidence-based where possible or developed with best practice/expert opinion.

Feasibility
• R34.1 & GPP34.1 There might be best practice education needed for clinical and domestic staff (not touching the filter itself, not removing filter when cleaning tap).

34.9 Expert Opinion

Summarise the expert opinion used in creating the Recommendation/ Good Practice Point; if none were involved, state “none”. Translating evidence into action often involves expert opinion where evidence is insufficient. Clearly outlining expert opinion helps users understand their influence on interpreting objective evidence. Expert opinion may also be required where there is no evidence available.

Expert opinion
R34.1 The evidence is sufficient to support this recommendation, no expert opinion to note. GPP34.1 ARHAI Scotland support extant UK expert opinion guidance that the installation and use of POU filters, including procedures for fitting, changing and cleaning filters should be agreed by the WSG and therefore a good practice point has been developed.

34.10 Value judgements

Summarise value judgements used by the Working Group in creating the Recommendation/Good Practice Point; if none were involved, state “none”. Translating evidence into action often involves value judgements, which include guiding principles, ethical considerations, or other beliefs and priorities. Stating them clearly helps users understand their influence on interpreting objective evidence.

Value judgements
None.

34.11 Intentional vagueness

State reasons for any intentional vagueness in the Recommendation/ Good Practice Point; if none was intended, state “none”. Recommendations/Good Practice Points should be clear and specific, but if there is a decision to be vague, acknowledging the reasoning clearly promotes transparency. Reasons for vagueness may include inadequate evidence; inability to achieve consensus regarding evidence quality, anticipated benefits/harms, or interpretation of evidence; legal considerations; economic reasons; ethical/ religious reasons.

Intentional vagueness
None.

34.12 Exceptions

List situations or circumstances in which the Recommendation/ Good Practice Point should not be applied.

Exceptions
POU filters should not be installed if there is lack of space with the filter between the basin or sink and the tap (and engineering solutions to solve these are not possible) to ensure that hands and objects do not touch the sink or filter, and that fluids being disposed of in the sink do not splash onto the filter. POU filters should also not be installed to an incompatible tap that will not take a filter.

34.13 Recommendations for research

List any aspects of the question that require further research.

Recommendations for research
Published peer-reviewed articles that assess the risks and harms caused by using POU filters would be beneficial to this research question. No evidence is available to inform cleaning of taps with POU filters – it may be reasonable for manufacturers to develop this.

Research question 35: When can POU filters be removed?

Part A: Quality of evidence

35.1 How reliable is the body of evidence? (see SIGN50, section 5.3.1, 5.3.4)

Comment here on the quantity of evidence available on this topic and its methodological quality. Please include citations and evidence levels.

If there is insufficient evidence to answer the key question, go to section B.

Comments	Evidence level
In total, 6 pieces of evidence were identified in relation to this research question which includes: • 2 Scottish guidance documents,[101, 156] • 1 British Standard,[122] • 1 guidance document from the Republic of Ireland,[124] • 2 UK guidance documents.[125, 126] All included guidance documents were deemed to be expert opinion and in accordance with SIGN50 methodology are graded level 4 evidence.[101, 122, 124-126, 156]	6x SIGN50 level 4

35.2 Is the evidence consistent in its conclusions? (see SIGN50, section 5.3.2)

Comment here on the degree of consistency demonstrated by the evidence. Where there are conflicting results, indicate how the group formed a judgement as to the overall direction of the evidence.

Comments
All evidence (six guidance documents[101, 122, 124-126, 156]) is consistent on the use of POU filters as a temporary control measure in response to water associated outbreaks and agrees that removal is only appropriate when a permanent

Comments
engineering solution has been installed and negative water results have been achieved.

35.3 Is the evidence applicable to Scottish health and care settings? (see SIGN50, section 5.3.3)

For example, do the studies include interventions, comparators or outcomes that are common to Scottish health and care settings?

Comments
The evidence base consists of two Scottish guidance documents,[101, 156] one British Standard that is code of practice within the UK,[122] one guidance document derived from the Republic of Ireland[124] and two other UK guidance documents (from the Health and Safety Executive and from the Department of Health).[125, 126] All countries have a similar health system and thus all are applicable to Scottish health and care settings.

35.4 Are the studies generalisable to the target population?

Comment here on sample size and methods of sample selection. Is the sample representative of the specific population/group of interest? Generalisability is only relevant to primary research studies.

Comments
N/A - no primary studies were identified for this research question.

35.5 Are there concerns about publication bias? (see SIGN50, section 5.3.5)

Comment here on whether there is a risk in the evidence base that studies have been selectively published based on their results (and thus a risk that results from published studies are systematically different from unpublished evidence).

Comments
No concerns.

Part B: Evidence to decision

35.6 Recommendations

What recommendations(s) or good practice point(s) does the Working Group agree are appropriate based on this evidence?

Note the following terminology:

- **"must"** implies that the health and care setting must implement the recommended approach and is used where a recommendation has been directly lifted from legislation or mandatory guidance
- **"should"** implies that the health and care setting "should" implement the recommended approach unless a clear and compelling rationale for an alternative approach is present
- **"should consider"** implies that the health and care setting should consider implementing the recommended approach

Recommendation	Grading
GPP35.1 Point of use (POU) filters should be removed when it is established by the WSG that water quality can be maintained without their use.	Good Practice Point
GPP35.2 The outlet should be taken out of service temporarily once the POU filter is removed, until the outlet and its associated pipework have been cleaned and flushed to remove any accumulated debris.	Good Practice Point

35.7 Balancing benefits and harms

Comment here on the potential impact of the Recommendation/Good Practice Point on service users, visitors and staff. Benefits and harms include considerations beyond IPC.

