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

July to September 2026

Titles and abstracts are reviewed for subject relevance. Additional exclusion criteria are also applied as per the NIPCM Development Methodology and individual literature review exclusion criteria.

Antimicrobial Resistance & Healthcare Associated Infection (ARHAI) Scotland
An NHS Scotland Assure Service, part of Public Services Delivery Scotland

Evidence Table – National Policy Guidance and Evidence (NPGE) - literature identified

Literature review	Papers identified	Summary of Findings and Impact on ARHAI Recommendations
Personal Protective Equipment (PPE): Aprons and Gowns	Firth A, Sian R, Nightingale J, et al. Single-use surgical gowns are associated with an increased rate of periprosthetic joint infection: analysis of 9,239 primary hip and knee arthroplasties from a single centre. The Bone & Joint Journal, 108-B, 913-919.	This retrospective cohort study evaluated the association between gown type (reusable vs single-use) and periprosthetic joint infection (PJI) within 12 months after surgery in a large single-centre cohort in Nottingham, United Kingdom. The outcomes of all primary hip and knee arthroplasties between January 2015 and September 2023 were identified from a prospectively maintained institutional arthroplasty registry. Gown preference data was available for the total 9,239 operations performed by the 16 consultant orthopaedic surgeons of interest. This study adds to the evidence base for the research question **"What type(s) of aprons/gowns should be used in health and care settings?"**. A logistic regression was used to evaluate the association between gown type and PJI in the 12 months following surgery, adjusting for age, sex, BMI, diabetes, and chronic obstructive pulmonary disease. A total of 76 infections (0.82%) were identified, and single-use gowns were associated with higher odds of infection (adjusted odds ratio (OR) 1.73 (95% CI 1.09 to 2.76); p = 0.020).

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		The findings of this study should be interpreted with caution due to the retrospective observational analysis and inability to exclude residual confounding. Additionally, despite all of the procedures occurring in identical ultraclean theatres, unmeasured intraoperative factors like door openings, staff movement or surgeon helmet use were not recorded and may have contributed to infection risk. No changes to current recommendations.
Personal Protective Equipment (PPE): Headwear	McCahon JAS, Thomas GM, Hsu A, et al. Surgical Helmet Systems Were Not Associated With Lower Operative Infection Rates After Total Ankle Arthroplasty: A Retrospective Cohort Study. Foot & Ankle International 2026; 47: 705–712.	This retrospective cohort study evaluated the association between surgical helmet systems (SHSs) and the rate of surgical site infection (SSI) for those who underwent a total ankle arthroplasty (TAA) at a private surgical facility in Pennsylvania, USA. Patients who underwent a TAA between January 2013 and June 2023 at a large private academic institution were identified, and patients were required to have at least a 2-year follow-up to be included. Patient data were identified through the institutional electronic medical record system. At the surgeon's discretion, the decision to use an SHS or conventional gowning was made; four surgeons used SHS, while three used conventional gowning. Their surgical teams wore the same level of protection. A total of 938 cases were

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		included; 496 wore the SHS, and 442 used the conventional gowning. This study adds to the evidence base for the following research questions **"When should headwear be worn for infection control purposes in health and care settings?"** and **"What type(s) of headwear should be used in health and care settings?"**. Regarding wearing SHSs during TAA, this study found that there was no significant difference between the use of a surgical hood and conventional gowning on the overall rate of surgical site infection (5.24% vs 4.98%, P = .972) and deep prosthetic joint infection (2.62% vs 2.71%, P = 1.000). A multivariable logistic regression model controlling for age, BMI, tobacco use, and diabetes found no association between the use of surgical hoods and SSIs after TAA (OR = 1.12, P = .710). The findings of this study are limited due to its retrospective observational design, introducing inherent limitations. Residual confounding may exist due to unmeasured factors biasing the analysis. Due to the rarity of SSI after TAA, an adequate sample size was not feasible for this study; therefore, small differences were not possible to detect.

