Summary of literature identified for the National Policy Guidance and Evidence (NPGE) and Infection Control in the Built Environment and Decontamination (ICBED) literature reviews – January to March 2025

Titles and abstracts are reviewed for subject relevance. Additional exclusion criteria are also applied i.e. exclusion of laboratory focussed studies such as molecular typing etc.

Evidence Table: National Policy Guidance and Evidence (NPGE) literature reviews

Literature review	Papers identified	Summary of Research and Impact on ARHAI Recommendations
SICPs and TBPs – Surgical Masks	Sanders WJ, Jones A, Milton T, et al. Impact of enhanced public health and infection control measures on pediatric hospital-acquired respiratory viral infections during the SARS-CoV-2 pandemic. Infect Dis Health. 2025: S2468-0451(25)00001-X. doi: 10.1016/j.idh.2025.01.001.	In this four-phase study in an Australian tertiary children's hospital, phases two and four required mandatory use of surgical face masks for staff and visitors older than 12 years old. Community-acquired infections (CAI) and occupied bed days (OBD) were used to adjust hospital-acquired respiratory viral infections (RVI) test data for the study period. This study adds to the evidence base for the NIPCM Surgical Masks literature review research questions "**When should health care workers wear a surgical mask for SICPs?**", "**When should healthcare workers wear a surgical mask for TBPs**" and "**When should visitors wear a surgical mask for TBPs?**". Mandatory use of surgical face masks when applied

Literature review	Papers identified	Summary of Research and Impact on ARHAI Recommendations
		alongside visitor restrictions was temporally associated with significantly reduced hospital-acquired RVIs, compared to visitor restrictions alone, in this setting (adjusted for OBD p=0.0123; adjusted for CAI p=0.0429). However, findings should be interpreted with caution as RVIs may have been missed by treating clinicians, and retrospective records data may have been subject to errors. Moreover, the generalisability of this study's findings may be limited, as clinical practice and community IPC measures during the SAR-CoV-2 pandemic in Australia are unlikely to reflect those of Scotland. No change to current recommendations.
Personal Protective Equipment (PPE): Gloves	Shrestha O, Basukala S, Bhugai N, et al. Postprocedural infection rate after minor surgical procedures performed with and without sterile gloves: a systematic review and meta-analysis. Int J Surg. 2024;110(11):7341-7352. Published 2024 Nov 1. doi:10.1097/JS9.0000000000001993	In this systematic review and meta-analysis, minor surgical procedures included excision, suturing, wound repair, urinary catheterization, and cystoscopy. This study adds to the evidence base for the NIPCM PPE Gloves literature review research questions "**When should sterile gloves be worn and are they specified for specific procedures?**" and "**When should non-sterile examination gloves be worn and are they specified for specific procedures?**". Meta-analysis of 14 comparative studies showed there was no significant difference between minor surgical procedures performed with sterile gloves compared to those without sterile gloves (OR: 0.88; 95% CI: 0.71-1.10; n=12,625; I^2=0%; p=0.26). Sensitivity and subgroup analyses (of randomised studies

Literature review	Papers identified	Summary of Research and Impact on ARHAI Recommendations
		n=11), surgical site infection, and patients not receiving prophylactic antibiotics) also showed no variation. Furthermore, there was no heterogeneity in the analysis or publication bias found in the funnel plot. However, findings should be interpreted with caution as an overall risk of bias is only presented for three non-randomised studies (two moderate, one low). Furthermore, the meta-analysis includes four older studies published in the 1980s and only three studies were from the UK which may limit generalisability to Scottish health and care settings. No change to current recommendations.
Personal Protective Equipment (PPE): Gloves	Santol J, Willegger M, Hanreich C, et al. Surgical glove perforation during intramedullary nailing of intertrochanteric fractures. Sci Rep. 2025;15(1):1203. Published 2025 Jan 7. doi:10.1038/s41598-024-84994-w	This prospective observational study evaluated the incidence of surgical glove perforations in a surgical team during intramedullary nail fixation and analysed surgical steps that were a risk for glove injury. Routine double-gloving was practiced by all surgical team members for orthopaedic trauma procedures. The study adds to the evidence base for the NIPCM PPE Gloves literature review research questions "**When should double gloving be adopted?**" and "**When should gloves be changed or removed?**" "**When should double gloving be adopted?**". Most (89.3%) macroperforations (holes >5 mm) were visually detected during operative procedures and resulted in glove changing. However, 19.1% of all perforations detected by water fill test were macroperforations. Surgeons had a

