

Summary of literature identified for the National Policy Guidance & Evidence (NPGE) and Infection Control in the Built Environment and Decontamination (ICBED) literature reviews

April to June 2026

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 identified

Literature review	Papers identified	Summary of Findings and Impact on ARHAI Recommendations
Hand Hygiene Indications and Techniques	Gozdzielewska L, McAloney-Kocaman K, Lang S et al. Deconstructing the Six-Step Hand rubbing Technique for Healthcare Staff: A Mixed-Methods Investigation of Efficacy, Acceptability and Feasibility. Journal of Hospital Infection, 2026.	This experimental study evaluated the effectiveness of the six-step hand rubbing technique with consideration of microbiological efficacy, acceptability and feasibility. The study employed a two-stage mixed-method design conducted between 2017 and 2020. Stage 1 used a Latin square design with a modified EN 1500 procedure to compare the full 6-step technique against six variations, each omitting one step, measuring bacterial load reduction and hand surface coverage (n=35). Stage 2 comprised a cross-sectional online survey of 78 healthcare workers assessing the acceptability and feasibility of the technique in clinical practice. This study adds to the evidence base of the research question “What is the correct process and technique when using hand rub, hand wipe and alternative products to ensure effective hand hygiene?”. The study found a significant difference in E. coli reduction between technique variations ($P = 0.013$), with significantly lower reduction for variation 4 (step 4: rubbing the backs of fingers to opposing palm with fingers interlocked omitted) than for the full six-step technique ($P = 0.001$) and for variation 3

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		(step 3: rubbing palm to palm with fingers interlaced omitted) (P < 0.001). However, findings should be interpreted with caution as this is a small-scale study involving artificial contamination with one micro-organism type, which may not fully reflect the complexity and variability of clinical practice in Scottish health and care settings where patient interactions, hand contamination levels, and time pressures may differ. Further testing in a clinical environment would be beneficial. No change to current recommendations.
Healthcare infection incidents and outbreaks literature review	Isidro J, Dionísio F, Alves F, et al. Genomic evolution and re-emergence of a multidrug-resistant <i>Clostridioides difficile</i> RT027 clone with reduced vancomycin susceptibility driving a prolonged hospital outbreak. Emerging Microbes & Infections. 2026 Dec 31;15(1):2640707.	This study reports a prolonged outbreak of <i>Clostridioides difficile</i> infection (CDI) RT027 clone in a Portuguese tertiary-care hospital. This study adds to the evidence base of the research question “How can healthcare infection incidents/outbreaks be recognised/detected?”. An outbreak was identified through surveillance, RT027 CDI incidence rate increased from zero in January 2023 to 1.34 in October 2023 and later peaked at 5.46 in April 2024. The outbreak involved 52 patients, 66 episodes (including recurrence), attributable mortality rate of 21.4% and was distributed across seven wards. This study adds to the evidence for the research question “How should healthcare infection incidents/outbreaks be investigated and managed?”. The outbreak was investigated

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		and managed using a multidisciplinary approach, including Infection Control Team who performed periodic reports, audits, and service visits; and the National Reference Laboratory (NRL) who performed microbiological and genomic analysis. CDI diagnoses were confirmed by GeneXpert <i>C. difficile</i> PCR assay (Cepheid, USA), and a subset of samples identified as presumptive 027 were sent to the NRL for further microbiological analysis, including culture, MALDI-TOF, antimicrobial susceptibility testing, genotyping (PCR ribotyping, toxin genes profile and WGS), and Single Nucleotide Polymorphism (SNP)-based comparative analysis to assess the genetic relatedness of outbreak strains. The outbreak was controlled by reviewing practices of personnel, including personal protective equipment (PPE) donning and doffing; reinforcing contact precautions and hand hygiene with soap and water; and reinforcing the use of sporicidal products for terminal and routine cleaning and disinfection. Limitations include that control measures were bundled and therefore a meaningful analysis of effectiveness of control measures could not be done. Moreover, authors identified structural limitations including limited access to single-room isolation, shared sanitation facilities, and inappropriate use of PPE which likely facilitated patient-to-patient spread of infection. No environmental or staff sampling reported.

