

Why you should read this article:

- To learn methods of improving compliance with hand hygiene measures
- To understand when it is appropriate to use soap or alcohol for hand hygiene
- To be reminded of the correct technique for undertaking hand hygiene

Using effective hand hygiene practice to prevent and control infection

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Abstract

Decontamination using hand hygiene remains one of the most important and effective methods for reducing healthcare-associated infections and cross-infection between patients. In 1860, Florence Nightingale wrote that nurses should wash their hands frequently throughout the day, demonstrating an early awareness of the effectiveness of this simple procedure. The COVID-19 pandemic has demonstrated that effectively applied hand hygiene is a vital intervention that can be used to prevent the spread of disease. This article details the correct procedure required for effective hand hygiene and emphasises the need for nurses to keep up to date with evidence-based guidelines. The article also outlines the differences between hand decontamination using alcohol-based hand gels and soap and water, and the complex factors that can interfere with effective hand hygiene compliance.

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Keywords

clinical, environment, hand hygiene, health promotion, infection, infection control, pandemic, public health

The COVID-19 pandemic has emphasised the importance of optimal hand hygiene practice to reduce cross-contamination and the spread of the SARS-CoV-2 virus that causes the disease (World Health Organization (WHO) 2020a). During circumstances that present a threat to public health, it is important that nurses across the globe adhere to their professional codes of conduct. This involves nurses acting as role models for their peers and the public with regard to clinical behaviours such as hand hygiene and demonstrating how to consider clinical evidence and deliver best practice, rather than following anecdotal information. In the UK, the 'promote professionalism and trust' standard in The Code: Professional Standards of Practice and Behaviour for Nurses, Midwives and Nursing Associates (Nursing and Midwifery Council (NMC) 2018) states that nurses should 'act as a role model of professional behaviour for students and newly qualified nurses, midwives and nursing associates to aspire to'.

In healthcare, the use of effective hand hygiene practice to prevent healthcare-associated infections, cross-infection and reduce the spread

of antimicrobial resistance has been common practice for many years (Pires and Pittet 2017). Nightingale (1860) called on nurses to wash their hands and faces frequently throughout the day, reflecting a long-standing recognition of the effectiveness of hand hygiene. Compliance with hand hygiene practices has improved in recent years due, in part, to effective role modelling and peer pressure, with increased research into the technique's effectiveness (Pires and Pittet 2017).

There are several important issues which, when understood, will enable nurses to undertake and promote effective hand hygiene. For example, the importance of hand hygiene in reducing cross-infection; the technique itself, which includes the choice of the optimal hand hygiene solution, such as soap and water, or alcohol-based hand gel; and the factors that can limit compliance with hand hygiene, for example, allergies to soap products.

Improving compliance

In nursing, so-called 'slips' and 'lapses' are linked to skill-based errors and take place, for example, when a piece of equipment or a medicine is

omitted, or a step in a procedure, such as part of a medicine equation, is missed. Errors are more likely to happen when tasks become familiar and require little conscious thought. Mistakes occur when the nurse is not consciously paying attention to the task and are more likely to be related to a lack of knowledge (knowledge-based errors), application of an incorrect rule, or incorrect application of a rule (rule-based errors) (Carayon 2012, Gluyas 2015).

Gluyas (2015) examined hand hygiene compliance from the perspective of human factors, which include interactions between people's cognitive processes and their actions, the environment they are working in, and the tools they are using. This knowledge can provide an improved understanding of errors, as well as identifying strategies that will reduce them (Gluyas 2015). Suboptimal hand hygiene compliance can also occur through violations of accepted practice, where a healthcare worker deliberately decides not to follow procedures or requirements (Seo et al 2019). This differs from slips, lapses and mistakes in that departures from procedures and protocols are deliberate choices. Gluyas (2015) suggested that the decision to violate rules or protocols is primarily associated with an intention to complete tasks in the most efficient manner and that resulting errors and any subsequent harm are not intended. Time pressures and the environment may have a role in infection control violations, for example where the lack of a nearby sink means a healthcare worker may not wash their hands before attending to a patient in an emergency.