Literature review	Papers identified	Summary of Research and Impact on ARHAI Recommendations
		greater incidence of glove micro- and macroperforations compared to assistants (p=0.003, p=0.006) and nurses (p=0.003, p=0.004). Longer operative times were associated with an increase in glove perforation incidence (p=0.002). However, findings should be interpreted with caution as perforations could have been influenced by glove removal activity and pressure from water fill testing, and site perforations were not statistical analysed. No change to current recommendations.
Indications and Techniques for Hand Hygiene	Arreba P, Iglesias J, Ríos J, et al. Gel nail polish does not have a negative impact on the nail bacterial burden nor on the quality of hand hygiene with an alcohol-based hand rub. J Hosp Infect. 2025;157:40-44. doi:10.1016/j.jhin.2024.12.006	This before and after study, carried out at a tertiary care centre in Spain, reports on the investigation of nail polish use (five unpolished nails, two standard polished and three gel polished nails) on the bacterial burden of nail surfaces of 46 healthcare workers performing hand hygiene (HH) using the World Health Organization alcohol hand rub (AHR) technique. Nail surface cultures were performed before and after HH on days 1, 4, 7, 14 and 21 from nail application. This study adds to the evidence base for the NIPCM Indications and Techniques for Hand Hygiene literature review research question "**What is the available evidence regarding infection risk from fingernails to enable effective hand hygiene?**". Following HH with AHR, no significant differences were found in CFU counts or the scale of relative reduction between the three polish type groups. Despite most standard polish nails (97.8%) demonstrating evidence of chipping, there was no significant

Literature review	Papers identified	Summary of Research and Impact on ARHAI Recommendations
		relationship between bacterial count and deterioration on any sampling day. Furthermore, no significant differences were seen in the mean CFU counts of nails with or without deteriorated polish on any evaluation days ($p>0.15$ for all comparisons). However, the results should be interpreted with caution as the study used a limited sampling method (compared to glove juice method) and did not identify isolated microorganisms. Furthermore, the nail technician was not truly blinded, there is possible influence of participation bias on hand hygiene performance, and the use of one specific standard and gel polish product and application may limit generalisability. No change to current recommendations.

Evidence Table: Healthcare Infection Incidents, Outbreaks and Data Exceedance literature reviews

Literature review	Papers identified	Summary of Research and Impact on ARHAI Recommendations
Healthcare infection incidents and outbreaks in Scotland	de Sá Paraskevopoulos DK, Camargo CH, Kodato PK, et al. A Burkholderia contaminans outbreak in an intensive care unit associated with contaminated bath solution: Control and microbiological findings. Am J Infect Control. 2025;53(3):308-313. doi:10.1016/j.ajic.2024.10.006	This descriptive outbreak study reports on the investigation and control of a *Burkholderia* cepacia complex outbreak involving patients in an intensive care unit linked to a no-rinse bathing solution (NRBS) at a tertiary hospital in Brazil between December 2022 and July 2023. This study adds to the evidence base for the NIPCM Healthcare Infection Incidents and Outbreaks literature review research question "**How should healthcare infection incidents/outbreaks be investigated and managed?**". The study provides methods for investigating an outbreak involving epidemiological and environmental investigations, microbiological and molecular analyses, with whole genome sequencing (WGS) on isolates which could not be typed. Despite a precautionary suspension of dirty bath carts, ongoing cases of infection led to the suspicion and suspension of NRBS, in which discontinuation coincided with no further cases and control of the outbreak. However, findings of this study must be interpreted with caution as the authors concluded that rapid control measures contributed towards control of the outbreak but did not report what these involved other than suspended items for use. Furthermore, not all samples were subject to pulsed-field-gel electrophoresis (PFGE) or whole genome sequencing (WGS),

