ARHAI Scotland

Antimicrobial Resistance and Healthcare Associated Infection

NHS National Services Scotland

Evidence table – SICPs - literature identified April - June 2022

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.

Literature review	Papers identified	Summary of Findings	Impact on Recommendations
Hand Hygiene – Skin Care	Symanzik C, Kezic S, Jakasa I, et al. Effects of skin washing frequency on the epidermal barrier function and inflammatory processes of the epidermis: An experimental study. *Contact dermatitis* 2022 2022/04/01. DOI: 10.1111/cod.14119.	This experimental study under laboratory conditions (Feb-April 2021) assessed the effects of varying washing frequencies on epidermal barrier function and inflammatory processes of stratum corneum (SC) using lipid-containing syndet (oil-in water emulsion with glycine soja oil) versus a standard skin cleanser (containing sodium laureth sulfate). Twenty-five (n=25) skin-healthy volunteers (23 women, mean ± SD: 33.8 ± 10.7 years) had six test areas on the volar aspects of their lower arms and one control area on upper arm (surface area 8 cm^2) marked. The test areas were randomised per participant to receive (via automated cleansing device using standardised amount of cleanser, cream & distilled water for rinsing): 1: Control site, no washing; 2: Five-time washing (60s each) with standard cleanser	None.

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		within 4h; 3: Five-time washing (60s each) with lipid-containing syndet within 4h;4: Five-time washing (60 s each) with a lipid-containing syndet within 4h followed by application of a rehydrating skin cream; 5: Eleven-time washing (60 s each) with a standard cleanser within 4h; 6: Eleven-time washing (60 s each) with a lipid-containing syndet within 4h; 7: Eleven-time washing (60 s each) with a lipid-containing syndet within 4 h followed by application of a rehydrating skin cream. Skin parameters (transdermal water loss [TEWL], SC hydration, erythema and SC pH) and biochemical/immunological parameters (interleukin-1α, interleukin-1α receptor antagonist and natural moisturizing factor) of SC samples were assessed at baseline prior to washing (T0), 15min after washing (T1), 60min after washing (T2) and 24h after last washing (T3). Findings show that under laboratory conditions for TEWL, SCH, erythema, SC pH, NMF, IL-1α and IL-1αRA there were no statistically significant differences at T3 comparing the various test areas with their respective control sites. No significant differences from T0 to T3 were observed in any of investigated parameters in this experimental study.	

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Hand Hygiene – Skin Care	Montero-Vilchez T, Martinez-Lopez A, Cuenca-Barrales C, et al. Assessment of hand hygiene strategies on skin barrier function during COVID-19 pandemic: A randomized clinical trial. *Contact dermatitis* 2022; 86: 276-285.	This RCT compared the impact on skin barrier function of 3 hand hygiene products: soaps (sodium laureth sulfate), alcohol-based hand sanitiser (ABHS in 70% alcohol, 0.2% glycerine) and disinfectant wipes (75% alcohol, 1.5% glycerine). 62 healthcare workers (mean age 38.32years) were randomised via computer on 1:1:1 ratio to sanitise their hands with water and soap (n=20), ABHS (n=21) and disinfectant wipes for (n=21) at least 20 seconds during their 8-hour working shift. Primary outcome was skin barrier impairment assessed by changes in transepidermal water loss (TEWL); secondary outcomes were changes in temperature, stratum corneum hydration [SCH], erythema, pH and antioxidant capacity, reduction of microbial load and perceived differences in tolerability and acceptability among the 3 hand hygiene. Parameters were assessed before shifts (08:00am) and immediately after the working day (approx. 3:00pm). Tolerance and acceptable of each hand hygiene product were recorded after work. Findings show that after 8-hour shift, TEWL increase was higher with disinfectant wipes than with soaps or ABHS (+5.45 vs +3.87 vs −1.46 $gh^{-1}m^{-2}$, respectively; P=0.023). TEWL was reduced by 1.46 ($g.h^{-1}.m^{-2}$) in the	Adds to evidence base on the following objective: • Which products should be used in order to maintain skin integrity and minimise the development of contact dermatitis?”