Benefits

List the favourable changes in outcome that would likely occur if the Recommendation/ Good Practice Point were followed correctly. Be explicit, clear about pros.

Benefits
• GPP35.1 The reduction / removal of temporary monetary costs and resource implications associated with supply and fitting of the POU filters. • GPP35.1 & GPP35.2 Minimises unintended consequences of accumulated debris at the outlet secondary to POU filter installation. • GPP35.1 & GPP35.2 Reinstates the expected sanitary assembly, sink, outlet, waste and drainage arrangements in accordance with the appropriate SHTM e.g., SHTM:64 and minimises any unintended consequences created by the install of POU filters.

Risks and Harms

List the adverse events or other unfavourable outcomes that may occur if the Recommendation/ Good Practice Point were followed correctly. Be explicit, clear about cons.

Risks/Harms
No risks and harms identified.

Benefit-Harm assessment

Classify as “benefit outweighs harm” (or vice versa) or a “balance of benefit and harm.” Description of this balance can be from the individual patient/staff/visitor perspective, the societal perspective, or both. Recommendations/ Good Practice Points are possible when clear benefit is not offset by important harms, costs or adverse events (or vice versa).

Benefit-Harm assessment
Only benefits identified.

35.8 Feasibility

Is the Recommendation/ Good Practice Point implementable in the Scottish context? Describe (if applicable) financial implications, opportunity costs, material or human resource requirements, facility needs, sustainability issues, human factors etc., that may be associated with following a Recommendation/Good Practice Point. State clearly if information on feasibility is lacking.

Feasibility
• GPP35.1 IMT resource for decision making. • GPP35.1 & GPP35.2 There might be financial costs involved for safe removal of POU filters. • GPP35.2 There might be a need for an alternative outlet while the POU filter is being removed and the outlet is temporarily out of use due to cleaning and flushing. Staff resource is required to complete this work.

35.9 Expert Opinion

Summarise the expert opinion used in creating the Recommendation/ Good Practice Point; if none were involved, state “none”. Translating evidence into action often involves expert opinion where evidence is insufficient. Clearly outlining expert opinion helps users understand their influence on interpreting objective evidence. Expert opinion may also be required where there is no evidence available.

Expert opinion
GPP35.1 ARHAI Scotland support extant expert opinion guidance that the use of POU filters is a temporary control measure in response to water associated outbreaks and agrees that removal is only appropriate when a permanent engineering solution has been installed and/or negative water results have been achieved. [101, 122, 124-126, 156] It is ARHAI Scotland opinion that staff and service user confidence in the safety of the facilities water system could increase when it has

Expert opinion
been the IMT/ WSG decision to remove POU filters. This will be indicative that primary control of the water system has been re-established. GPP35.2 ARHAI Scotland supports the two expert opinion guidance documents (SHTM 04-01 part B and HTM 04-01 part B) that the outlet should be taken out of service temporarily once the POU filter is removed, until the outlet and its associated pipework have been cleaned and flushed to remove any accumulated debris and therefore a good practice point has been developed.

35.10 Value judgements

Summarise value judgements used by the Working Group in creating the Recommendation/ Good Practice Point; if none were involved, state “none”. Translating evidence into action often involves value judgements, which include guiding principles, ethical considerations, or other beliefs and priorities. Stating them clearly helps users understand their influence on interpreting objective evidence.

Value judgements
None.

35.11 Intentional vagueness

State reasons for any intentional vagueness in the Recommendation/Good Practice Point; if none was intended, state “none”. Recommendations/Good Practice Points should be clear and specific, but if there is a decision to be vague, acknowledging the reasoning clearly promotes transparency. Reasons for vagueness may include inadequate evidence; inability to achieve consensus regarding evidence quality, anticipated benefits/harms, or interpretation of evidence; legal considerations; economic reasons; ethical/ religious reasons.

Intentional vagueness
The pre-determined criteria for removal of POU filters has not been specified and instead it has been that the WSG should establish if the water quality can be maintained. This is because removal of POU filters depend on a number of factors and is situation specific, so this should ultimately be a clinical decision.

35.12 Exceptions

List situations or circumstances in which the Recommendation/ Good Practice Point should not be applied.

Exceptions
POU filters should not be removed if water quality cannot be assured.

35.13 Recommendations for research

List any aspects of the question that require further research.

Recommendations for research
More research is required to investigate the on-the-ground challenges associated with use of POU filters.

Research question 36: Whose responsibility is it to carry out any of the above actions?

Part A: Quality of evidence

36.1 How reliable is the body of evidence? (see SIGN50, section 5.3.1, 5.3.4)

Comment here on the quantity of evidence available on this topic and its methodological quality. Please include citations and evidence levels.

If there is insufficient evidence to answer the key question, go to section B.

Comments	Evidence level
In total, six pieces of evidence were identified including: • 3 Scottish guidance documents,[101, 156, 158] • 1 British Standard,[122] • 1 Guidance document from the Republic of Ireland,[124] • 1 English guidance document.[127] All included guidance documents were deemed to be expert opinion and thus graded SIGN50 level 4.	6x SIGN50 level 4

36.2 Is the evidence consistent in its conclusions? (see SIGN50, section 5.3.2)

Comment here on the degree of consistency demonstrated by the evidence. Where there are conflicting results, indicate how the group formed a judgement as to the overall direction of the evidence.

