



**Standard Infection Control Precautions Literature Review:
Hand Hygiene:
Hand washing**

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Description	This literature review examines the available professional literature on Hand Hygiene – hand washing in the healthcare setting.
Purpose:	To inform the Standard Infection Control Precaution (SICP) Hand Hygiene (hand washing) section of the National Infection Prevention and Control Manual.
Target audience:	All NHS staff involved in the prevention and control of infection in NHSScotland.
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Cross reference:	National Infection Prevention and Control Manual http://www.nipcm.hps.scot.nhs.uk/ SICP Literature Review: Surgical Hand Antisepsis in the Clinical Setting http://www.nipcm.hps.scot.nhs.uk/documents/sicp-hand-hygiene-surgical-hand-scrubbingrubbing-in-the-hospital-setting/
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1. Objectives

The aim of this review is to examine the extant professional literature regarding the correct technique for hand washing for standard infection control purposes. The specific objectives of the review are to determine:

- What is the recommended water temperature for hand washing?
- How should hands be washed?
- What is the correct technique to ensure that all surfaces of the hands are covered during washing?
- How should hands be dried after hand washing?
- What is the evidence relating to finger nails to enable effective hand washing?
- What is the evidence regarding the wearing of jewellery in relation to hand washing?
- What is the evidence regarding the bare below the elbows policy?
- Where should hand washing products be placed in the patient care environment?
- What are the requirements for sink design, provision and types of taps?

N.B. Recommendations relating to specific hand hygiene products, i.e. soap types, are outlined in the [hand hygiene products literature review](#).

2. Methodology

This targeted literature review was produced using a defined methodology as described in the [National Infection Prevention and Control Manual: Development Process](#).

3. Recommendations

This review makes the following recommendations based on an assessment of the extant professional literature on hand washing for standard infection control purposes:

What is the recommended water temperature for hand washing?

Hands should be washed with warm/tepid water to mitigate the risk of dermatitis associated with repeated exposures to hot water and to maximise hand washing compliance.

(Grade D recommendation)

(AGREE rating: Recommend)

How should hands be washed?

Cuts and abrasions should be covered with a waterproof dressing before commencing hand washing.

(AGREE rating: Recommend)

Hands should be washed as follows:

- Wet hands under running warm/tepid water.
- Apply the manufacturers recommended quantity of liquid soap – normally via a measured dispenser.
- Rub hands together for at least 15 seconds, ensuring all surfaces of the hands are covered with lather.
- Rinse hands well under running water.
- Dry hands thoroughly using a disposable paper towel.
- Turn off the tap(s) using elbow or a paper towel to prevent contamination of clean hands.

(Grade D recommendation)

(AGREE rating: Recommend)

What is the correct technique to ensure that all surfaces of the hands are covered during washing?

The following technique should be used to ensure that all surfaces of the hands are covered during hand washing:

- Rub hands palm to palm.
- Rub right palm over the back of the other hand with interlaced fingers and vice versa.
- Rub palm to palm with the fingers interlaced.
- Rub the backs of fingers to opposing palms with fingers interlocked.
- Use rotational rubbing of the left thumb clasped in the right palm and vice versa.
- Use rotational rubbing, backwards and forwards with clasped fingers of the right hand in the left palm and vice versa.

(Grade D recommendation)

(AGREE rating: Recommend)

How should hands be dried after hand washing?

Wet surfaces transfer microorganisms more readily than dry ones, it is therefore vitally important that healthcare workers dry their hands after hand washing. Furthermore, failure to adequately dry hands can, over time, lead to skin irritation/damage.

- Cloth towels – either roll or hanging type – pose a contamination risk and therefore should not be used in the clinical/hospital setting.
- Air dryers may be unsuitable for use in the clinical setting because they are noisy and may disperse microorganisms via the airborne (aerosol) route.
- Hands should therefore be dried with soft, absorbent, disposable paper towels from a dispenser which is located close to the sink but beyond the risk of splash contamination.

(Grade D recommendation)

(AGREE rating: Recommend)

Soft, absorbent, disposable paper towels should be used to dry each area of the hands thoroughly remembering all of the steps included in the hand washing process. Drying should be achieved by patting dry each part of the hand avoiding rubbing, which may lead to skin irritation/damage.

(Good Practice Point (GPP))

What is the evidence relating to finger nails to enable effective hand washing?

When providing patient care, nails should be kept short and clean and staff should not wear false nails.