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		ABHS group. pH increased by 0.37 (0.12) in the water and soap group but remain unchanged in ABHS and wipes group. Bacteria and fungi CFU count reductions were lower for water and soap group compared to ABHS and disinfectant wipes (65.7% vs 90.5% vs 87.44%, P=0.002). Disinfectant wipes were considered more difficult to use (P=0.013) compared with water and soap and ABHS. Wipes also received worse ratings for drying effect than ABHS (P=0.047). The study concluded that daily hand hygiene with ABHS showed lowest rates of skin barrier disruption and highest reduction of CFU compared to soap and water and disinfectant wipes.	
Hand Hygiene – Skin Care	Peters A, Cave C, Carry J, et al. Tolerability and acceptability of three alcohol-based hand-rub gel formulations: a randomized crossover study. *Journal of Hospital Infection* 2022; 123: 112-118. DOI: https://doi.org/10.1016/j.jhin.2022.01.019.	This randomised cross-over study compared the tolerability and acceptability of 3 different ABHR gel formulations in adult volunteers from 17May – 18June 2021. Thirty-eight participants (median age 24yrs [range 21-37], 30 female) were computer randomised to 3 different hand-rub gel formulations: isopropanol-based with isopropyl mystrate and bisabolol (Hopigel®); ethanol-based and glycerol (World Health Organization [WHO] gel formulation) and ethanol-based containing superfatting agents (Saniswiss Sanitizer Hands H1). Blinded participants were instructed to perform hand hygiene 20	None.

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		consecutive times with 3ml of ABHR, allowing the skin to dry in between applications, over a series of three five-day interventions followed by a nine-day washout period. Skin condition and tolerability was assessed based on WHO protocol (redness, scaliness, fissures) and self-reported feedback (skin appearance, integrity, level of hydration and physical sensation) collected at the end of each intervention. A total of 574 hand-rubbing sessions were analysed in the study. Findings show no statistically significant difference regarding tolerability between the 3 ABHR formulations tested; however, there were differences in acceptability. The smell of H1 and WHO gel formulations were preferred (P=0.003 and P=0.040 respectively); H1 was considered to have better texture compared to WHO gel formulation (P<0.001) and H1 was considered more pleasant overall than Hopigel (P=0.037). There was high variability observed among participants but H1 was rated the favourite often among participants and the least favourite the least often. The authors concluded that no significant differences in tolerability was observed between the 3 gel formulations tested but there was high variability in participant's reactions to all 3 products indicating that preference is personal. Further study with a larger sample size is	

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		required to demonstrate how different ABHRs compare in clinical settings.	
HH – Surgical Hand Antisepsis	Palak EA, Iyigun E, Albay A, Bedir O. Impact of methods and duration of surgical hand scrub on bacterial count: A randomised controlled trial. *American Journal of Infection Control* 49(11): 1376-1383, 2021	This randomised control trial was performed within the Operating Room Department of a training and teaching hospital in Ankara, Turkey. The aims of the study were to identify difference in bacterial hand contamination when scrubbing with or without using a nail brush, and the difference in bacterial hand contamination after a 1-minute and 2-minute scrub. 180 healthcare workers with at least 6 months of experience participated in the study, with 45 in each of the 4 study arms. 1) one-minute scrub with a nail brush, 2) one-minute scrub without a nail brush, 3) two-minute scrub with a nail brush, 4) two-minute scrub without a nail brush. Samples were collected from participants dominant hand using the “glove juice method” under aseptic technique. Briefly the participant’s hand was immersed in a sterile bag containing 50mL of tryptic soy broth and massaged for 60 seconds before the hand was removed from the bag and specimens were taken for lab analysis. Samples were collected 3 times: once before surgical hand scrub, once after surgical hand scrub but before performing	Adds to the evidence base for recommendations under the objective • Should nail brushes, sponges, and picks be used when performing hand hygiene? However, the findings of this study could impact upon the recommendations under the objective • How long should surgical hand antisepsis be carried out to ensure good technique? It should be noted that the findings of a single study would not cause

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		surgery, and once in the final stages of surgery. Use of a nail brush during scrub (comparison of groups 1vs2, and groups 3vs4) Bacterial count on hands prior to surgical scrub and following surgery was similar in all four groups, but significantly different following surgical scrub ($p<0.001$). Statistical differences were found between (Mean, SD, vs mean, SD, p value) - Groups 3 and 4 following surgical scrub (0.87, 1.48 vs 0.20, 1,19, $p<0.001$). Bacterial counts were found to be significantly higher on hands of participants in group 3. - Group 1 and 3 following surgical scrub (0.27 ± 0.35 vs 0.87, 1.48, $p=0.005$). Bacterial counts were found to be significantly higher on the hands of participants in group 3. These findings suggest that for a one-minute scrub time, the protocol that did not use a nail brush resulted in significantly greater reduction in bacterial count on the hands. When a nail brush was used, a two-minute scrub was found to cause a significantly greater reduction in bacterial	changes in a recommendation alone.