Literature review	Papers identified	Summary of Research and Impact on ARHAI Recommendations
		and the study may have limited applicability to Scottish health and care settings. No change to current recommendations.
Healthcare infection incidents and outbreaks in Scotland	Barbian HJ, Lie L, Kittner A, et al. Candida auris Outbreak and Epidemiologic Response in Burn Intensive Care Unit, Illinois, USA, 2021-2023. Emerg Infect Dis. 2025;31(3):438-447. doi:10.3201/eid3103.241195	This descriptive outbreak study reports on the investigation and control of a *Candia auris* outbreak involving 28 cases in a burn intensive care unit in the United States of America between 2021 and 2023. This study adds to the evidence base for the NIPCM Healthcare Infection Incidents and Outbreaks literature review research question "**How should healthcare infection incidents/outbreaks be investigated and managed?**". The study provides detailed methods for investigating an outbreak involving epidemiological investigation, microbiological and molecular analyses, with whole genome sequencing on available isolates, and enhanced infection control measures to control the outbreak. However, findings should be interpreted with caution as a definitive source was not determined, environmental sampling was not undertaken, and bundled measures were applied to control the outbreak. Furthermore, applicability to Scottish health and care settings may be limited. No change to current recommendations.

Literature review	Papers identified	Summary of Research and Impact on ARHAI Recommendations
Management of incidents and Outbreaks in neonatal units (NNUs)	White RT, Balm M, Burton M, et al. The rapid detection of a neonatal unit outbreak of a wild-type Klebsiella variicola using decentralized Oxford Nanopore sequencing. Antimicrob Resist Infect Control. 2025;14(1):6. Published 2025 Feb 7. doi:10.1186/s13756-025-01529-2	This study investigates a suspected outbreak of *Klebsiella pneumoniae* in four isolates within a NICU in New Zealand in May 2024. Following sequencing it was found that three of the four isolates were confirmed to be *K. variicola*. Subsequent environmental sampling revealed *K. variicola* present in two sink traps and prospective sequencing of all *K. pneumoniae* isolates found a further two infants carrying the same strain of *K. variicola*. This study adds to the evidence base for the NIPCM Management of Incidents and Outbreaks in neonatal units' literature review within the research question "**How should NNU incidents/outbreaks be investigated and managed?**" The study took a proactive approach to identify the source of an increased incidence of suspected *K. pneumoniae* through investigation using a nanopore-decentralized whole-genome sequencing (dWGS) system and multilocus sequence typing (MLST). This approach enabled rapid detection of an outbreak. Following this, isolates from NICU samples were sequenced and an additional two infants were discovered with the same strain. The suspected source was disinfected, and environmental cleaning processes were updated. The outbreak was closed after two months. Limitations to this study were that active screening of all infants within the NICU was not carried out therefore there may have been other cases in addition to those reported. Environmental sampling was not completed using specific environmental

Literature review	Papers identified	Summary of Research and Impact on ARHAI Recommendations
		sampling techniques and occurred opportunistically. Given the opportunistic approach taken to sampling for this study, care should be given to its interpretation. No change to current recommendations.
Management of Incidents and Outbreaks in neonatal units (NNUs)	Dupin C, Cissé A, Lemoine V, et al. Emergence and establishment of Staphylococcus haemolyticus ST29 in two neonatal intensive care units in Western France. J Hosp Infect. Published online January 17, 2025. doi:10.1016/j.jhin.2025.01.003	This retrospective outbreak study investigated all positive *S. haemolyticus* clinical samples between 2020 and 2023 across two NICUs in France; environmental samples and samples from healthcare workers were also collected. Microbiological investigations using WGS identified distinct clonal populations and the ST29 strain was highly predominant. There was evidence of cross-transmission occurring following the transfer of neonates between facilities. This study adds to the evidence base for the NIPCM Management of Incidents and Outbreaks in neonatal units' literature review within the research question "**How should NNU incidents/outbreaks be investigated and managed?**" through investigating the outbreak using phenotypic analysis and whole genome sequencing. Although environmental sampling was performed this was limited to a small number of sites across the two facilities. In addition, incorrect application of ABHR was postulated to be one of the causes of the outbreak however only healthcare workers from one of the two outbreak sites had their hands swabbed. Finally, systematic screening was not performed across either outbreak site. No change to current recommendations.

Summary of literature identified for the National Policy Guidance and Evidence (NPGE) and Infection Control in the Built Environment and Decontamination (ICBED) literature reviews – January to March 2025

Titles and abstracts are reviewed for subject relevance. Additional exclusion criteria are also applied i.e. exclusion of laboratory focussed studies such as molecular typing etc.