(Mandatory)

Finger nails should not exceed $\frac{1}{4}$ inch (approx. 0.5 cm) beyond the end of the finger tip to prevent the accumulation of debris under nails and to facilitate effective hand hygiene.

Artificial nails should not be worn as they inhibit hand hygiene and pose an infection risk.

Nail products should not be worn as chips may harbour bacteria and thus represent an infection risk.

(Grade D recommendation)

(AGREE rating: Recommend)

What is the evidence regarding the wearing of jewellery in the clinical setting?

Jewellery, including wrist watches, bracelets and rings (excluding a plain metal finger ring), should not be worn because it inhibits effective hand washing, may increase bacterial load on the hands and thus pose an infection risk and may interfere with the provision of clinical care.

(Please note that specific recommendations for surgical scrub are included in the surgical hand antisepsis review)

(Mandatory)

What is the evidence regarding the bare below the elbows policy?

The Scottish Government in line with the Department of Health recommendation, and as part of the development of a new national NHSScotland uniform policy, have recommended that clinical staff in NHSScotland should be “bare below the elbows”.

(Mandatory)

Where should hand washing products be placed in the patient care environment?

Liquid soaps and paper towels must be wall mounted and placed near sinks allowing for easy operation.

(Mandatory)

What are the requirements for sink design, provision and types of tap?

Sinks located in the clinical area need to be fit for purpose (e.g. designed to prevent splashing, enable effective cleaning, designed not to have a plug or overflow, include a splash-back).

In healthcare settings mixer taps should be used as high water temperatures are used to control *Legionella* spp.

Mixer taps should be operated either by the persons elbow, wrist, knee or by a sensor.

The cleaning and flushing of non-touch taps should be considered.

The operation of the mixer tap should allow them to be easily turned on and off without recontamination on the operator's hands.

The mixer tap should be placed in such a way that they do not point directly into the sink outlet.

The use of a shallow sink will also cause splashing and therefore should be avoided.

Strainers and anti-splash devices for sink outlets should also not be used as they can become easily contaminated.

In areas where clinical procedures or examinations are undertaken (e.g. outpatients department), the sink should be located close to the procedure.

In intensive care and high dependency units, one sink per bed space is recommended.

Low dependency settings, one sink between six patients is recommended.

Acute, elderly and long-term care settings, one sink between four patients is recommended.

Hand washing facilities should:

- Only be used for the purpose of hand washing.
- NOT be used for disposal of any body fluids.

(Mandatory)

4. Discussion

4.1 Implications for practice

There is a substantial volume of evidence published in the literature which examines hand hygiene, including hand washing in health and social care settings. Specifically, the extant professional literature on hand washing, whilst extensive, is typically in the form of non-systematic reviews, consensus/practice guidelines, expert opinion and low evidence studies.

What is the recommended water temperature for hand washing?

A limited volume of evidence was identified by this review which examines water temperature for hand washing. The identified evidence is consistent in its recommendations that hands should be washed using warm or tepid water because repeated exposure to hot water may lead to the development of dermatitis.¹⁻⁴ There is also consensus in international and national guidance which supports the assertion that hands should be washed in warm water due to the risk of dermatitis associated with repeat exposure to hot water as well as intolerance to cold water.⁵⁻⁸

(Grade D recommendation)

(AGREE rating: Recommend)

Furthermore, it is possible that extremes of water temperature could have a detrimental effect on hand washing compliance of healthcare workers or the rigour of their hand washing technique; although no evidence was identified by this review to support this assertion.

How should hands be washed?

The identified guidance recommends that all cuts and abrasions should be covered with a waterproof dressing before hand hygiene, including hand washing is commenced.⁶

(AGREE rating: Recommend)

There is consensus in the literature regarding the recommended method for hand washing in the healthcare setting, which can be summarised as follows:

- Wet hands under running warm/tepid water: hot water should **not** be used.

- Apply the manufacturers recommended quantity of liquid soap.
- Rub hands together for at least 15 seconds, ensuring all surfaces of the hands are covered.
- Rinse hands well under running water.
- Dry hands thoroughly using a disposable paper towel.
- Turn off the tap using elbow or a paper towel to prevent contamination of clean hands. ^{1-7;9-21}

(Grade D recommendation)

(AGREE rating: Recommend)

What is the correct technique to ensure that all surfaces of the hands are covered during washing?