Comments
As there is limited evidence available per subject, a high degree of consistency cannot be achieved. However, the guidance included is consistent in advising that a multidisciplinary team (Water Safety Group) should have general oversight including carrying out risk assessments and manage the identified risks associated

Comments
via their water safety plan. Some guidance have added information on who should lead and chair the WSG and responsibilities regarding maintenance and flushing.[101, 156, 158] SHTM 04-01 Part B states that management has the overall responsibility for implementation procedures to ensure that safe, reliable hot and cold-water supply, storage and distribution systems operate within the organisation. Board management is provided by the NHSScotland Board Chief Executives.

36.3 Is the evidence applicable to Scottish health and care settings? (see SIGN50, section 5.3.3)

For example, do the studies include interventions, comparators or outcomes that are common to Scottish health and care settings?

Comments
Three guidance documents are derived from Scotland[101, 156, 158] and the British Standard is code of practice within the UK.[122] The other guidance is derived from the Republic of Ireland[124] and England.[127] All have similar health and care practices as Scotland and therefore are applicable to Scottish health and care settings.

36.4 Are the studies generalisable to the target population?

Comment here on sample size and methods of sample selection. Is the sample representative of the specific population/group of interest? Generalisability is only relevant to primary research studies.

Comments
N/A - no primary studies were identified for this research question.

36.5 Are there concerns about publication bias? (see SIGN50, section 5.3.5)

Comment here on whether there is a risk in the evidence base that studies have been selectively published based on their results (and thus a risk that results from published studies are systematically different from unpublished evidence).

Comments
No concerns.

Part B: Evidence to decision

36.6 Recommendations

What recommendations(s) or good practice point(s) does the Working Group agree are appropriate based on this evidence?

Note the following terminology:

- **"must"** implies that the health and care setting must implement the recommended approach and is used where a recommendation has been directly lifted from legislation or mandatory guidance
- **"should"** implies that the health and care setting "should" implement the recommended approach unless a clear and compelling rationale for an alternative approach is present
- **"should consider"** implies that the health and care setting should consider implementing the recommended approach

Recommendation	Grading
GPP36.1 A multidisciplinary team (the Water Safety Group) should have general oversight of water safety inclusive of carrying out risk assessments and management of the identified risks associated with water via the boards water safety plan.	Good Practice Point

Recommendation	Grading
GPP36.2 For details on roles and responsibilities within NHSScotland regarding water safety for healthcare premises, SHTM 04-01, Part B: Operational management should be followed.	Good Practice Point
GPP36.3 Each NHSScotland board Chief Executive has overall responsibility for ensuring their board is providing and maintaining a safe environment inclusive of safe water.	Good Practice Point
GPP36.4 A multi-disciplinary IMT chaired by the ICD/ Consultant in Public Health Medicine (CPHM) should be established when any water associated infection risk is identified, to support the board and WSG to manage the incident.	Good Practice Point

36.7 Balancing benefits and harms

Comment here on the potential impact of the Recommendation/Good Practice Point on service users, visitors and staff. Benefits and harms include considerations beyond IPC.

Benefits

List the favourable changes in outcome that would likely occur if the Recommendation/ Good Practice Point were followed correctly. Be explicit, clear about pros.

Benefits
• GPP36.1 The WSG provides demonstratable oversight and assurance for water safety within NHSScotland healthcare facilities, GPP36.2 Clarity on roles and responsibilities regarding water safety within NHSScotland healthcare facilities minimises organisational divergence and enables coordination and transparency.

Benefits
• GPP36.1, GPP36.2, GPP36.4 Supports boards governance arrangements to enact and maintain their water safety plan consistently and contribute to a reduction in water–associated infection risks. • GPP36.1, GPP36.3, GPP36.4 Increased staff and service user confidence in the organisation's arrangements for maintaining water safety.

Risks and Harms

List the adverse events or other unfavourable outcomes that may occur if the Recommendation/ Good Practice Point were followed correctly. Be explicit, clear about cons.

Risks/Harms
No risks or harms identified.

Benefit-Harm assessment

Classify as “benefit outweighs harm” (or vice versa) or a “balance of benefit and harm.” Description of this balance can be from the individual patient/ staff/visitor perspective, the societal perspective, or both. Recommendations/Good Practice Points are possible when clear benefit is not offset by important harms, costs or adverse events (or vice versa).

Benefit-Harm assessment
Only benefits identified.

36.8 Feasibility

Is the Recommendation/ Good Practice Point implementable in the Scottish context? Describe (if applicable) financial implications, opportunity costs, material or human resource requirements, facility needs, sustainability issues, human factors etc., that may be associated with following a Recommendation/ Good Practice Point. State clearly if information on feasibility is lacking.

Feasibility
• GPP36.1 The provision of general oversight might result in additional demands on staff resource. • GPP36.1, GPP36.2, GPP36.4 There may be additional education requirements.

36.9 Expert Opinion

Summarise the expert opinion used in creating the Recommendation/ Good Practice Point; if none were involved, state “none”. Translating evidence into action often involves expert opinion where evidence is insufficient. Clearly outlining expert opinion helps users understand their influence on interpreting objective evidence. Expert opinion may also be required where there is no evidence available.