Evidence Table: Infection Control in the Built Environment and Decontamination (ICBED) literature reviews

Literature review	Papers identified	Summary of Research and Impact on ARHAI Recommendations
Infection Prevention and Control (IPC) for Safe Healthcare Water Systems	Low JM, Ko KKK, Ong RTH, et al. Pathogenic Bacteria Rapidly Colonise Sinks of Neonatal Intensive Care Unit: Results of A Prospective Surveillance Study. J Hosp Infect. Published online February 6, 2025. doi:10.1016/j.jhin.2025.01.013	This prospective longitudinal study investigated bacterial growth in NICU handwashing sinks before and after occupation of the new NNU facility. Samples collected from sink traps showed rapid colonisation with potentially pathogenic bacteria within a month of occupation of the new NNU. *Klebsiella pneumoniae* and *Enterobacter cloacae* were found within the milk preparation room sink; and *Burkholderia cepacia* complex and *Serratia marcescens* and *Elizabethkingia* species were primarily found in the handwashing sinks. This paper adds to the evidence base for the NIPCM Infection Prevention and Control (IPC) for safe healthcare water systems literature review. This paper adds to the following research question "**What are the causes/sources of environmental contamination with healthcare water system-associated organisms?**". Identification of potentially pathogenic bacteria

Literature review	Papers identified	Summary of Research and Impact on ARHAI Recommendations
		that rapidly colonise handwashing and milk preparation sinks within a newly opened NNU enables greater awareness of possible sources of environmental contamination. This study also compares its results with samples from sinks taken from the established NNU enabling further understanding of sources of contamination. The study found that discontinuing sink use led to reducing the levels of these potentially pathogenic bacteria however this may be impractical as a sole solution in a real-world clinical setting. The study was conducted in Singapore and so the results may not be generalisable to Scotland. No change to current recommendations.
Infection Prevention and Control (IPC) for Safe Healthcare Water Systems	Li Q, Ding H, Chen Z, et al. Contaminated faucets and sinks as a reservoir for antibiotic-resistant bacterial transmission in healthcare settings. J Infect Dev Ctries. 2025;19(1):98-106. Published 2025 Jan 31. doi:10.3855/jidc.18907	This study tested for the presence of multidrug-resistant bacteria in sinks and faucets in an acute hospital in Wuhan, China. Comprehensive sampling was undertaken, results found carbapenem-resistant *Acinetobacter* species, methicillin-resistant *Staphylococcus aureus* and carbapenem-resistant *Klebsiella pneumoniae* present in the sinks and faucets. These results suggest that sinks and faucets can act as a reservoir for antibiotic-resistant bacterial transmission and a carrier of antibiotic-resistant bacteria. This paper adds to the evidence base for the NIPCM Infection Prevention and Control (IPC) for safe healthcare water systems literature review. This paper adds to the following research question "**What are the causes/sources of environmental**

Literature review	Papers identified	Summary of Research and Impact on ARHAI Recommendations
		contamination with healthcare water system-associated organisms?" by investigating the presence of multidrug-resistant bacteria in sinks and faucets in an acute hospital setting. A limitation of this study is that no sampling of patients took place to investigate possible colonisation with the bacterial species discovered and there was no reporting of any outbreak associated with the presence of the bacteria within the faucets and the sinks. The generalisability of this study may also be limited as this study was conducted in China. No change to current recommendations.
Infection Prevention and Control (IPC) for Safe Healthcare Water Systems	Cabal A, Hörtenhuber A, Salaheddin Y, et al. Three prolonged outbreaks of metallo-β-lactamase-producing Pseudomonas aeruginosa in an Upper Austrian hospital, 2017-2023. Microbiol Spectr. 2024;12(10):e0074024. doi:10.1128/spectrum.00740-24	This outbreak study investigated an increased prevalence of metallo- β-lactamase-producing *Pseudomonas aeruginosa* (MBL-Pa) infections in a hospital in Austria. Whole genome sequencing (WGS) identified three genomic clusters occurring in patients; isolates of *P.* aeruginosa belonging to these three clusters accounted for 47 out of 52 cases between 2020 and 2023. The nosocomial source of cluster 1 and 2 was identified to be the sinks in the ICU washroom, the source of cluster 3 was postulated to be from the urology ward however this was not proven. Control measures were put in place which led to the outbreak being declared closed in March 2023. This paper adds to the evidence base for the NIPCM Infection prevention and control (IPC) for safe healthcare water systems literature review. This paper adds to the following research