Gluyas (2015) noted that there is a risk that nurses can begin to focus on clinical activities and forget to undertake hand hygiene practice, even when there is time available. However, when hand hygiene is considered using human factors rather than a punitive approach that regards nurses' mistakes as aberrant or negligent, the environment can be adapted to reduce the effect of those factors. Adapting the environment includes the provision of education regarding when hand hygiene practice must be applied.

Gluyas (2015) further suggested that sustained improvement in hand hygiene practices have been inconsistent but, where they have been successful, a combination of approaches has been involved. These approaches include: effective role modelling of optimal practice; peer pressure where non-compliance has become routine; and an emphasis on the importance of leadership, commitment and provision of resources. The availability of equipment such as running water, soap and alcohol-based hand gel at the point of care and a clear space to store healthcare staff's belongings such as lockers for nurses to put their non-uniform clothes and bags are also crucial to sustained improvement in hand hygiene practices.

In any healthcare organisation, Burnett (2018) stated that leadership is crucial when developing, implementing and evaluating effective infection prevention and control measures. The purpose of effective leadership in infection prevention and control is to reduce the risks of healthcare-associated infection, particularly those caused by antimicrobial resistant organisms, and to achieve continuous quality improvement (Gould et al 2016, Burnett 2018).

Burnett (2018) raised two important points in relation to infection control, which can be related to hand hygiene. One is the need for an effective leader to improve competence where necessary by developing a non-punitive culture. Encouraging an open learning culture where staff feel comfortable to raise any challenges involved in undertaking effective hand hygiene – particularly related to human factors such as errors and omissions – can prevent issues being hidden and suboptimal practice being maintained. Second, the effectiveness of any infection prevention control and prevention strategy depends on the efforts of the whole multidisciplinary team and should not rely solely on the leader (Burnett 2018).

When to undertake hand hygiene

In attempting to understand when it is necessary to undertake hand

hygiene, nurses should follow local policy and keep up to date with best practice guidelines. There are five main moments when healthcare workers, such as nurses, should undertake hand hygiene during clinical care (WHO 2009b):

- » Before touching a patient.
- » Before undertaking aseptic procedures.
- » After exposure or risk of exposure to bodily fluids.
- » After touching a patient.
- » After touching a patient's surroundings.

These factors support other guidelines such as those by Loveday et al (2014), who defined touching a patient as 'each episode of direct patient contact or care'. In addition, Loveday et al (2014) stipulated that hand hygiene must occur after the removal of clinical gloves, although wearing gloves should never replace optimal hand hygiene. Gloves are reserved for specific activities such as invasive procedures, contact with sterile sites or non-intact skin and mucous membranes, handling contaminated devices, and for activities assessed as carrying a risk of exposure to blood or bodily fluids (Loveday et al 2014). Gloves are therefore generally not worn for administering injections; rather, the nurse should follow optimal hand hygiene practice.

Hand hygiene in clinical practice

During clinical practice and when in contact with patients, healthcare staff should ensure their clothing does not extend below the elbow and many local guidelines suggest that jewellery should be limited to one plain single-band wedding ring. Any cuts or breaks in the skin should be covered with a water-resistant dressing. Nails should be short and clean, with no varnish or artificial additions. Some small-scale observational studies have demonstrated that wearing rings and false nails is associated with increased carriage of microorganisms and, in some cases, linked to the carriage of outbreak strains (Loveday et al 2014).

Healthcare staff should have ready access to a sink with warm water for washing hands using

soap and water. This is not required when using alcohol-based hand gel. Soap should be obtained from a liquid dispenser – not from a bar of soap, which can harbour germs – or alcohol-based hand gel should be used. Moisturiser, which is not required when using alcohol-based hand gel, and paper towels, which can be disposed of, should be available when using soap and water.

Where access to appropriate equipment is limited, such as when the nearest sink is located some distance away or there is a lack of readily available alcohol-based hand gel, it could be argued that there is a risk that compliance with hand hygiene will be omitted, particularly in a time-pressured environment. WHO (2020b) noted that the availability of alcohol-based hand gel increases the likelihood of compliance with hand hygiene. Healthcare staff now frequently carry a small hand gel dispenser with them for this reason.

Soap and water or alcohol-based hand gel

The use of soap and water and alcohol-based hand gel are both effective hand hygiene methods, although each has limitations. It is important for nurses to follow local and national best-practice guidelines so they are aware of the circumstances in which each method is effective.