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		No change to current recommendations.
Healthcare infection incidents and outbreaks literature review	Capitani V, Ceparano M, Rosso A, et al. Outbreak Investigation Collaborating Group. Hospital outbreak sustained by <i>Klebsiella pneumoniae</i> sequence type 147 co-producing NDM-1 and OXA-48, Rome, Italy, February to March 2025: molecular tracing and control measures. Euro Surveill. 2026 Mar;31(10):2500457.	This study reports on an outbreak of carbapenemase-producing <i>Klebsiella pneumoniae</i> that occurred between February and March 2025 in a tertiary care hospital in Rome, Italy. This study adds to the evidence base of the research question "How can healthcare infection incidents/outbreaks be recognised/detected?". Outbreak was detected when five patients tested positive for NDM- and OXA-48 co-producing <i>K. pneumoniae</i> during routine screening in the sub-intensive care unit (S-ICU) and neighbouring wards. Eight more positive patients were identified through contact tracing and active surveillance. This study adds to the evidence for the research question "How should healthcare infection incidents/outbreaks be investigated and managed?". The outbreak was investigated and managed by the hospital's IPC committee team, including introduction of enhanced control measures, initiation of active surveillance and sampling of contacts, environmental sampling to identify potential reservoirs, and microbiological investigation. Microbiological identification and antimicrobial resistance were determined using VITEK2 (bioMérieux SA), susceptibility was evaluated with Strip-Test, agar disc diffusion and broth microdilution. Rapid molecular typing using NanoTyping (Oxford

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		Nanopore Technologies), supported by whole genome sequencing, confirmed all patient isolates and one environmental sample (on a bed edge) were ST147 clone. The outbreak was controlled by suspension of non-urgent patient transfers and active surveillance of contacts; reinforced adherence to IPC protocols through supervision and documentation, including hand hygiene, dedicated equipment, enhanced cleaning and disinfection of the environment; and assigning healthcare workers exclusively to patients in isolation to avoid cross-contamination. The findings of this study should be interpreted with caution as clinical practices and ICU protocols may differ from those in Scottish health and care settings. No change to current recommendations.
Management of Incidents and Outbreaks in Neonatal Units (NNU)	Rivera-Valenzuela G, Senaldi L, Tiwari P, et al. Investigation and control of an outbreak of methicillin-susceptible <i>Staphylococcus aureus</i> skin and soft tissue infections in a neonatal intensive care unit. Infection Control & Hospital Epidemiology. 2026;47(2):139-144.	This study reported on a methicillin-susceptible <i>Staphylococcus aureus</i> (MSSA) outbreak that occurred in a neonatal intensive care unit (NICU) in the United States of America. This study adds to the evidence base of the research question, “How can healthcare infection incidents/outbreaks be recognised/detected?”. An investigation began after four patients developed MSSA skin and soft tissue infections within three weeks. Clinical cultures were taken for suspicion of infection.

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		This study adds to the evidence base of the research question, “How should NNU incidents/outbreaks be investigated and managed?” Further investigation into the outbreak was performed by surveillance testing, which was initially conducted in patient rooms adjacent to and across from the first four cases, later expanded to the entire unit and continued monthly. Surveillance cultures were obtained from asymptomatic neonates from four body sites (bilateral nares, axillae, umbilicus, and groin) using one swab for all sites. Isolates were identified by matrix-assisted laser desorption ionization-time of flight (MALDI-TOF) mass spectrometry, susceptibility to mupirocin, whole-genome sequencing (WGS) and multi-locus sequencing typing (MLST). Five main sequence clusters were identified: ST-121 ($n = 15$), ST-398 ($n = 10$), ST-15 ($n = 7$), ST-30 ($n = 6$), and ST-582 ($n = 2$) with six individual isolates with unknown MLST. All isolates in ST-121 differed by fewer than 10 genetic variants, indicating they were closely related suggesting potential transmission between patients or acquisition from a common source. Multiple control measures were utilised, with contact precautions for case patients, decolonising patients who had clinical- or surveillance-positive cultures, increased availability of alcohol-based hand sanitisers in patient care areas, re-education of healthcare workers (HCW) about hand and nail hygiene, assessing HCW hand skin condition, introduction of bare-below-