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		count on hands when compared to a one-minute scrub protocol.	
Personal Protective Equipment (PPE): Gloves	Li L, Ni K, Du X, et al. Assessment of the invisible blood contamination on nurses' gloved hands during vascular access procedures in a hemodialysis unit. *American Journal of Infection Control* 2022; 50: 712-713. DOI: https://doi.org/10.1016/j.ajic.2021.12.009.	This brief prospective study was carried out to assess potential invisible blood contamination on nurses' gloved hands during vascular access procedures using occult blood detection method in a haemodialysis unit from September 2020 – January 2021. The unit has 390 registered patients and employed 38 nurse practitioners. At the end of vascular access connection and disconnection process, the nurses' gloved hands were sampled using occult blood detection kits (BWE™, Shanghai, China) that can identify haemoglobin concentrations as low as 5µg Hb/g. A total of 454 samples were collected from gloved hands of nursing staff of which 60.13% (273/454) of samples tested positive for haemoglobin. 68.3% (134/196) of haemoglobin-positive samples were from after the connection of vascular access and 53.88% (139/258) were from after disconnection of vascular access, this difference was significant (χ^2=9.757, P=0.002). It was concluded that using the occult blood detection kit was useful in assessing invisible blood contamination on nurses' hands in dialysis settings and provides evidence of importance of hand	Adds to evidence base on the following objective: • When/where should gloves be worn?

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		hygiene and glove change during vascular access procedures.	
Safe Management of Linen	Sundermann AJ, Clancy CJ, Pasculle AW, et al. Remediation of Mucorales-contaminated Healthcare Linens at a Laundry Facility Following an Investigation of a Case Cluster of Hospital-acquired Mucormycosis. *Clinical infectious diseases : an official publication of the Infectious Diseases Society of America* 2022; 74: 1401-1407. 2021/07/21. DOI: 10.1093/cid/ciab638.	This USA-based study describes the investigation of 4 hospital-acquired mucormycosis cases among solid organ transplant recipients from May 2015-April 2016 where Mucorales-contaminated healthcare linens (HCLs) delivered to the hospital were identified as the likely source by the Infection Control team. Monthly cultures of freshly laundered HCLs samples (7 types [bath blanket, thermal blanket, fitted sheet, flat sheet, pillowcase, washcloth and patient grown]; n=49 articles/month) were performed directly upon arrival to the centre from October 2016-October 2019. Prior to remediation at laundry agency on Feb2017, 20% 19/95 of freshly laundered HCLs were culture positive for Mucorales immediately upon arrival at the centre. The HCL facility layout and processes were consistent with USA industry standards and CDC guidelines including separation of dirty and clean areas. Significant increases in Mucorales and mould culture-positivity of HCLs were detected at the post-dryer step (0% to 12% [P = .04] and 5% to 29% [P = .01], respectively) with further increases to 17% and 40% culture-positivity, respectively observed during pre-transport holding. Site inspections revealed significant Mucorales-	Adds to evidence base on the following objective: • How should clean linen be stored?

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		positive lint accumulation in rooftop air intake and exhaust vents that cooled drying step, intake and exhaust vents facing each other, rooftop and plant-wide lint accumulation (estimated using satellite images), including in the pre-transport clean room; uncovered carts with freshly laundered HCLs. Remediation and interventions included: large filter device placed around exhaust vents to catch lint, air intake vents moved away from exhaust vents, frequent removal of lint on rooftop, enhanced environmental cleaning focusing on lint removal from floors, walls and ceiling and placement of plastic cover over carts containing freshly laundered HCLs. Following remediation, there was reduction of Mucorales culture-positivity of newly laundered HCLs to 0.3% (P=.001) and a reduction of rooftop lint-contaminated area from 918 m^2 to 0 m^2 on satellite images. The authors conclude that targeted remediation and intervention at this commercial laundry facility achieved significant reductions in Mucorales contamination of HCLs.	
Safe Management of the Care Environment (Environmental	Warren BG, Turner NA, Addison R, et al. The Impact of Infection Versus Colonization on *Clostridioides difficile* Environmental Contamination in Hospitalized Patients With Diarrhea. *Open Forum*	This prospective cohort study set in Duke University Health System, November 2019 – June 2021 (Durham, North Carolina, USA) evaluated *Clostridioides difficile* contamination in rooms (all single patient rooms with no shared bathrooms) housing	Adds to evidence base on the following objective: • What is the risk of healthcare associated