There is also a less extensive body of evidence which is consistent in its recommendations regarding how all surfaces of the hands should be covered during hand washing. This technique was first outlined by Ayliffe *et al* in the late 1970s ²² and despite the fact that it was not designed for application in clinical practice, there is now consensus across the literature that this technique constitutes best practice. The technique can be summarised thus:

- Rub hands palm to palm.
- Rub right palm over the back of the other hand with interlaced fingers and vice versa.
- Rub palm to palm with the fingers interlaced.
- Rub the backs of fingers to opposing palms with fingers interlocked.
- Use rotational rubbing of the left thumb clasped in the right palm and vice versa.
- Use rotational rubbing, backwards and forwards with clasped fingers of the right hand in the left palm and vice versa. ^{6;7;12;16;20;23;24}

(Grade D recommendation)

(AGREE rating: Recommend)

How should hands be dried after hand washing?

Although a considerable volume of evidence was identified in the extant professional literature relating to hand drying, most of this was in the form of non-systematic reviews, consensus guidelines and low level studies. There is agreement in the literature, that because wet surfaces transfer microorganisms more readily than dry surfaces, thorough hand drying following hand washing is important for healthcare workers.^{4;11;13;25-27} Furthermore, failure to adequately dry hands can, over time, lead to skin damage or irritation.^{11;13;25}

(Grade D recommendation)

(AGREE rating: Recommend)

A limited volume of evidence relating to use of warm air dryers was identified. Three non-systematic reviews concluded that air dryers are unsuitable for hand drying due to proposed dispersal of microorganisms via the airborne route and the potential to increase bacterial counts on hands. In addition, reduced drying efficacy compared to use of paper towels and the potential of being too noisy for use in clinical areas was also reported.^{4;23;25} A number of recent experimental studies also compared various hand drying methods and concluded that air-dryers, in particular high speed air dryers, produced significantly more droplets which were dispersed over a larger area as compared with use of paper towels.²⁸⁻³⁰ Microbial contamination on nearby sampled equipment was also higher following use of air dryers.³⁰ In addition, a randomized prospective study found that hand rubbing during air drying increased bacterial numbers on hands, in comparison to holding hands stationary.³¹ Provision of advice relating to this may be unfeasible in practice. An identified experimental study presented contrasting results relating to air drying; air dryers were found to be comparable with paper towels in relation to hand drying efficiency and dispersal of microorganisms via the airborne route. In addition, use of air dryers did not increase environmental contamination.²⁷ A further study found that there were no statistically significant differences in the efficiency of various hand drying methods (including air drying and use of paper towels) for removing bacteria from washed hands.³²

A degree of risk has been identified in the literature relating to use of air dryers in the clinical setting, therefore they are not recommended for use in NHSScotland.

(Grade D recommendation)

There is a general consensus in the literature relating to the use of disposable paper towels.

A number of studies stipulate that it is important to use paper towels which are soft and absorbent, due to perceived increased acceptability by healthcare workers, prevention of skin irritation/damage and resulting effective drying.^{4;13;25} The physical removal of bacteria from areas of the hands by use of paper towels has also been described in several studies.^{26;31}

Paper towels are also recommended for hand drying by a further review but no detail is provided relating to the properties of towels.²³ The use of paper towels is also recommended in national and international guidelines; recommendations include that good quality paper towels should be used for hand drying⁶ and that towels should be disposable.⁵ It is also recommended that hands should be dried using a method which avoids recontamination and that towels should not be used multiple times or by multiple individuals.⁷

One study concluded that paper towels were found to harbour culturable bacteria, although the majority of bacteria were not transmitted to hands during drying. The authors also stated that bacterial numbers found in the study were unlikely to pose a toxicity risk.³³ Based on the identified evidence, it is recommended that soft, absorbent, disposable paper towels are used across NHSScotland for hand drying following hand washing in the healthcare environment.

In addition, there is consensus that cloth towels (both hanging and roll type), represent a contamination risk and are therefore unsuitable for use in health and social care settings.

1;2;5;13;16;23;25

(Grade D recommendation)

(AGREE rating: Recommend)

What is the recommendation relating to finger nails to enable effective hand washing?