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		the-elbows practice for HCW, environmental cleaning and disinfection targeting high-touch areas, and removing excess equipment and supplies from patient areas. A multidisciplinary quality improvement project was implemented to monitor compliance with the above interventions, with continued monthly surveillance for MSSA infections. After week 26, no further cases of MSSA infections occurred. Limitations include that clinical practices and NICU protocols may differ from Scottish health and care settings. Whilst WGS was used to identify potential transmission events and sources of infection, no attempt was made to directly identify these through microbiological sampling of HCW or the environment. No change to current recommendations
Management of Incidents and Outbreaks in Neonatal Units (NNU)	K. Thorley, J. Foster, S. Urquhart, et al. Investigation and control of a methicillin-resistant <i>Staphylococcus aureus</i> (MRSA) outbreak in a Level 2 neonatal unit in England: findings from a cohort study. Infection Prevention in Practice. 2026 June,8(2):100532.	This outbreak investigation study reports on a two-wave methicillin-resistant <i>Staphylococcus aureus</i> (MRSA) outbreak in a level two neonatal unit in England from May to September 2023, and cohort study aiming to identify risk factors. This study adds to the evidence base of the research question, “How can healthcare infection incidents/outbreaks be recognised/detected?”. The outbreak was detected when MRSA colonisation was identified during weekly screening (as recommended by regional neonatal networks), two further cases

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		were identified in different infants during the following weekly screening round. This study adds to the evidence base of the research question, “How should NNU incidents/outbreaks be investigated and managed?”. All positive specimens were referred for WGS, and genetic relatedness was determined using multi-locus sequence typing (MLST) and single nucleotide polymorphism (SNP) distance thresholds with a cut-off of 5 SNPs. The outbreak isolates represented a single staphylococcal lineage with a novel MLST and formed a single 5-SNP cluster, suggestive of linked transmission events. The hospital’s infection prevention control team implemented control measures once the investigation began. These measures were bundled therefore their effectiveness cannot be assessed individually, only a narrative description can be provided. After reviewing common exposures, the multidisciplinary incident management team decided to: • Recommend a standard approach for decolonising the MRSA-positive infants, cleaning procedures were reviewed including the introduction of double cleaning of incubators. • Perform terminal cleaning when discharging or moving a positive infant.

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		• Utilise single use items, or items being allocated to individual infants were used to reduce crossover contamination. • Review the unit to reduce clutter and increase cleaning efficiency. • Conducted observation assessments and hand hygiene audits, finding high compliance. • Provide training on hand washing to staff and visitors, and measures were taken to reduce footfall. With these measures in place, between weeks 9 and 15 no further cases were detected. The second wave began on week 16, resulting in all staff members of the unit being invited to be screened, with 88/92 providing swabs. With two staff members positive and WGS-linked to the outbreak cluster, they both were decontaminated successfully and returned to work. Nose and groin swabs were taken from the mothers of 12 of the 14 colonised infants, all were negative. Additionally, after the second wave 58 environmental swabs were taken from key locations on a single occasion, all returning negative. The unit underwent a one-off fogging with hydrogen peroxide vapour and ultraviolet cleaning while it was unoccupied. Following this clean an IMT meeting was convened, and the unit

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		reopened 4 weeks later, where weekly MRSA screening continued on the unit. Findings of this study indicate the challenges of identifying persistent infection reservoirs and how important weekly infant screening for MRSA is in detecting an outbreak. The outbreak was successfully managed and controlled as no more cases were identified after the control measures were implemented. No change to current recommendations.
Hand Hygiene: Skincare	Argawal R., Daga R.G. Prospective Study of Skin Barrier Dysfunction and Development of Occupational Hand Dermatitis in Healthcare Workers Using Frequent Hand Hygiene Practices. International Journal of Life Sciences 15(3):1222-1230, 2026 DOI: 10.69605/ijlbpr_15.3.2026.191	This prospective observational study evaluated skin barrier dysfunction and development of occupational hand dermatitis among healthcare workers in a tertiary care hospital in India using frequent hand hygiene practices. This study adds to the evidence base for the research question “What factors related to hand hygiene increase the likelihood of developing contact dermatitis?”. Skin barrier dysfunction of 90 healthcare workers was assessed using clinical parameters, while characteristics and exposure assessments were conducted using qualitative methods. 26.67% of participants developed occupational hand dermatitis, with significant associations reported between this and higher frequency of performing hand hygiene (p=0.012), longer duration of glove use (p=0.006), wet work exposure (p=0.009), and infrequent moisturiser use (p=0.041).