Expert opinion
GPP36.1 ARHAI Scotland support extant expert opinion guidance (from the Republic of Ireland HPSC and UK) that a multidisciplinary team should have general oversight of water safety within healthcare settings. Therefore, a good practice point has been developed. GPP36.2 It is important that the ‘SHTM 04-01 Part B: Operational management’ should be followed which details on roles and responsibilities within NHSScotland regarding water safety for healthcare premises, should be followed. GPP36.3 SHTM 04-01 Part B advises that management has the overall responsibility for implementation procedures to ensure a safe environment inclusive of water. Board management is provided by the NHSScotland Board Chief Executives. ARHAI Scotland agrees with this and therefore a good practice point has been developed. GPP36.4 The available evidence did not clarify the role of the IMT, it is ARHAI Scotland opinion that a multi-disciplinary IMT chaired by the ICD/ Consultant in Public Health Medicine (CPHM) should be established when any water associated infection risk is identified, to support the board and WSG to manage the incident.

36.10 Value judgements

Summarise value judgements used by the Working Group in creating the Recommendation/ Good Practice Point; if none were involved, state “none”. Translating evidence into action often involves value judgements, which include guiding principles, ethical considerations, or other beliefs and priorities. Stating them clearly helps users understand their influence on interpreting objective evidence.

Value judgements
None.

36.11 Intentional vagueness

State reasons for any intentional vagueness in the Recommendation/ Good Practice Point; if none was intended, state “none”. Recommendations/ Good Practice Points should be clear and specific, but if there is a decision to be vague, acknowledging the reasoning clearly promotes transparency. Reasons for vagueness may include inadequate evidence; inability to achieve consensus regarding evidence quality, anticipated benefits/harms, or interpretation of evidence; legal considerations; economic reasons; ethical/ religious reasons.

Intentional vagueness
None.

36.12 Exceptions

List situations or circumstances in which the Recommendation/Good Practice Point should not be applied.

Exceptions
None.

36.13 Recommendations for research

List any aspects of the question that require further research.

Recommendations for research
None.

Definitions

Term used	Description	Evidence
Recommendation	In general, 'Recommendations' should be supported by high- to moderate-quality evidence. In some circumstances, however, 'Recommendations' may be made based on lower quality evidence when high-quality evidence is impossible to obtain, and the anticipated benefits strongly outweigh the harms or when the Recommendation is required by Legislation or Mandatory Guidance	Sufficient evidence (SIGN50 level 1++, 1+, 2++, 2+, 3, 4* AGREE Recommend AGREE Recommend with Modifications) Legislation, or mandatory guidance
Good Practice Point	Insufficient evidence or a lack of evidence to make a recommendation but identified best practice based on the clinical/technical experience of the Working Group, with a clear balance between benefits and harms	Insufficient evidence + Working Group opinion OR No evidence + Working Group opinion
No Recommendation	Both a lack of pertinent evidence and an unclear balance between benefits and harms	No evidence

* A Recommendation cannot be developed when there is only SIGN50 level 4 evidence available.

Appendix 1: Summary of Recommendations and Good Practice Points

R1.1 Colonisation or infection in any patient should raise a high degree of suspicion for a healthcare associated environmental link if gram-negative microorganisms or non-tuberculous mycobacteria are isolated from a clinical sample. These may include the following: *Acinetobacter* species (spp.), *Burkholderia* spp., *Chryseomonas indologenes*, *Cupriavidus pauculus*, *Pseudomonas* spp., *Stenotrophomonas maltophilia*, *Sphingomonas* spp., *Serratia marcescens.*

R1.2 Isolation of *Legionella* spp. from a clinical sample in any patient indicates transmission from the environment and should be investigated as a possible healthcare associated infection incident if the incubation period fits and there is no established link to a community source.

GPP1.1 An environmental source should be considered when Enterobacteriaceae is isolated from a clinical sample in the patient groups listed in R4.1 when in association with a data exceedance.

R3.1 When conducting water risk assessments and investigating colonisation/infection incidents involving the microorganisms listed in R1.1 and GPP1.2, the Water Safety Group (WSG) (for water risk assessments)/ and the Incident Management Team (IMT) (for investigating colonisation/infection incidents) should consider that both the environment (water supply itself plus the plumbing components) and patients may be reservoirs, enabling ongoing transmission to other patients and further contamination of the environment.

R4.1 The Water Safety Group (WSG) should agree a local approach to identify the location of high-risk patients within healthcare settings (as a minimum including haematology and oncology patients, cardiac surgery patients, bone marrow and stem cell transplant patients, neonatal, paediatric and adult ICU patients, transplant patients, burns patients, and any other patients that are severely immunocompromised through disease or treatment) particularly those who may not receive care or treatment in a high-risk facility (for example theatres), and these should be included in the board Water Safety Plan.

GPP4.1 Specific patient groups should be considered for being at higher risk for Legionellosis which includes patients over 45 years, patients with respiratory disease, patients suffering from chronic kidney disease, diabetes patients, patients with heart disease and immunocompromised patients.

GPP6.1 When determining HAI status, the incubation period should be considered, acknowledging the wide variation (a few hours to years).

GPP6.2 Careful consideration should be applied when assessing an HAI in this category, recognising that whilst a patient is receiving antibiotics which may assist in selecting a gram-negative organism more readily, HAI status should still be considered and investigated.