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		No change to current recommendations.
Management of Incidents and Outbreaks in Neonatal Units (NNUs)	Atıcı S, Memişoğlu AÇ, Aksu B, et al. Experience of an environmental-associated Stenotrophomonas maltophilia colonization outbreak: genetic diversity and outbreak management. BMC Infectious Diseases 2026; 26: 309.	This study reports on an environmental associated *Stenotrophomonas maltophilia* colonisation outbreak occurring within a neonatal intensive care unit (NICU) at the Marmara University School of Medicine in Istanbul, Turkey. A retrospective study conducted between September and October 2013 reviewed medical records of all neonates during the outbreak period. Six out of the total 15 neonates had *S. maltophilia* isolated from rectal swabs, none of these affected neonates developed an invasive infection. This study adds to the evidence base of the research question **"How should NNU incidents/outbreaks be investigated and managed?"**. The outbreak was detected due to routine weekly rectal swab surveillance cultures. Once detected, "Demographic and clinical characteristics (gestational age, birth weight, delivery type, gender), exposure to invasive procedures (mechanical ventilation, intubation, umbilical/urinary catheters, orogastric tubes), antimicrobial exposure (agents, duration), nutritional support such as total parenteral nutrition (TPN), steroid therapy and hospitalisation length, underlying diseases, interval from NICU admission to colonisation and duration of colonisation

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		were recorded." A case-control analysis found that colonised neonates were significantly more likely to be preterm and had greater exposure to invasive procedures, antibiotics, and total parenteral nutrition. Microbiological investigations confirmed the species was *S. maltophilia* by matrix-assisted laser desorption/ionization time-of-flight mass spectrometry. Genotyping was performed using REP-PCR and used to confirm the relatedness between clinical and environmental samples. This preliminary epidemiological investigation identified that all colonised neonates shared a common exposure, consumption of formula prepared with carboy water. This was further supported by the environmental cultures as *S. maltophilia* was detected exclusively in the carboy water systems. "The outbreak was managed using a multi-modal intervention strategy, involving the immediate cessation of carboy water use for formula preparation, cohort isolation of colonised neonates under strict contact precautions, and reinforcement of hand hygiene protocols among healthcare workers. Mandatory alcohol-based disinfection or hand washing was required before

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		and after patient contact. Compliance monitoring and staff retraining were also implemented." The bundled nature of outbreak management means that the effectiveness of individual measures cannot by determined. No change to current recommendations.
Management of Incidents and Outbreaks in Neonatal Units (NNUs)	Rath A, Klages LJ, Kieninger B, et al. Genome-oriented outbreak management reveals the first detection of concurrent transmissions of *Serratia sarumanii* and *Serratia bockelmannii* in a neonatal department. Journal of Hospital Infection 2026; 170: 60–68.	This study reported on the outbreak management of concurrent transmissions of *Serratia sarumanii* and *Serratia bockelmannii* in a neonatal department at the University Hospital of Regensburg in Germany. This outbreak occurred between March and October 2023 and involved patients in the neonatal intensive care unit (NICU), paediatric ICU, and adjacent neonatal stepdown unit (NStU). This study adds to the evidence base of the research question **"How should NNU incidents/outbreaks be investigated and managed?"**. This outbreak was detected due to the routine surveillance involving weekly screening of throat and rectal swabs for multi-drug-resistant organisms. Over a period of three weeks after the first patient was identified, an additional 11 cases were

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		detected, which prompted outbreak management and the use of proactive whole-genome sequencing (WGS) on all isolates. In weeks 14-32, the incidence rose again (N = 28), with a peak in weeks 14-16 (N = 12) that triggered a doubling in routine screening frequency to twice weekly. The bundled control measures included, “observation of infection prevention and control (IPC) compliance, education of parents and staff on IPC, and environmental investigations (sink drains: N = 53, sampled twice; soap dispensers: N = 20; cleaning trolleys and different surfaces in the milk kitchen: N= 22)”. After outbreak management was in place, there were only three healthcare-acquired cases detected between weeks 4 and 13. During the second phase of the outbreak, with the doubling of screening, a temporary stop in admissions occurred and two sinks were immediately replaced in week 14. The intensified containment measures quickly reduced healthcare-acquired cases to 0-2 per week, which was maintained until week 32, which was the end of the observation. The WGS analysis enabled the identification of 3 separate clusters instead of one prolonged outbreak, demonstrating different transmission dynamics per cluster.