Loveday et al (2014) noted that alcohol-based hand gel can be used for decontamination of the hands before and after direct patient contact and clinical care, except in some situations when soap and water must be used. These situations include when the hands are visibly soiled or potentially contaminated with body fluids and when caring for patients with vomiting or diarrhoeal illnesses, regardless of whether or not gloves have been worn. One reason that it is important to use soap and water when caring for patients with a diarrhoeal illness is that alcohol-based hand gel is ineffective against *Clostridium difficile* spores. Therefore, the use of soap and water is a vital component of hand hygiene interventions in *C. difficile* infection (Barker et al 2017, Loftus et al 2019). As it can

sometimes be unclear initially whether patients with a diarrhoeal illness have a *C. difficile* infection, it is prudent to use soap and water for hand hygiene practice at the outset in these patients.

Although alcohol-based hand gel is effective in reducing the spread of infection of Gram-negative and Gram-positive bacteria, it is less effective against some non-enveloped viruses such as rotavirus and norovirus and is dependent on the alcohol concentration of the gel (Kampf 2018). In cases of actual or suspected norovirus, healthcare staff should follow local policy and washing the hands with soap and water is generally recommended, with alcohol-based hand gel used as an additional safety measure. The efficacy of alcohol-based hand gel against norovirus varies according to the type and concentration of alcohol in the formulation, with a minimum 60% concentration of ethanol required for effectiveness (Kampf 2018, WHO 2020b). Research on the use of alcohol-based hand gel in the management of COVID-19 is increasing, with guidance recommending a concentration of at least 60% ethanol (Centers for Disease Control and Prevention 2020).

When the hands are visibly clean and nurses have not been exposed to patients presenting with *C. difficile* or diarrhoea of unknown origin, alcohol-based hand gel with 70% ethanol content is more effective at cleansing the hands and reducing the spread of infection compared with soap and water alone (Turner et al 2010).

Handwashing with soap and water

When the hands are washed using soap and water, it is not the soap and/or water alone that disrupts the microorganisms. It is also important that healthcare staff understand that the mechanical process of handwashing assists in the removal of contaminants from the hands. This effect combined with that of the warm water, promotes the opening of the pores in the skin of the hands and lower arms, aiding microorganism removal (Wilkinson and Treas 2010).

When handwashing with soap and water, healthcare staff should

Key points

- The COVID-19 pandemic has emphasised the importance of optimal hand hygiene practice
- With regards to optimal hand hygiene, nurses should follow local policy and keep up to date with best practice guidelines
- There is a risk that nurses may focus on clinical activities and forget to decontaminate their hands
- Nurses should decontaminate their hands before touching a patient, after touching a patient, after touching a patient's surroundings, before undertaking aseptic procedures and after exposure to bodily fluids

follow local hand hygiene protocols, although the principles will reflect those listed below. Before commencing handwashing, the hands and wrists need to be fully exposed and should be free from jewellery and any long-sleeved clothing (Loveday et al 2014). The procedure for handwashing with soap and water is as follows:

- » Turn on the taps at the sink using the elbows, or foot pedals if provided. Check that the water is at a comfortable warm temperature and soak the hands thoroughly from the tips of fingers to the lower forearms.
- » Dispense one to two applications of liquid soap into the palm of the hand.
- » Rub the hands together to create a lather – this should take approximately ten seconds.
- » Follow handwashing stages 2-7 of the WHO (2009a) guidance, as outlined in Figure 1.
- » Rinse the hands thoroughly using water only, ensuring that all soap is removed from the hands and lower arms.
- » Turn off the taps using the elbows, or foot pedals if provided. Alternatively, use a clean paper towel to turn off the taps. Do not use the hands.
- » Dry the hands and lower arms using a clean paper towel, and dispose of the used towel in accordance with local policy.
- » If the skin on the hands is

noticeably dry, a hand moisturiser from a wall-mounted dispenser can be applied sparingly until absorbed. The whole procedure should take 40-60 seconds (WHO 2009a). After handwashing using soap and water, nurses should dry their hands thoroughly. This is because the spread of microorganisms is more likely when the nurse's hands are warm and moist, creating ideal conditions for microbial growth (Huang et al 2012). Evidence also suggests that the use of soap and water together is more effective compared with using water alone (Burton et al 2011).