GPP7.1 When considering whether to declare an infection incident or outbreak as 'closed', the IMT should provide assurance that transmission risk from any remaining colonised or infected patient(s) in the care area is mitigated.

R8.1 NHSScotland boards should acknowledge within water safety plans and amongst incident management teams (IMTs) the following potential transmission routes for water system associated organisms: direct contact, indirect contact (including via contaminated personnel/patients, environment, equipment, and medical products), aerosolisation, and aspiration.

R9.1 All staff, including the Water Safety Group, should be aware of the risks from all uses of water in healthcare procedures which may include oral care, washing/bathing, enteral tube flushes, intravenous procedures including their ongoing management, hydrotherapy, use of cardiac heater coolers during surgery.

GPP10.1 A sampling regime with appropriate microbiological parameters should be agreed by the board water safety group (WSG) prior to tender. As a minimum it should include testing for TVCs, coliform bacteria (including *E. coli*) and *Legionella* spp. (all settings). Testing for *P. aeruginosa* should be conducted in (but not limited to) high-risk settings including haematology and oncology, bone marrow and stem cell transplant units, neonatal, paediatric and adult ICUs (including surgical), transplant and burns units). A risk assessment should be carried out to determine if there are additional testing requirements.

GPP10.2 Samples should be taken no sooner than five days and no later than seven days after a full disinfection process and another set of samples should be taken immediately prior to handover. Accredited testing should be undertaken by an independent organisation.

GPP11.1 The IPC team should be represented at WSGs within NHS boards and have ongoing input throughout the building process including during commissioning, the development of risk assessments, the water safety plan and involvement with the HAI-SCRIBE process.

GPP11.2 IPC teams should be involved from the outset in the design and planning process and engaged through to commissioning in order to ensure IPC input and oversight of IPC risk.

GPP11.3 The WSG should confirm the water is of potable quality and meets other minimum testing requirements (for example around *Pseudomonas* spp. or *Legionella* spp.) with clinical and microbiological oversight from the ICD/microbiologist who is a member of the WSG.

R12.1 Routine water testing should be undertaken for *P. aeruginosa* and *Legionella* spp. in high-risk units.

GPP12.1 A risk assessment according to BS 8580-1 and BS 8580-2 should be undertaken to determine the need for routine water testing in other care areas and testing for organisms other than *P. aeruginosa* and *Legionella* spp.

GPP12.2 Routine total viable count (TVC) testing could be considered to monitor water quality and only if trend analysis is performed.

GPP12.3 Equipment and/or medical procedures that use water that is separate from the main hot and cold water distribution system should be routinely tested in line with relevant guidance/manufacturer’s instructions which includes water for heater cooler units, endoscopy rinse water, water used for renal dialysis and hydrotherapy pool water.

GPP12.4 The WSG should have sight of routine testing results of water used in procedures (for example heater cooler units, endoscopy rinse water, water used for renal dialysis and hydrotherapy pool water).

GPP12.5 Where no UKAS accreditation exists for specific healthcare water system-associated organisms, boards should still consider testing and can seek advice from ARHAI Scotland.

R13.1 The following microbiological limits are recommended for all water system testing in healthcare facilities:

- Coliform bacteria (incl. *Escherichia coli*): 0 cfu/100 ml;
- Enterococci: 0 cfu/100 ml;
- *P. aeruginosa*: 0 cfu/100 ml;
- *Legionella* spp.: <100 cfu/litre in non-high-risk units and undetectable in high-risk units and procedures.

GPP13.1 The following additional microbiological limits are recommended for healthcare procedures that present an increased risk:

- Heater cooler unit water
    - 0 cfu/100 ml for *Mycobacterium* spp.
    - TVC cut-off levels of <100 cfu/ml
- Hydrotherapy water
    - <20 cfu/litre for *Legionella* spp.
    - 0 cfu/100 ml for *Staphylococcus aureus* as part of wider investigations only (local decision)
    - TVC cut-off levels of <10 cfu/ml
- Endoscopy final rinse water
    - 0 cfu/100 ml for *Mycobacterium* spp.
    - TVC cut-off levels of <10 cfu/100 ml
    - Endotoxin limit of <0.25 EU/ml
- Final rinse water in surgical instrument washer disinfectors
    - TVC cut-off levels of <1 cfu/100 ml
    - Endotoxin limit of <0.25 EU/ml

- Renal dialysis fluid and water
    - TVC cut-off levels of <50 cfu/ml
    - Endotoxin limit of <0.125 EU/ml

GPP13.2 The microbiological limit for *Legionella pneumophila* serogroup 1 (Lp1) should be undetectable for all water system testing in healthcare facilities.

GPP13.3 For gram-negative healthcare water system-associated organisms other than those mentioned in R13.1, GPP13.1 and GPP13.2, microbiological limits and actions should be the same as those for *Pseudomonas* spp. (0 cfu/100 ml).

GPP14.1 The frequency of routine microbiological water testing (see R12.1 and GPP12.1) should be based on a comprehensive risk assessment and in agreement with the WSG; however, six-monthly should be the minimum.

GPP14.2 The frequency of testing may be increased to improve trend analysis depending on the status of the water system.

GPP15.1 The frequency of routine water testing should be increased after implementing changes (for example after biocide dosing, remedial works, refurbishment) to the water system and/or its treatment strategy.