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		The bundled nature of outbreak management means that the effectiveness of individual measures cannot by determined. No change to current recommendations.
Transmission Based Precautions (TBPs) Definitions	Zhou CY, Hu WQ, Li JY, et al. What is the source event of infectious respiratory particles release during bronchoscopy: a prospective environmental study. The Journal of Hospital Infection. 2026; 174:194-202.	This Chinese observational environmental study measured the airborne bacterial concentration, particle counts, and particle sizes released during bronchoscopy in 16 patients with pulmonary infections. This study adds to the evidence base of 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 clearance/fallout time?"**. This study measured IRPs during bronchoscopy where key events were noted for comparison which included bronchoscope insertion, coughs, vomiting, BAL and bronchoscope removal. IRPs were also measured before bronchoscopy to establish a baseline. Overall, the mean airborne bacterial concentration rose from 77.30 cfu/m3 before bronchoscopy to 103.06 cfu/m3 during (statistical test not performed). When compared with

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		background levels, small particles, measured as stages 5 to 6 of a six-stage sampler, showed significantly elevated bacterial concentrations during bronchoscopy (P = 0.027). During bronchoscopy, compared to the detection frequency of bacteria found before, *Micrococcus luteus* was increased and *Acinetobacter baumannii* complex was detected. Peak particle counts for all measured sizes during bronchoscopy were significantly higher than baseline (0.5 µm: P = 0.002; 5 µm: P = 0.003; PM2.5: P < 0.001) and the rises correlated significantly with cough episodes (ρ = 0.683, P = 0.004). Scope insertion in patients with no cough or emesis did not raise particle levels, while particle levels fell significantly during BAL (0.5 µm and 5 µm: P < 0.001; PM2.5: P = 0.028), which the authors attribute to suction clearance. One patient vomited and 0.5 µm particles rose 105-fold above baseline. Limitations of this study include the small sample (16 patients) with no sample size calculation, and its single-centre design, with the authors noting that differences in ventilation systems between institutions may limit the generalisability of absolute particle concentrations. Patients were not sedated which may limit applicability to settings where sedation is routine. Findings should be interpreted with caution as particle release may differ

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		with ventilation, air change rates, room layout and patient factors in Scottish health and care settings. No change to current recommendations.
Transmission Based Precautions (TBPs) Definitions	Lai J, Sobhani H, Coleman KK, et al. Evaluating modes of influenza transmission (EMIT-2): Insights from lack of transmission in a controlled transmission trial with naturally infected donors. PLoS Pathog. 2026;22(1):e1013153.	This randomised controlled trial (RCT) investigated influenza transmission using healthy volunteers and volunteers with recent-onset community-acquired influenza virus infection who interacted during exposure events in a sealed room to provide low ventilation. This study adds to the evidence base of 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 clearance/fallout time?"**. This study recruited 11 healthy volunteers (recipients) and 5 volunteers with PCR-confirmed influenza A (donors). Recipients were randomised into either the control group or the intervention group. The intervention group wore a face shield and sanitised hands every 15 minutes. In total, 23 exposures were conducted totalling 82.2 cumulative influenza exposure-event hours.