Literature review	Papers identified	Summary of Research and Impact on ARHAI Recommendations
		question "**Which organisms associated with healthcare water systems are responsible for colonisation/infection of patients?**" An outbreak of *P. aeruginosa* was investigated within an acute hospital and several distinct genomic clusters present within the hospital environment were linked to multiple infections within patients. Widespread sampling of patients for colonisation with *P. aeruginosa* did not occur therefore any asymptomatic colonised patients would have not been identified. Although isolates were tracked back to 2017, any isolates present before this date were not tracked therefore making it difficult to date how long the three clusters were present before 2017. It is possible that the three clusters were present before this date as *P. aeruginosa* forms biofilms. Finally widespread environmental sampling did not take place so other sources of *P. aeruginosa* may have been present. No change to current recommendations.
Infection Prevention and Control (IPC) for Safe Healthcare Water Systems	Tsukada M, Miyazaki T, Aoki K, et al. The outbreak of multispecies carbapenemase-producing Enterobacterales associated with pediatric ward sinks: IncM1 plasmids act as vehicles for cross-species transmission.	An outbreak caused by carbapenemase-producing Enterobacterales (CPE) in Tokyo is described. A total of 19 cases were detected during the outbreak lasting from June 2016 to October 2017. WGS analysis determined the relevance of isolates; the same carbapenemase gene (bla_{IMP-1}) was detected in patients and sinks present in the paediatric ward. Nine sinks were detected as CPE-positive including hospital rooms, a nurse centre, a waste room and an ice machine. Sinks in hospital rooms uninhabited by CPE patients exhibited no CPE-

Literature review	Papers identified	Summary of Research and Impact on ARHAI Recommendations
	Am J Infect Control. 2024;52(7):801-806. doi:10.1016/j.ajic.2024.02.013	positive specimens during the outbreak. Despite the replacement of all sinks in June 2017, the outbreak persisted and was only closed following implementation of infection control precautions. This paper adds to the evidence base for the NIPCM Infection prevention and control (IPC) for safe healthcare water systems literature review. This paper adds to the following research question "**What are the causes/sources of environmental contamination with healthcare water system-associated organisms?**", demonstrating the sinks as environmental reservoirs for ongoing transmission. Limitations to this study include its applicability to NHS settings in Scotland as it was a single-centre study containing a small number of cases. The cause of the initial sink contamination was not proven but hypothesised to be transfer from an infected patient. No change to current recommendations.
Infection Prevention and Control (IPC) for Safe Healthcare Water Systems	Larsen AL, Pedersen T, Sundsfjord A, et al. Hospital toilets and drainage systems as a reservoir for a long-term polyclonal outbreak of clinical infections with multidrug-	This retrospective outbreak study investigated toilet and water drainage systems for evidence of reservoirs of multidrug-resistant bacteria. WGS identified four clusters of ESBL-producing *K. oxytoca* and *Klebsiella michiganensis*, clinical and environmental isolates were present in all four clusters. Most environmental findings in the outbreak ward were from toilet water. Enhanced cleaning and disinfection practices were introduced in bathrooms and toilets, this had the effect of

Literature review	Papers identified	Summary of Research and Impact on ARHAI Recommendations
	resistant Klebsiella oxytoca species complex. Infect Prev Pract. 2024;7(1):100430. Published 2024 Dec 21. doi:10.1016/j.infpip.2024.100430	reducing the number of systemic infections caused by the outbreak strains in the following year. This paper adds to the evidence base for the NIPCM Infection prevention and control (IPC) for safe healthcare water systems literature review. This paper adds to the following research question "**How do healthcare water system-associated organisms survive in the environment?**" through hypothesising that toilet and water drainage systems act as a reservoir for MDR bacteria within acute care settings, and through linking patient and environmental isolates with WGS. This study used available historical clinical data to provide evidence of an outbreak however additional asymptomatic patients colonised with MDR bacteria could have been missed due to the lack of clinical presentation. Furthermore, environmental samples were collected 3 months after patients had been discharged from the ward that was 'likely to be' the ward the patients were staying in therefore affecting the reliability of the findings. This study was also conducted in Norway where healthcare practices may not be the same as in Scotland, therefore affecting applicability to Scottish NHS acute settings. No change to current recommendations.