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Decontamination)	*Infectious Diseases* 2022; 9: ofac069. DOI: 10.1093/ofid/ofac069.	adult inpatients (n=94, median age 65yrs [IQR 55-72], 47 female) with diarrhoea based on *C difficile* status and test result via PCR and enzyme immunoassay (infected (n=28), colonised (n=32) or negative/control [n=34]). Routine disinfection was carried out in all study rooms as per standard protocol while rooms housing patients with *C difficile* infections (CDIs) were disinfected daily with bleach and terminal disinfected with bleach and UV-C. Environmental samples (total n=740) from 3 locations (patient area [bedrails and overbed table surface], bathroom area [top of bathroom sink bowl, toilet seat and floor around base of toilet] and care area [in-room computer keyboard, mouse and IV poles adjacent to patient bed]) were taken within 24hrs of *C difficile* testing and again for 2 successive days. Findings show that highest burden of *C difficile* contamination was seen in infected patient rooms with mean CFU at 337 (±913) in infected patient rooms, 221 (±811) in colonised patient rooms and 94 (±637) in control rooms. *C difficile* was recovered in 93 (38%) patient rooms: 44 (62%) infected patient rooms, 35 (43%) colonized patient rooms (P=0.08 vs infected 38 patient rooms), and 14 (15%) negative patient rooms (P<0.01 vs infected; P<0.01 vs colonised). Additionally, *C difficile* was recovered in 49	infection (HAI) from the care environment?

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		(56%), 6 (9%), and 20 (28%) of bathrooms, care areas and patient areas in 40 infected patient rooms; 34 (41%), 1 (1%), and 4 (5%) samples in colonised patient rooms; and 12 (13%), 1 (1%), and 3 (3%) of samples in negative patient rooms, respectively. The authors concluded that patients colonised with *C difficile* frequently contaminated the hospital environment. They also recommended the use of contact precautions when entering rooms of patients colonised with *C difficille* especially the bathroom area.	
Patient Placement	Biehl LM, Higgins PG, Stemler J, Gilles M, Peter S, et al. Impact of single-room contact precautions on acquisition and transmission of vancomycin-resistant *enterococci* on haematological and oncological wards, multicentre cohort-study, Germany, January-December 2016. *Euro Surveillance* 27(2), 2022	This prospective 12-month cohort study aimed to assess the impact of single-room contact precautions (SCP) on in-hospital acquisition and transmission of vancomycin-resistant *enterococci* (VRE) in haematological/oncological patients, with comparison to no contact precautions (NCP). The study was undertaken across 4 hospitals in Germany. Two facilities performed single-room contact precautions, and the other two did not. Single room contact precautions involved single room accommodation, gloves, and gowns. The IPC procedures of facilities that did not implement single-room contact precautions were not reported. In-patients were screened for VRE within 72 hours of admission, once weekly, and	The findings of this study would not have an impact on current NIPCM Patient Placement recommendations. The IPC protocols within NCP facilities were not reported meaning that comparison was not clear enough for inclusion.

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		within 72 hours of discharge by deep rectal swab or stool sample. 1,397 patients (2,435 admissions) were included at NCP facilities and 1,531 patients (3,023 admissions) were included at SCP facilities. Incidence of overall VRE colonisation or bloodstream infection (BSI) was significantly higher at NCP facilities (20.3%, 283/1397) compared to SCP facilities (14%, 215/1531) (RR 1.56, 95% CI 1.28-1.89, p<0.001). The proportion of patients with hospital associated VRE differed significantly between the groups, with NCP facilities (12.2%, 170/1397) being significantly higher than SCP facilities (7.4%, 113/1531) (RR 1.74, 95% CI 1.35-2.23). The corresponding incidence densities of hospital associated VRE were 6.93 cases/1000 patient days (95% CI 5.95-8.04) and NCP facilities, and 4.19cases/1000 patient days (95% CI 3.47-5.01) at SCP facilities.	
Patient Placement	Jung J, Choe PG, Choi S, Kim E, Lee HY, et al. Reduction in the acquisition rate of carbapenem-resistant *Acinetobacter baumannii* (CRAB) after room privatization in an intensive care	This retrospective study was undertaken within an ICU after renovation to create single rooms (10 regular rooms and 2 isolation rooms), with rate of carbapenem-resistant *Acinetobacter baumannii* (CRAB) acquisition compared to pre-renovation	Adds to the evidence base for recommendations under • Under which circumstances