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		Exposure-events included conversations, interactive games, passing an object and physical activity. No recipient developed symptoms, a positive PCR or an antibody rise. Viral RNA was found in 44% (n=7) of the fine (<5μm) exhaled breath samples and in 6% (n=1) of the coarse (≥5μm) exhaled breath samples. Viral RNA was found in two ambient air samples, one at sitting height in the 1–4 μm size fraction and one at standing height in the >4 μm size fraction. One of the 23 surface swabs grew live virus, which was the marker pen that was passed around. None of the personal air samples (placed at the front strap of a backpack) detected viral RNA. The authors discussed that the lack of transmission might be due to low shedding by donors who rarely coughed, middle-aged recipients who may already be immune and the rapid air mixing that limited the amount of concentrated breath plumes. The findings of this study should be interpreted with caution due to its limitations and environmental conditions may differ from those in Scottish health and care settings. Limitations of this study include the small number of participants with a descriptive analysis only. Recipients were not selected based on antibody levels or vaccination status due to small number available; however, it was reported that two participants were vaccinated and nine of 11 recipients had higher relevant antibody levels.

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		Pre-existing immunity in recipients might limit the ability to detect transmission. Moreover, the exposure room was sealed with a ventilation rate of 0.25-0.5 air changes per hour, with two fan coil units, two large dehumidifiers on high speed and portable air cleaners. No change to current recommendations.
Healthcare Infection Incidents and Outbreaks	Vock I, Capoferri G, Kuster S, et al. Two clusters of carbapenemase-producing bacteria linked to hospital utility room wastewater drains – an outbreak report. Antimicrobial Resistance & Infection Control. 2026, Jun 2.	This study reports on an outbreak of carbapenemase-producing Bacteria (CPB), linked to colonisation of a ward's utility room wastewater drains (URWDs) at the University Hospital Basel (UHB) in Switzerland. This study adds to the evidence base of the research question **"How can healthcare infection incidents/outbreaks be recognised/detected?"**. Both outbreak clusters were detected through monthly routine screening of high-risk patients with hematologic malignancies. In January 2024, VIM-1 carbapenemase-producing *Enterobacter hormaechei* sequence type 90 (ST90) was identified in clinical urine and rectal samples of two patients hospitalized on the same ward within two weeks. Sequencing confirmed clonal relatedness of the two isolates and further comparison with previous CPB isolates identified at the UHB revealed a close genetic link with the isolate of VIM-1 producing *E. hormaechei* from two additional patients, one

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		hospitalized on the same ward in June 2022 and the other hospitalized on a different medical ward of the same hospital wing in August 2023. In June 2024 a KPC-3 carbapenemase-producing *C. freundii* was detected in a patient who had previously tested negative in March and April 2024. One month later, another KPC-3-producing *Citrobacter freundii* was detected in a patient hospitalized in a neighbouring room of the index patient on the same ward. The two clinical isolates had a single nucleotide polymorphism (SNP) distance of 43 SNP. 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 a multidisciplinary team, including active surveillance and sampling of contacts, environmental sampling to identify potential reservoirs, microbiological and genomic analysis, auditing of infection prevention practices and a bundle of control measures. Environmental CPB screening detected VIM-producing *C. freundii and Klebsiella pneumoniae* in one out of two URWDs located on the affected ward, as well as a VIM-producing *C. freundii* in the water drain of the ward's pharmacy, all with the bla_{VIM-1} gene related to the clinical isolate. For the second cluster, colonization with KPC-3-producing

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		C. freundii and K. pneumoniae was detected in one out of three of the ward's URWDs located opposite of the patient's room, both with the bla$_{KPC-3}$ gene related to the clinical isolate. The outbreak was declared over when consecutive ward screenings as well as screening of direct contact patients of both clusters did not reveal any further cases, almost two months after outbreak detection. 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. Moreover, the direction of transmission could not be determined. No change to current recommendations.
Healthcare Infection Incidents and Outbreaks	Slavenburg S, Souverein D, Witteveen S, et al. Control of a hospital outbreak with methicillin-resistant Staphylococcus argenteus in The Netherlands, June–September 2023.	This study reports on an outbreak of Methicillin-resistant *Staphylococcus argenteus* (MRSArg), affecting both patients and health care workers (HCWs), at a hospital in the Netherlands. 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 MRSArg carriage was identified in both an inpatient (blood) and