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		When multivariate logistic regression was undertaken, more than 40 hand hygiene episodes per shift, glove use for more than 4 hours per shift, wet work exposure and history of atopy (genetic predisposition to allergic conditions) were independent predictors of occupational hand dermatitis. While regular use of moisturiser was found to be protective against development of occupational hand dermatitis. This findings of this study should be interpreted with caution as product use and procedure in the study setting may differ from Scottish health and care settings. Further limitations of this study include the use of self-reported data which may be biased, and lack of consideration given to factors outside of work which may impact the risk of developing dermatitis. No change to current recommendations.
Transmission Based Precaution Definitions	Xie Y., Shiu E.Y.C., Ye D., et al. Detection of airborne respiratory viruses in paediatric patient rooms in Guangzhou, China. Journal of Hospital Infection 173:21-29, 2026 DOI: 10.1016/j.jhin.2026.04.004	This observational study, undertaken in a paediatric infectious disease unit of a tertiary hospital in Guangzhou, China, evaluated the presence of viral particles in the air of patients with confirmed respiratory virus infection (influenza B virus, respiratory syncytial virus (RSV), adenovirus (AdV), or parainfluenza virus (PIV) infection). This study adds to the evidence base for the research question “How are infectious agents released into the air of the health and care environment from the respiratory tract with consideration of particle size, distance and

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		clearance/fallout time?”. The rooms of patients with confirmed respiratory virus infection were sampled for 4 hours using two stage cyclone samplers placed at child’s seating height both near patient beds and 1.1-1.9m away. The sampler collected particles in three size ranges <1µ, 1-4µm, and >4µm. Room air volume was 86.3m³ and the air change rate was 1.46/h. Rooms without infectious patients were sampled as a negative control. Sampling events were categorised into three types; 1a where an infectious patient was in either of the neighbouring bed spaces, 1b where an infectious patient was placed in the same room but further from the sampled space, and 2 where no infectious patients were placed in the sampled room. The findings of this study suggest that viral particles can be found in the air both when infectious patients are present and when they are not. During category 1a sampling events, all 5 viruses were found to be present in samples collected; both influenza viruses, RSV and AdV were present in samples collected at both near the patient’s bed and 1.1-1.9m away, while PIV was only found in samples further from the patient bed. Viral loads between log 10² and 10⁵ were detected across the five assessed respiratory viruses. For influenza viruses (A and B) only particles <1µ and 1-4µm were detected, for PIV only particles >4µm were

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		detected, for RSV only particles <1 and >4µm were detected, and particles within all three size ranges were detected for AdV. During category 1b sampling events, only RSV, AdV, and influenza A were detected; with influenza A and RSV found both near the patient's bed and further from the patient's bed, and AvD only found in samples collected closer to the patient's bed. Viral loads between log 10² and 10⁵ were detected across the three assessed respiratory viruses present. For AdV only particles <1 µm were detected, while particles within all three size ranges were detected for RSV and influenza A. During category 2 sampling events, all five assessed respiratory viruses were reported, however influenza A were found in significantly more samples when compared to the other assessed viruses (p<0.001). Both influenza viruses and RSV were found in samples collected by both samplers, while AvD was only found in samples collected further from the patient's bed, and PIV was only found in samples collected closer to the patient's bed. Viral loads between log 10² and 10⁵ were detected across the five assessed respiratory viruses. For PIV only particles 1-4µm were detected, for AdV particles 1-4µm and >4µm were detected, while all three size ranges were detected for RSV and both influenza A and B. The findings of this study should be interpreted with caution, with note given to the paediatric setting of the study making

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		application of findings to general adult settings more difficult. Furthermore, the study is limited as samples were not cultured and so it cannot be confirmed if the respiratory viral particles collected in air samples were viable and represented transmission risk.