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	unit. *Journal of Hospital Infection* 121: 14-21, 2022	levels where the ICU was a multi-bed bay room (20 beds) with two single rooms. No other changes in IPC protocol were made during this time. The ICU was cleaned three times a day using 4% benzalkonium chloride wipes for regular patients, and >500 ppm sodium hypochlorite wipes for multi-drug-resistant organisms colonised patients. Routine CRAB screening was undertaken using sputum or tracheal aspiration samples collected from intubated patients. Medical records of patients admitted to the ICU between 1st September 2015 and 28th February 2019 were reviewed as part of this study. The pre-renovation group were all admitted between September 2015 and February 2017. The post-renovation group were admitted between September 2017 and February 2019. During the study period 1651 patients were admitted to the ICU and 901 of these were included in the analysis; 479 in pre-renovation group, 422 in post-renovation group. Of the 901 patients included in this study, 95 (10.5%) acquired CRAB during their stay in the ICU. The CRAB acquisition rate was significantly higher during the pre-	should a patient be placed in a single-bed room?

Literature review	Papers identified	Summary of Findings	Impact on Recommendations
		renovation group (1.87 per 100 patient-days) than during the post-renovation group (0.39 per 100 patient-days) (P<0.001). A multi-variable Cox regression model found CRAB acquisition to be significantly associated with admission after renovation (aHR 0.23, 95% CI 0.12-0.41,p<0.001).	

Evidence table – TBPs - literature identified

Literature review	Papers identified	Summary of scientific findings	Impact on recommendations
Definitions of Transmission Based Precautions	Dinkele R, Gessner S, McKerry A, et al. Aerosolization of Mycobacterium tuberculosis by Tidal Breathing. *Am J Respir Crit Care Med* 2022; 206: 206-216. 2022/05/19. DOI: 10.1164/rccm.202110-2378OC.	This sampling study compared the aerolisation of *Mycobacterium tuberculosis (Mtb)* and total particulate matter during 3 respiratory manoeuvres – tidal breathing (TiBr), forced vital capacity (FVC), cough - from 38 patients (>13years old) with confirmed TB (via positive GeneXpert sputum test) recruited from March 2020 – June 2021 at primary healthcare facilities in Cape Town, South Africa prior to standard anti-TB chemotheraphy. Bioaerosols from FVC, TiBr and cough were captured in liquid cycling collectors within a Respiratory Aerosol Sampling Chamber and *Mtb* was enumerated by live-cell; fluorescence microscopy were combined with real-time measurement of CO_2 concentration and total particle counts. During TiBr sampling, participants breathed normally into the elliptical cone of the sampling chamber for 5 mins for an average of 92 breaths. During FVC and cough sampling, participants performed 15 manoeuvres directly into the elliptical cone every 15 seconds conducted as 3 sets of 5 with rest periods between each set. Findings for all manoeuvres show similar proportions for particles detected across five size categories (C1: 0.5 – 1 µm, C2: 1 - 1.5 µm, C3: 1.5 – 2 µm , C4: 2 – 5 µm, and C5: >5 µm) with most particles	Adds to the evidence base under the following objectives: • Which infectious agents are transmissible by the airborne route? • Which activities result in airborne transmission?

Literature review	Papers identified	Summary of scientific findings	Impact on recommendations
		falling between 0.5 – 5 µm.. As expected, total particle counts were greater (by 4.8-fold) in cough samples compared to TiBr or FVC however all 3 manoeuvres returned similar rates of positivity for *Mtb*, all 3 were equally likely to produce *Mtb* with TiBr, FVC and cough returning positive results in 66%, 70% and 65% of samples respectively. Additionally, no correlation was observed between total particle production and *Mtb* count for either FVC (r^2=0, P=1) or cough (r^2=0.04, P=0.4) while a slight linear relationship was observed for TiBr but this did not reach significance (r^2=0.15, P=0.08). It was estimated using 24-hour breath and cough frequency model that TiBr might contribute 93% of daily aerosolised *Mtb* bacili among symptomatic patients suggesting coughing is likely to produce fewer bacilli per day than TiBr. The authors concluded that based on this data, TiBr might have significant contribution to TB transmission among active cases.	

Evidence table – Healthcare Infection Incidents, Outbreaks and Data Exceedance - literature identified

Literature review	Papers identified	Summary of scientific findings	Impact on Recommendations
	No literature Identified		