The Scottish Government's Chief Executive Letter CEL42(2010) on dress code across NHSScotland, states that staff should keep their nails short and clean and that they should not wear false/artificial nails when providing patient care.³⁴

This mandatory requirement for NHSScotland healthcare workers is supported by a significant volume of evidence, identified by this review. There is agreement across the literature that nails should be kept short in the healthcare setting,^{6;11;16;18;23;25;35;36} with the specific recommendation that finger nails should not exceed ¼ inch (approximately 0.5 cm) in length beyond the end of

the finger tip.^{1;5-7;9;10;14;15;19} This recommendation is intended to facilitate thorough cleaning underneath finger nails^{1;25} and is in part based on evidence which demonstrates that larger numbers of microorganisms can be found under longer nails when compared to short nails,^{25;36} as well as there being the potential for debris to build up under longer nails.²³ Furthermore, one study suggests that because most microbes are found on or around the finger nails and with long nails having the potential to tear gloves, it is vital that healthcare workers have clean short nails.³⁶ Therefore, in order to help ensure correct and thorough hand hygiene and to mitigate against the potential risks associated with longer nails, healthcare workers across NHSScotland should have short nails which do not exceed $\frac{1}{4}$ inch (approximately 0.5 cm) in length beyond the end of the finger tip.

(Mandatory)

CEL42(2010) also states that NHSScotland healthcare workers should not wear false/artificial nails when providing patient care.³⁴ This mandatory requirement is consistent with the evidence identified from the extant professional literature by this review. National guidelines and several studies state that wearing false/artificial nails of any kind should not be permitted in the healthcare setting.^{1;6;9;10;14;18;19} The evidence suggests that the wearing of artificial nails is inappropriate in the clinical setting due to various demonstrated detrimental effects. These include an increase in subungual (underneath the nail) bacteria¹⁵ and hand microflora^{25;36;37} associated with wear, which is exacerbated by gradual nail lifting at the edges and results in further microbial growth,³⁶ the inefficiency of hand hygiene in comparison to individuals with natural nails as well as the possibility of glove tearing or interference with the donning of gloves.^{36;37} There are also documented outbreaks where the wearing of artificial nails has been identified as a source of infection.³⁸⁻⁴⁰ Therefore NHSScotland healthcare workers should not wear any form of artificial nail as they inhibit hand hygiene and pose an infection risk.

(Mandatory)

The evidence regarding the wearing of nail products (including polish/varnish and gel nails) is unclear, leading to conflicting recommendations in the literature. Some studies and practice recommendations advise that the wearing of nail products should be prohibited in the clinical setting,^{6;8;11;15;25;35;36} as chipped nail products may harbour microorganisms and thus represent

an infection risk.¹¹ Conversely, two studies state that nail products can be worn in clinical areas provided that these are clear and free from chips.^{19;36}

Therefore, because it is acknowledged that chipped nail products may act as a reservoir for microorganisms and thus pose an infection risk, it is recommended that nail products should not be worn by NHSScotland healthcare workers.

(Grade D recommendation)

(AGREE rating: Recommend)

What is the evidence regarding the wearing of jewellery in the clinical setting?

CEL42(2010) states that NHSScotland healthcare workers should not wear any wrist or hand jewellery (other than a plain band) when providing patient care.³⁴ This mandatory requirement for NHSScotland healthcare workers is supported by a moderate volume of evidence identified by this review.

The consensus of the identified literature is that the wearing of jewellery (i.e. rings, watches and/or bracelets) prevents effective hand cleansing.^{6;11;23;36;41} A number of studies report that healthcare workers who wore jewellery, predominantly but not exclusively rings, exhibited greater bacterial counts on their hands, even following hand hygiene.⁴¹⁻⁴⁵ Further studies also suggest that jewellery can harbour microorganisms^{1;36;46} and thus pose an infection risk. It should be noted that plain rings have been shown to harbour lower numbers of bacteria in comparison to ornate rings.⁴⁶ Recommendations from a number of guidance documents state that jewellery should not be worn when providing clinical care^{35;36} or should at least be removed prior to hand hygiene.^{6;25} Furthermore, the practicality of wearing rings in the clinical setting has also been cited as an issue, with a non-systematic review suggesting that wearing rings may make donning gloves more difficult as well as having the potential to breach glove integrity.³⁶

The majority of the evidence identified for this review examines the wearing of rings, however less evidence is available for the wearing of watches or bracelets. A non-systematic review found that wearing a wrist watch prevents effective cleansing of the skin.¹¹

Similarly, a further non-systematic review makes the same assertion; that wearing of jewellery, including watches, inhibits correct hand hygiene.³⁶

One cohort study which examined contamination of hands and wrist watches concluded that wearing a watch does not contribute to higher levels of bacteria on hands unless they are physically manipulated or touched.⁴⁷

In contrast with the majority of studies, the findings of a further recent cohort study demonstrated that the wearing of rings and wrist watches was not associated with higher bacterial counts on the hands of medical staff in comparison with those that did not wear these items.⁴⁸

Based on the majority consensus from the evidence; healthcare workers should not wear jewellery, including wrist watches, bracelets and rings (excluding a plain band), because they inhibit effective hand hygiene and may pose an infection risk.