GPP15.2 The frequency of water testing should be increased during a suspected or confirmed outbreak known or suspected to be associated with the water system or if surveillance identifies an increased incidence of infection known or suspected to be associated with the water system.

GPP15.3 The frequency of routine water testing should be increased when control levels of the treatment regime are not achieved (for example when levels of biocide are lower than the agreed limit).

GPP15.4 Consideration may be given to increasing the frequency of routine water testing when pre-flush trend analysis demonstrates increasing cfu/100 ml for *P. aeruginosa*.

GPP16.1 A sampling plan should be developed by the water safety group which includes an up-to-date schematic of the system(s) with identified sampling points noted to enable resampling and trend analysis.

GPP16.2 Water samples should be taken from selected areas within the water distribution system and this selection should be on the basis of risk assessments ensuring that areas identified as 'high risk' both in terms of supporting microorganism growth and patient susceptibility (see section 2.6 and R4.1) are represented.

GPP16.3 As a minimum, samples should be taken from the proximal and distal ends of each water system with an agreed number of sampling points in between.

GPP16.4 The number of samples obtained during any single round of sampling should be sufficient to be fully representative of the water distribution system.

GPP16.5 Sampling of outlets within clinical facilities should be rotated at each sampling round unless a decision has been made to sample all outlets.

GPP16.6 Outlets within common shared facilities such as staff kitchen, domestic services room (DSR), treatment room, preparation room, should be tested at every sampling round.

GPP17.1 Taking water samples further back in the system could be beneficial when positive tests reoccur following remedial intervention at the outlet(s).

GPP17.2 Positive pre- and post-flush sample test results might indicate an issue beyond the outlet and testing further back in the system could be beneficial.

GPP18.1 During commissioning of new builds, the contractor should provide a full set of the water sample analysis results to the project manager (or equivalent) for approval by the WSG (including IPC team) before the system is put into clinical use.

GPP18.2 After replacement/remedial activities, water sample analysis results should be approved by the IMT/ WSG or agreed local process.

GPP18.3 Each NHS board must have processes in place to describe reporting and dissemination of results which includes as a minimum:

- Exceptions are tabled at WSG meetings,
- Exceptions are recorded and rapidly disseminated to all WSG members and local IPC team,
- A record should be kept of distribution lists for reporting,
- Clear responsibilities are defined for interpretation and actions of results (see GPP19.3, GPP36.1 and GPP36.2).

GPP19.1 If water test results are above microbiological limitations, known quantifiable environmental factors (for example water temperature, pH, residual disinfectant, water softeners, water turnover) should be reviewed to aide interpretation of water test results and reviewed along with the water system's schematic diagram.

GPP19.2 Routine water test results should be interpreted as a series of trends (over time) and with an awareness of the systems schematic and current condition.

GPP19.3 To ensure prompt decision making, interpretation of water test results that are above microbiological limits should be led by the Infection Prevention and Control Doctor and Consultant Microbiologist.

GPP19.4 When interpreting results, the clinical risk associated with the location should be taken into account.

GPP20.1 If coliforms are identified in a water sample, a repeat sample should be collected and tested to rule out a false positive.

GPP20.2 Whenever pre-flush sample results remain above the microbiological limits, pre- and post-flush samples should be collected to ascertain if there is a local or systemic contamination. Where post-flush samples remain above microbiological limits, it may indicate systemic contamination. Negative/low post-flush samples may indicate a local contamination (outlet and/or associated pipework and/or fittings near the outlet).

GPP20.3 The water system/outlet should be resampled when disinfection/remedial actions have taken place following a positive water test result to ensure the actions undertaken have been effective.

GPP21.1 Following a positive water test result, an immediate review of existing control measures and risk assessment by the IPC team and estates team should be carried out to identify additional remedial/clinical actions required.

GPP21.2 Remedial actions should be determined based on consideration of the water test results in context with the water system as a whole, for instance considering routine control measures (for example temperature control, pressure control, flushing, disinfection) as well as chemical and potability analysis results.

GPP22.1 The need for routine environmental sampling (surface swabbing) for healthcare water system-associated organisms and its frequency should be based on a risk assessment taking into account prior incident/outbreak information and should be part of an overall management strategy.

Risk assessment may include (but is not limited to): sampling history (clinical and environmental), system design, system materials, temperature control, water use, retrograde contamination risks, patient group/clinical risks and building use and should be designed to assure a safe environment for at-risk patient groups and to consider effectiveness of any decontamination methods in use.

GPP22.2 Routine air sampling is recommended fortnightly for cardiac heater cooler units (HCUs).

GPP23.1 Remedial measures should be directed towards the outlet (and associated pipework and fittings) when post-flush samples are negative or have low counts as this indicates a local contamination.

GPP24.1 If there is a clinical need to retain the outlet, the following methods (acknowledging that more than one method may be required) should be considered by the water safety group (WSG) and/or incident management team (IMT) when attempting to remove or reduce microbial contamination at the outlet (inclusive of the drain); disinfection (chemical and/or heat treatment), physical replacement of parts of the outlet or the entire outlet.

GPP24.2 Whole system water disinfection may be appropriate if contamination is suspected to extend beyond the outlet (further back in the system).

GPP24.3 When considering the most suitable method of whole water system disinfection (of the entire system or isolated loops), the advantages and disadvantages should be considered as outlined in (SHTM) 04-01 part D 'Disinfection of Domestic Water Systems'.