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	Antimicrobial Resistance & Infection Control. 2026 May 30.	HCW (nasal and throat) in same week, through routine screening and contact tracing around another MRSA positive patient respectfully. Further screening of a cohort of HCWs, patients and family members let to identification of a total of 15 MRSArg carriers. This study adds to the evidence base of the research question **"How should healthcare infection incidents/outbreaks be investigated and managed?"**. The outbreak was investigated and managed by a multidisciplinary team, including implementing additional cleaning protocols; contact tracing and screening for patients, HCWs and families; pre-emptive isolation of high-risk patients; work suspension for MRSArg-positive HCWs; and decolonization treatment for MRSArg-positive individuals. Microbiological analysis and subsequent genomic analysis, including whole-genome sequencing (WGS) and multilocus sequence typing (MLST), confirmed genetic relatedness of the 15 MRSArg isolates from screening samples (ST2250). The findings of this study should be interpreted with caution as clinical practices and protocols may differ from those in Scottish

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		health and care settings. Moreover, the investigation did not establish the exact direction or route of transmission route. No change to current recommendations.

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

Literature review	Papers identified	Summary of Findings and Impact on ARHAI Recommendations
Infection prevention and control (IPC) for safe healthcare water Systems review	Vock I, Capoferri G, Kuster S, et al. Two clusters of carbapenemase-producing bacteria linked to hospital utility room wastewater drains – an outbreak report. Antimicrobial Resistance & Infection Control. 2026, Jun 2.	This study reports on an outbreak of carbapenemase-producing Bacteria (CPB), linked to colonisation of a ward's utility room wastewater drains (URWDs) at the University Hospital Basel (UHB) in Switzerland. 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?"**. In January 2024, VIM-1 carbapenemase-producing *Enterobacter hormaechei* sequence type 90 (ST90) was identified in clinical urine and rectal samples of two patients hospitalized on the same ward within two weeks. Sequencing confirmed clonal relatedness of the two isolates and further comparison with previous CPB isolates identified at the UHB revealed a close genetic link with the isolate of VIM-1 producing *E. hormaechei* from two additional patients, one hospitalized on the same ward in June 2022 and the other hospitalized on a different medical ward of the same hospital wing in August 2023.

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		In June 2024 a KPC-3 carbapenemase-producing *C. freundii* was detected in a patient who had previously tested negative in March and April 2024. One month later, another KPC-3-producing *Citrobacter. freundii* was detected in a patient hospitalized in a neighbouring room of the index patient on the same ward. The two clinical isolates had a single nucleotide polymorphism (SNP) distance of 43 SNP. This study adds to the evidence for the research question **"How and by whom should water-associated incidents be investigated?"**. The outbreak was investigated and managed by a multidisciplinary team of Infection Prevention & Control specialist. The investigation includes active surveillance and sampling of contacts, environmental sampling to identify potential reservoirs, microbiological and genomic analysis, auditing of infection prevention practices and a bundle of control measures. Environmental CPB screening detected VIM-producing *C. freundii and Klebsiella pneumoniae* in one out of two URWDs located on the affected ward, as well as a VIM-producing *C. freundii* in the water drain of the ward's pharmacy, all with the bla_{VIM-1} gene related to the clinical isolate. For the second cluster, colonization with KPC-3-producing *C. freundii and K. pneumoniae* was detected in one out of three

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		of the ward's URWDs located opposite of the patient's room, both with the bla_{KPC-3} gene related to the clinical isolate. The outbreak was declared over when consecutive ward screenings as well as screening of direct contact patients of both clusters did not reveal any further cases almost two months after outbreak detection. 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. Moreover, the direction of transmission could not be determined. No change to current recommendations.