(Mandatory)

What is the evidence regarding the bare below the elbows policy?

The Department of Health (DH) in England produced guidance on uniforms and work-wear in 2010, which has been interpreted as suggesting that the practice of being “bare below the elbows” should be adopted.⁴⁹ This guidance was based on two systematic literature reviews conducted to assess the microbiological impact of the wearing of uniforms⁵⁰ and public perceptions in relation to uniforms and their associated infection risk,⁵¹ in addition to empirical research into the effective laundering of uniforms.⁵²

The Scottish Government in line with the DH recommendation, and as part of the development of a new national NHSScotland uniform policy, have also recommended that clinical staff in NHSScotland should be “bare below the elbows”.³⁴ In addition, a number of the Royal Colleges have also included the “bare below the elbows” advice within their HAI/infection control policy documents.⁵³⁻⁵⁵

A rapid review of the literature by Health Protection Scotland evaluating the evidence for the policy of being “bare below the elbows”⁵⁶ concluded that there is insufficient evidence to support this policy. A recent cohort study was additionally identified which found that medical staff who were “bare below the elbow” and those that were not did not have significantly different bacterial loads on their hands following hand washing.⁴⁸ The evidence base which currently underpins

the policy is not comprehensive, with the majority of studies being of low level evidence, based on professional opinion or on small scale studies.

(Mandatory)

Where should hand washing products be placed in the patient care environment?

The placement of hand hygiene products is crucial to encourage and assist staff to comply with correct hand hygiene practices.⁷ In terms of liquid soap and disposable paper towels the current NHSScotland guidance states that these must be wall mounted and placed near sinks allowing for easy operation.⁵⁷

(Mandatory)

What are the requirements for sink design, provision and types of tap?

Sink design, provision and types of tap are important factors to consider when making an assessment of hand washing facilities. Health Facilities Scotland guidance⁵⁷ states that sinks located in the clinical area need to be fit for purpose (e.g. designed to prevent splashing, enable effective cleaning, not be able to have a plug or overflow, include a splash-back). This is supported by a recent national practice recommendation.⁸ In addition, in areas where clinical procedures or examinations are undertaken (e.g. outpatients department) the sink should be located close to the procedure.⁵⁷

The adequate provision of sinks in clinical areas is important as this should encourage staff to comply with hand hygiene protocols. In a recent cross-sectional study adequate sink visibility was found to correlate with increased hand washing frequency by healthcare staff.⁵⁸ In addition, a further observational study found that hand hygiene compliance increased following the installation of additional sinks, the design of which focused on increased visibility.⁵⁹ It is recommended that the number of sinks varies dependant on the clinical area.⁵⁷ For example intensive care and high dependency units should ideally have one sink at the front of each bed space, where as for low dependency settings one sink between six patients is recommended. Acute, elderly and long-term care settings should ideally have one sink between four patients. Furthermore it is recommended that sinks used for hand washing should be used solely for this purpose.⁵⁷ The use of hand washing facilities has also been discussed in a DH letter⁶⁰ which

states that hand washing facilities should only be used for the purpose of hand washing; NOT for disposal of any body fluids.

In terms of taps, Health Facilities Scotland guidance⁵⁷ states that both hot and cold running water should be available for employees where they are expected to wash their hands. In healthcare settings mixer taps should be used as high water temperatures are used to control *Legionella* spp. The taps should be operated either by the persons elbow, knee or by a sensor. The operation of the taps should allow them to be easily turned on and off without recontamination of the operator's hands. The use of non-touch taps can aid this, however, there are known issues associated with the cleaning and flushing of these. The placement of the tap is crucial to prevent splashes and contaminated aerosols. It is therefore recommended that taps are placed in such a way that they do not point directly into the sink outlet. In addition, the use of a shallow sink will also cause splashing and therefore should be avoided. Swan-neck tap outlets must not be used due to them not emptying. Strainers and anti-splash devices for sink outlets should also not be used as they can become easily contaminated.