GPP24.4 Where possible, assessment of the success of a removal method or combined removal methods should be undertaken by carrying out environmental sampling pre- and post- intervention.

GPP25.1 In high-risk settings, all outlets should be flushed at least daily for a minimum of one minute and a record should be kept of when they were flushed.

GPP25.2 Outwith high-risk settings, flushing of all outlets is recommended twice weekly as a minimum for at least three minutes in occupied buildings and should be based on local risk assessment taking into account the local water pressure, temperature and flow rate.

GPP25.3 If an outlet is fitted with a POU filter, the filter should not be removed in order to flush the tap unless the manufacturer's instructions advise otherwise.

GPP25.4 Records should be maintained to demonstrate that flushing has been undertaken and for the appropriate duration.

GPP26.1 All departments should identify a responsible person to ensure that flushing of all outlets is being performed in that area(s) as specified, in practice this may be the Senior Charge Nurse, Clinical Lead or domestic manager.

GPP26.2 The water safety group (WSG) should have oversight and provide an assurance to the NHS board on compliance with requirements including flushing, including in unused areas or outlets.

GPP26.3 Flushing could be incorporated into the local domestic cleaning schedule and associated training of all relevant staff.

R27.1 Clinical wash hand basins should only be used for the purpose of performing hand hygiene.

R27.2 Clinical wash hand basins and patient sinks should not be used for disposal of food and drink items, clinical waste, body fluids, or medicines.

GPP27.1 Consideration should be given to minimising patient contact with tap water in immunocompromised patients (haematology and oncology patients, cardiac surgery patients, bone marrow and stem cell transplant patients, neonatal, paediatric and adult ICU patients, transplant patients).

GPP27.2 Consideration should be given to removing outlets including sinks and showers where they are used infrequently or not at all, provided there is not a clinical need to retain the outlet.

GPP27.3 For extremely immunosuppressed patients (for example allogeneic stem cell transplant patients – until engraftment) sterile water should be considered for drinking, oral care and washing.

GPP27.4 Sterile water should be considered for washing babies within neonatal settings specifically babies that are under 28 weeks gestation, those that do not have intact skin, have invasive line access and those being cared for in humidified incubators.

GPP27.5 Ice for consumption by immunocompromised patients (haematology and oncology, cardiac surgery, bone marrow and stem cell transplant, neonatal, paediatric and adult ICU patients, transplant patients) should not be made using ice-making machines. Where ice is required for consumption in these patient groups, it should be made by putting drinking water into single-use ice-making bags and frozen in a conventional freezer. Alternatively, iced water may be provided by freezing single bottles of commercially available spring water and allowing patients to drink that ice water as it melts.

GPP27.6 Where ice is required for treatment purposes in immunocompromised patients (haematology and oncology, cardiac surgery, bone marrow and stem cell transplant, neonatal, paediatric and adult ICU patients, transplant patients), it should not be made using an ice machine. It should be made using water obtained through a microbiological point of use (POU) filter, sterile water, or boiled water in single-use ice-making bags and frozen in a conventional freezer.

GPP27.7 Conventional freezers used in healthcare should be maintained and cleaned in line with manufacturer's instructions with an agreed cleaning, maintenance and audit schedule in place.

GPP27.8 Installation of ice machines should be by approval of the Water Safety Group (WSG). Local teams should have an agreed process for installation (acknowledging any manufacturer instructions) and an agreed cleaning, maintenance and audit schedule in place.

GPP27.9 Frozen breast milk should be defrosted using a water-free warming device, by defrosting in a designated fridge, or at room temperature. Once infant feeding is completed, any unused milk should be discarded in accordance with local waste policy.

GPP27.10 Powdered infant formula should be prepared using boiled water according to manufacturer's instructions.

GPP27.11 Installation of point of use (POU) filters may be considered in settings where the following patient groups are treated (haematology and oncology, cardiac surgery, bone marrow and stem cell transplant, neonatal, paediatric and adult ICU patients, transplant patients) where there is clinical risk identified associated with the water and/or historical water sampling results that demonstrate ongoing issues with water quality.

GPP27.12 Sink basins in health and care settings should be deep enough to allow hand hygiene to be performed without making contact with the basin sides or fixtures and fittings (for example, taps), even when point of use (POU) filters are installed.

GPP27.13 Water flow from taps should not create any splashing onto surrounding areas.

GPP27.14 The flow of water from the tap should not directly hit the drain (so to avoid any splash back from the drain).

GPP27.15 Where there is a need to perform hand hygiene with soap and water, use of hand rub as a follow up should be considered where there is an ongoing water quality issue.

GPP27.16 Health and care staff should be made aware of the HAI risks associated with healthcare water.

GPP27.17 Patients and care givers should be educated about what they can do to help minimise the risk of infection from water.

GPP27.18 Patients should be discouraged from storing personal items (for example toothpaste, cosmetics) on the patient sink as this can prevent access for environmental cleaning and puts these items at risk of contamination.

GPP27.19 The NHS Scotland National Cleaning Specification should be followed for the routine cleaning and disinfection of sinks and associated fittings (for example taps).

GPP27.20 Hand hygiene product dispensers should be placed so that the contents cannot leak or spill into/onto water outlets.

GPP28.1 Drug preparation, aseptic procedures and other clinical procedures should not be carried out close to sinks or other water outlets where the potential for contamination due to splashing and/or spraying from mains water is possible. Where relocation or reconfiguration is not possible, physical barriers should be considered in such instances.