Evidence Table – Infection Control in the Built Environment and Decontamination (ICBED) - literature identified

Literature review	Papers identified	Summary of scientific findings and Impact on ARHAI Recommendations
Infection prevention and control (IPC) for safe healthcare water Systems review	Pírez LA, Papa-Ezdra R, Outeda M, et al. Containing a PER-1-producing <i>Pseudomonas aeruginosa</i> outbreak linked to sink contamination in an intensive care unit. Infection Prevention in Practice. 2026 Jun 1;8(2):100538.	This study reports on an outbreak of PER-1-producing <i>Pseudomonas aeruginosa</i> (PaePER) which occurred at an intensive care unit (ICU) of a university hospital in Montevideo, Uruguay between July 2021 to November 2022. This study adds to the evidence base of the research question "Which organisms associated with healthcare water systems are responsible for colonisation/infection of patients?" and "What types of infection can healthcare water system-associated organisms cause?" An increase in PaePER was detected in the ICU, affecting a total of 31 patients (2.8% attack rate), with 25 infections, six colonisations and 16 total deaths recorded. Clinical isolates were obtained from respiratory, blood, catheter tips, urine, soft tissue, cerebrospinal fluid and surgical wound. This study adds to the evidence base of the research question "What are the environmental testing requirements when investigating healthcare water system-associated incidents/outbreaks?" and "What are the causes/sources of environmental contamination with healthcare water system-associated organisms?"

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		Environmental sampling was performed in ICU sinks from rooms of patients with PaePER isolates and in associated clean utility areas. Four of seven sinks yielded PaePER, with six positive samples isolated from the rubber gasket near the P-trap, two from the strainer body and one from the junction between basin and strainer; samples from faucets were negative. Moreover, several risk factors for sink-related transmission were identified, investigation revealed that patient fluids and solutions used for care and medication preparation were routinely discarded in the ICU sinks. This study adds to the evidence for the research question "How and by whom should water-associated incidents be investigated?". The outbreak was investigated by a multidisciplinary team including Infection Prevention & Control, and Clinical Microbiology Laboratory. The investigation included epidemiological analysis and extensive environmental sampling of sinks and drainage systems. Molecular characterisation of patient and environmental isolates was done using MALDI-TOF MS, PCR, and PFGE to confirm clonal relatedness. The source was identified as sinks and drainage systems, which acted as the primary environmental reservoir. The outbreak was controlled by implementing multiple interventions, including discontinuing patient room sink use, relocating medication preparation, renewing drainage systems,

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		instituting regular acetic acid treatment of sinks and drains, and reinforcement of standard infection prevention measures. Limitations of this study include that clinical practices, water system infrastructures, and drain management protocols may differ from Scottish health and care settings. No change to current recommendations.
Infection prevention and control (IPC) for safe healthcare water Systems review	Prabaker K, Zhuo R, Malhotra S, et al. Clinical and operational impact of a four-year-long bronchoscopy-associated pseudo-outbreak of <i>Mycobacterium mucogenicum</i>. Infection Control & Hospital Epidemiology. 2026;47(4):379-385. Doi:10.1017/ice.2026.10399	This study reports on the investigation of a four-year-long pseudo-outbreak of <i>Mycobacterium mucogenicum</i> isolated from bronchoalveolar lavage (BAL) samples following bronchoscopy procedures at an academic medical centre in Los Angeles, USA. This study adds to the evidence base for the research question "Which organisms associated with healthcare water systems are responsible for colonisation/infection of patients?" A 15-month retrospective review of electronic medical records revealed that 154 patients, 51 (33.1%) of whom were highly immunocompromised, had <i>M. mucogenicum</i> growth in BAL cultures, an increase in incidence from 6.1% in 2020 to 18.6% in the first quarter of 2024. However, no true infections were identified. This study adds to the evidence for the research question "How and by whom should water-associated incidents be investigated?". The outbreak was investigated by a multidisciplinary team including Infection Prevention & Control, the Clinical Microbiology Laboratory, and the Molecular

Literature review	Papers identified	Summary of scientific findings and Impact on ARHAI Recommendations
		Microbiology and Pathogen Genomics Laboratory. The investigation included epidemiological analysis and extensive environmental sampling of the perioperative ice machine, water supply, and bronchoscopy equipment. The source was identified as non-sterile ice baths used to cool uncapped sterile syringes during bronchoscopy procedures, which were then used to help control procedural bleeding. Whole-genome sequencing (WGS) of clinical isolates and environmental isolates revealed that the environmental isolates were closely related to patient isolates collected in April 2024 (4 to 92 SNPs apart). The pseudo-outbreak was controlled by discontinuing the use of non-sterile ice and water during procedures and implementing modified processes for saline handling. The perioperative ice machine was also replaced with a new one, new point-of-use filter, and new tubing between the filter and the machine. Limitations of this study include that clinical practices, water system infrastructures, and equipment reprocessing protocols may differ from Scottish health and care settings. No change to current recommendations.