(Mandatory)

4.2 Implications for research

There is an extensive body of literature which examines hand washing in health and social care settings. Much of this literature is in the form of expert opinion and consequently, when assessed, yields a low level of evidence and graded recommendation. Hand washing has been recognised as being central to the prevention and control of infections within the healthcare setting for a considerable period of time and forms the basis of Standard Infection Control Precautions. Therefore, this may explain why the majority of evidence identified by this review is in the form of practice guidelines, non-systematic reviews and small scale studies, as more detailed research is deemed unnecessary. Ethical restrictions would also make it difficult to conduct “higher” quality studies as it would be likely that these could place either healthcare workers or patients at unnecessary risk. Despite this, future research should seek to determine the risk posed by change to the NHScotland (e.g. staff and environment), as well as the implementation of new technologies. These factors may have implications for the prevention and control of infection as well as potentially impacting on facilities and planning and having a wider impact on costs across NHSScotland.

In addition, evidence underpinning the “bare below the elbows” policy needs to be re-evaluated and updated. Specifically, robust research assessing the potential impact of cross-contamination from healthcare workers clothing is necessary. In addition, studies examining the opinions of a representative sample of all healthcare workers and patients towards the “bare below the elbows” policy, preferably at a UK level would also be beneficial.

5. References

- (1) Bjerke NB. The evolution: Handwashing to hand hygiene guidance. *Critical Care Nursing Quarterly* 2004 Jul;27(3):Jul.
- (2) Katz JD, Katz JD. Hand washing and hand disinfection: more than your mother taught you. *Anesthesiology Clinics of North America* 2004 Sep 20;22(3):457-71.
- (3) McConnell EA. Clinical do's & don'ts. Proper hand-washing technique. *Nursing* 1999 Apr;29(4):26.
- (4) Ward D. Clinical. Handwashing facilities in the clinical area: a literature review. *British Journal of Nursing (BJN)* 2000 Jan 27;9(2):82-6.
- (5) Boyce JM, Pittet D, Healthcare Infection Control Practices Advisory Committee. Society for Healthcare Epidemiology of America. Association for Professionals in Infection Control. Infectious Diseases Society of America. Hand Hygiene Task Force., Boyce JM, Pittet D, Healthcare Infection Control Practices Advisory Committee. Society for Healthcare Epidemiology of America. Association for Professionals in Infection Control. Infectious Diseases Society of America. Hand Hygiene Task Force. Guideline for Hand Hygiene in Health-Care Settings: recommendations of the Healthcare Infection Control Practices Advisory Committee and the HICPAC/SHEA/APIC/IDSA Hand Hygiene Task Force. *INFECT CONTROL HOSP EPIDEMIOL* 2002 Dec;23(12 Suppl):S3-40.
- (6) Loveday HP, Wilson JA, Pratt RJ, Golsorkhi M, Tingle A, Bak A, et al. epic3: national evidence-based guidelines for preventing healthcare-associated infections in NHS hospitals in England. *J HOSP INFECT* 2014 Jan;86:Suppl-70.
- (7) World Health Organization. WHO guidelines on hand hygiene in health care: first global patient safety challenge clean care is safer care. Geneva: WHO; 2009.
- (8) Ellingson K, Haas JP, Aiello AE, Kusek L, Maragakis LL, Olmsted RN, et al. Strategies to prevent healthcare-associated infections through hand hygiene. *Infection Control and Hospital Epidemiology* 2014;35(SUPPL2):2014.
- (9) How to keep your hands clean. *Hospital Employee Health* 2007 Mar;26(3):31.
- (10) Alspach G. Protecting your patients, colleagues, family, and yourself from infection: first wash. *Critical Care Nurse* 2008 Feb;28(1):7-12.
- (11) Dryer LN. Clean hands: protocol for maintaining proper hand hygiene. *RDH* 2010 Mar;30(3):62.
- (12) Gould D. Hand hygiene technique. *NURS STAND* 2008 30 Apr. 22(34).
- (13) Gould D, Gould D. Hand decontamination. *NURS STAND* 2000;15(6):45-50.
- (14) Houghton D. HAI prevention: the power is in your hands. *Nursing Management* 2008 Jun 2;1-8.
- (15) Hughes NL. Health & safety. Handwashing: going back to basics in infection control. *American Journal of Nursing* 2006 Jul;106(7):96.
- (16) Kovach TL. Freedom from the chain of septic flow: hand washing in infection control. *J PRACT NURS* 2005 Dec;55(4):10-5.
- (17) Morrissey E. A "handy" PR tip: appropriate handwashing isn't just good infection control, it's good marketing. *Modern Hygienist* 2009 Oct;5(5):20-1.
- (18) Peate I. Body fluids, part 1: infection control. *Br J Healthcare Assistants* 2008;2(1):6-10.