GPP28.2 Medical equipment and patient care equipment should not be placed in, or washed in, clinical wash hand basins or patient sinks, showers or baths.

GPP28.3 As refillable bottles are difficult to adequately decontaminate and can act as a reservoir for water associated microorganisms they should not be used in settings where immunocompromised patients are treated (haematology and oncology, cardiac surgery, bone marrow and stem cell transplant, neonatal, paediatric and adult ICU, transplant units).

GPP28.4 When investigating infection incidents where there is suspicion of an environmental link to water, potential involvement of refillable bottles should be considered.

GPP28.5 Sterile water, and not tap water, should be used in humidified neonatal incubators.

GPP28.6 Neonatal incubators (including mattresses) should be completely dismantled, cleaned, decontaminated and thoroughly dried between patients (or every 7 days when used continuously by the same patient), using cleaning products that are compatible with the equipment and in accordance with manufacturer's instructions. The re-usable reservoirs of humidified incubators should be cleaned and sterilised between uses in a central decontamination unit, if manufacturer guidance allows.

GPP28.7 Health and care settings should refer to NHSScotland Guidance for the interpretation and clinical management of endoscopy final rinse water and NHSScotland Guidance for Decontamination and testing of Cardiac Heater Cooler Units (HCUs).

R29.1 All high-risk settings should have a setting-specific alert organism list for healthcare water system associated organisms which can be isolated from clinical samples, which should be informed by the known historical epidemiology of that setting. As a minimum, this alert organism list should include *Acinetobacter* spp., *Burkholderia* spp., *Chryseomonas indologenes*, *Cupriavidus pauculus*, *Legionella* spp., *Pseudomonas* spp., non-tuberculous Mycobacteria (NTM), *Serratia marcescens*, *Sphingomonas* spp. and *Stenotrophomonas maltophilia*.

GPP29.1 All care settings should have a water safety plan inclusive of a business continuity/contingency arrangement in preparation for the event that a water source (for example mains water, system water, tap water) cannot be used.

GPP30.1 Where a transmission event associated with the healthcare water system is suspected or confirmed it should be assessed using the NIPCM Healthcare Infection Incident Assessment Tool (HIIAT).

GPP31.1 A water sampling plan should be agreed by the incident management team (IMT) to identify and prioritise potential sources (both mains water supply and water associated equipment/procedures) taking account of the known epidemiological and historical information at the time, the geographical distribution of any

infected/colonised cases throughout their entire healthcare journey, and the layout/schematics of the associated water system.

GPP31.2 Consideration should be given to taking water samples from equipment that utilises water (sterile and non-sterile) to function (both medical and non-medical) if it is a suspected source.

GPP31.3 Water samples should be taken before disinfection of the water system/equipment or before any other remedial actions are initiated.

GPP31.4 A pre-flush sample should be taken from each outlet being sampled.

GPP31.5 For sampling guidance specific to *Legionella* spp., BSI 7592:2022 'Sampling for Legionella bacteria in water systems – Code of practice' should be followed.

GPP32.1 Environmental sampling (swabbing) should be conducted in scenarios where there is more than one hypothesis for source and an environmental source is suspected, taking account of a data exceedance (for example sporadic cases of colonisation/infection over a set time period which might be protracted over many years).

GPP32.2 An environmental sampling plan should be agreed by the incident management team (IMT) to identify and prioritise potential sources/reservoirs taking account of the known epidemiological information at the time (including historical), and the geographical distribution of the infected/colonised cases throughout their entire healthcare journey. Environmental sites may include any sites that are exposed to water for example taps and drains.

GPP32.3 Environmental samples should be taken before environmental decontamination or other environmental remedial actions are initiated.

GPP33.1 Chapter 3 NIPCM (section 3.2) should be followed when investigating any healthcare water system-associated infection incident.

GPP33.2 As per Chapter 3 of the NIPCM, an individual member of the IPC team or health protection team may undertake the initial HIIAT assessment prior to a problem

assessment group (PAG) or incident management team (IMT). If a PAG or IMT is established, then further assessments should be led by the chair of the PAG/IMT.

R34.1 If it is essential for the water outlet(s) to remain in use, POU filters should be installed while investigations are ongoing and remedial actions are being considered.

GPP34.1 The Water Safety Group should have in place a risk assessment which establishes the process for fitting of POU filters, their ongoing maintenance and for review of their ongoing need.

GPP35.1 Point of use (POU) filters should be removed when it is established by the WSG that water quality can be maintained without their use.

GPP35.2 The outlet should be taken out of service temporarily once the POU filter is removed, until the outlet and its associated pipework have been cleaned and flushed to remove any accumulated debris.

GPP36.1 A multidisciplinary team (the Water Safety Group) should have general oversight of water safety inclusive of carrying out risk assessments and management of the identified risks associated with water via the boards water safety plan.

GPP36.2 For details on roles and responsibilities within NHSScotland regarding water safety for healthcare premises, SHTM 04-01, Part B: Operational management should be followed.

GPP36.3 Each NHSScotland board Chief Executive has overall responsibility for ensuring their board is providing and maintaining a safe environment inclusive of safe water.

GPP36.4 A multi-disciplinary IMT chaired by the ICD/Consultant in Public Health Medicine (CPHM) should be established when any water associated infection risk is identified, to support the board and WSG to manage the incident.

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