- (19) Sandlin D. Did You Wash Your Hands? campaign. *J Perianesthesia Nursing* 2007;22(2):139-41.
- (20) Pan S-C, Chen E, Tien K-L, Hung I-C, Sheng W-H, Chen Y-C, et al. Assessing the thoroughness of hand hygiene: "Seeing is believing". *AM J INFECT CONTROL* 2014;42(7):July.
- (21) Griffith CJM. Environmental surface cleanliness and the potential for contamination during handwashing. *AM J INFECT CONTROL* 2003 Apr;31(2):Apr.
- (22) Ayliffe GA, Babb JR, Quoraishi AH. A test for 'hygienic' hand disinfection. *Journal of Clinical Pathology* 1978 Oct;31(10):923-8.
- (23) Parker LJ. Importance of handwashing in the prevention of cross-infection. *British Journal of Nursing (BJN)* 1999 Jun 10;8(11):716.
- (24) Pinney E. Back to basics. Hand washing. *British Journal of Perioperative Nursing* 2000 Jun;10(6):328-31.
- (25) Jumaa PA. Hand hygiene: simple and complex. [Review] [113 refs]. *International Journal of Infectious Diseases* 2005 Jan;9(1):3-14.
- (26) Snelling AM, Saville T, Stevens D, Beggs CB. Comparative evaluation of the hygienic efficacy of an ultra-rapid hand dryer vs conventional warm air hand dryers. *J Appl Microbiol* 2010;doi: 10.1111/j.1365-2672.2010.04838.x.
- (27) Taylor JH, Brown KL, Toivenen J, Holah JT, Taylor JH, Brown KL, et al. A microbiological evaluation of warm air hand driers with respect to hand hygiene and the washroom environment. *J Appl Microbiol* 2000 Dec;89(6):910-9.
- (28) Best EL, Redway K. Comparison of different hand-drying methods: The potential for airborne microbe dispersal and contamination. *J HOSP INFECT* 2015;89(3):01.
- (29) Best EL, Parnell P, Wilcox MH. Microbiological comparison of hand-drying methods: The potential for contamination of the environment, user, and bystander. *J HOSP INFECT* 2014;88(4):01.
- (30) Margas E, Maguire E, Berland CR, Welander F, Holah JT. Assessment of the environmental microbiological cross contamination following hand drying with paper hand towels or an air blade dryer. *J Appl Microbiol* 2013;115(2):August.
- (31) Yamamoto Y, Ugai K, Takahashi Y, Yamamoto Y, Ugai K, Takahashi Y. Efficiency of hand drying for removing bacteria from washed hands: comparison of paper towel drying with warm air drying. *INFECT CONTROL HOSP EPIDEMIOL* 2005 Mar;26(3):316-20.
- (32) Gustafson DR, Vetter EA, Larson DR, Ilstrup DM, Maker MD, Thompson RL, et al. Effects of 4 hand-drying methods for removing bacteria from washed hands: a randomized trial. *Mayo Clinic Proceedings* 2000 Jul;75(7):705-8.
- (33) Gendron LM, Trudel L, Moineau S, Duchaine C. Evaluation of bacterial contaminants found on unused paper towels and possible postcontamination after handwashing: a pilot study. *AM J INFECT CONTROL* 2012 Mar;40(2):e5-e9.
- (34) National uniform policy, dress code and laundering policy CEL 42 (2010). Edinburgh: The Scottish Government; 2010.
- (35) Pellowe C. How to wash your hands. *Midwives* 2008 Aug/Sep. 11(4).
- (36) Ward DJ. Hand adornment and infection control. *Br J Nurs* 2007 Jun 14;16(11):654-6.
- (37) McNeil SA, Foster CL, Hedderwick SA, Kauffman CA. Effect of hand cleansing with antimicrobial soap or alcohol-based gel on microbial colonization of artificial fingernails worn by health care workers. *Clin Infect Dis* 2001 Feb 1;32(3):367-72.

- (38) Foca M, Jakob K, Whittier S, Latta PD, Factor S, Rubenstein D, et al. Endemic *Pseudomonas aeruginosa* infection in a neonatal intensive care unit. *New England Journal of Medicine* 343, 695-700. 2000.
- (39) Gordin FM, Schultz ME, Huber R, Zubairi S, Stock F, Kariyil J. A cluster of hemodialysis-related bacteremia linked to artificial fingernails. *INFECT CONTROL HOSP EPIDEMIOL* 2007 Jun;28(6):743-4.
- (40) Gupta A, Della-Latta P, Todd B, San GP, Haas J, Wu F, et al. Outbreak of extended-spectrum beta-lactamase-producing *Klebsiella pneumoniae* in a neonatal intensive care unit linked to artificial nails. *INFECT CONTROL HOSP EPIDEMIOL* 2004 Mar;25(3):210-5.
- (41) Alp E, Haverkate D, Voss A. Hand hygiene among laboratory workers. *INFECT CONTROL HOSP EPIDEMIOL* 2006 Sep;27(9):978-80.
- (42) Chugh Y, Baliga S. Semmelweis's forgotten gift: Has handwashing lost its importance? *Journal of Clinical and Diagnostic Research* 2013;7(3):2013.
- (43) Trick WE, Vernon MO, Hayes RA, Nathan C, Rice TW, Peterson BJ, et al. Impact of ring wearing on hand contamination and comparison of hand hygiene agents in a hospital. *Clin Infect Dis* 2003 Jun 1;36(11):1383-90.
- (44) Yildirim I. A prospective comparative study of the relationship between different types of ring and microbial hand colonization among pediatric intensive care unit nurses. *International Journal of Nursing Studies*. 45[11], 1572-1576. 2008.
- (45) Fagernes M, Lingaas E. Impact of finger rings on transmission of bacteria during hand contact. *INFECT CONTROL HOSP EPIDEMIOL* 2009;30(5):427-32.
- (46) Fagernes M, Nord R. A study of microbial load of different types of finger rings worn by healthcare personnel. *Nordic Journal of Nursing Research & Clinical Studies / V+Ñrd i Norden* 2007 Jun;27(2):21-4.
- (47) Jeans AR, Moore J, Nicol C, Bates C, Read RC. Wristwatch use and hospital-acquired infection. *J HOSP INFECT* 2010;74(1):January.
- (48) Burger A, Wijewardena C, Clayson S, Greatorex RA. Bare below elbows: Does this policy affect handwashing efficacy and reduce bacterial colonisation? *Ann R Coll Surg Engl* 2011;93(1):January.
- (49) Jones, E. Uniforms and workwear: guidance on uniform and workwear policies for NHS employers. Department of Health; 2010
- (50) Wilson JA, Loveday HP, Hoffman PN, Pratt RJ. Uniform: an evidence review of the microbiological significance of uniforms and uniform policy in the prevention and control of healthcare-associated infections. Report to the Department of Health (England). *J HOSP INFECT* 2007 Aug;66(4):301-7.
- (51) Loveday HP, Wilson JA, Hoffman PN, Pratt RJ. Public perception and the social and microbiological significance of uniforms in the prevention and control of healthcare-associated infections: an evidence review [corrected] [published erratum appears in *BR J INFECT CONTROL* 2008 Mar;9(2):27]. *British Journal of Infection Control* 2007 Sep;8(4):10-21.
- (52) University College London Hospital. 2007.
- (53) Healthcare acquired infections: Policy position. The Royal College of Surgeons of England Policy Unit; 2008 <http://www.rcseng.ac.uk/publications/docs/healthcare-acquired-infections-policy-position>

-
- (54) Guidance on uniforms and work wear. Royal College of Nursing; 2009
http://www.rcn.org.uk/_data/assets/pdf_file/0010/78652/002724.pdf
- (55) Common Competences Framework for Doctors. Academy of Medical Royal Colleges; 2009
<http://www.aomrc.org.uk/aomrc/admin/news/docs/CCFD-August-2009.pdf>
- (56) Health Protection Scotland. SBAR - An evaluation of the available evidence to support the Hand Hygiene "bare below the elbows" policy. 2010.
- (57) Health Facilities Scotland. SHFN 30 Part A: Manual Information for Design Teams, Construction Teams, Estates & Facilities and Infection Prevention & Control Teams. HFS; 2014
- (58) Cloutman-Green E, Kalaycioglu O, Wojani H, Hartley JC, Guillas S, Malone D, et al. The important role of sink location in handwashing compliance and microbial sink contamination. AM J INFECT CONTROL 2014 May;42(5):554-5.
- (59) Zellmer C, Blakney R, Van Hoof S, Safdar N. Impact of sink location on hand hygiene compliance for Clostridium difficile infection. AM J INFECT CONTROL 2015 Apr;43(4):387-9.
- (60) Water Sources and Potential for Infection from Taps and Sinks. Department of Health 2010 August 27 [cited 2011 Jan 27]; Available from: URL:
http://www.dh.gov.uk/en/Publicationsandstatistics/Lettersandcirculars/Dearcolleagueletters/DH_119169