Hand cleansing using alcohol-based hand gel

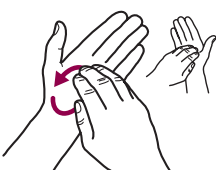
Alcohol-based hand gel works by lysing (the process of breaking down the cell membrane) and denaturing the cells of microorganisms, reducing microbial contamination on the hands to low levels.

Before commencing hand hygiene with alcohol-based hand gel, the hands and wrists need to be fully exposed and therefore should be free from jewellery and any long-sleeved clothing (Loveday et al 2014). The procedure for hand cleansing using alcohol-based hand gel is as follows:

- » Apply a palmful of alcohol-based hand gel to the hands.
- » Rub hands together, ensuring that the gel is spread all over hands, fingers and lower arms.
- » Follow hand-cleansing stages 2-7 of the WHO (2009a) guidance, as outlined in Figure 2.
- » Ensure hands are dry and that no gel residue remains on the hands or lower arms. If there is residue, repeat the stages shown in Figure 2 until the hands and lower arms are dry.
- » Moisturiser should not be required after using alcohol-based hand gel, because these preparations often contain

Figure 1. Handwashing steps using soap and water

 Duration of the entire procedure: 40-60 seconds

<p>0</p>  <p>Wet hands with water</p>	<p>1</p>  <p>Apply enough soap to cover all hand surfaces</p>	<p>2</p>  <p>Rub hands palm to palm</p>
<p>3</p>  <p>Right palm over left dorsum with interlaced fingers and vice versa</p>	<p>4</p>  <p>Palm to palm with fingers interlaced</p>	<p>5</p>  <p>Backs of fingers to opposing palms with fingers interlocked</p>
<p>6</p>  <p>Rotational rubbing of left thumb clasped in right palm and vice versa</p>	<p>7</p>  <p>Rotational rubbing, backwards and forwards with clasped fingers of right hand in left palm and vice versa</p>	<p>8</p>  <p>Rinse hands with water</p>
<p>9</p>  <p>Dry hands thoroughly with a single use towel</p>	<p>10</p>  <p>Use towel to turn off faucet</p>	<p>11</p>  <p>Your hands are now safe</p>

(Adapted from World Health Organization 2009a)

emollients to prevent dry skin. However, healthcare staff can check the ingredients of the gel to verify the presence of an emollient.

Evidence base

Duration

Wong and Lee (2019) noted that there is a lack of empirical evidence concerning the optimal duration of handwashing for the general public. For healthcare staff, a minimum handwashing duration of 20 seconds is recommended across the guidance (WHO 2009a, 2020b). In the UK, the author recommends that healthcare staff

could use a technique such as singing the ‘happy birthday’ song to themselves while they undertake handwashing, which equates to approximately 20 seconds. Importantly, following the process of decontamination with soap and water or alcohol-based hand gel advocated in the WHO (2009a) guidance, healthcare staff should ensure that they pay attention to areas of the hands that are commonly missed. While these areas vary across the literature, they include the finger tips, the palm of the hands, the back of the hands, the thumbs and the wrists (Wong and Lee 2019).

Cultural considerations

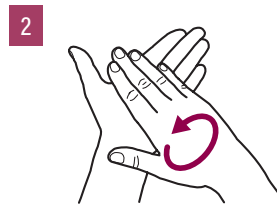
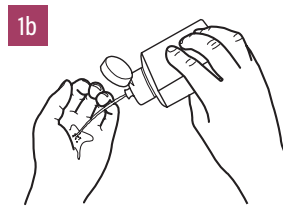
It is important to remember that during the continued emphasis on effective hand hygiene associated with the COVID-19 pandemic, people from some cultures and religions may prefer not to use alcohol-based products (Loftus et al 2019). While this preference needs to be sensitively addressed by healthcare staff, recent research has suggested that culturally-specific interventions – such as involving religious groups in planning guidelines and careful use of terminology related to alcohol (WHO 2009b) – could significantly improve compliance and beliefs

Figure 2. Hand decontamination steps using alcohol-based hand gel

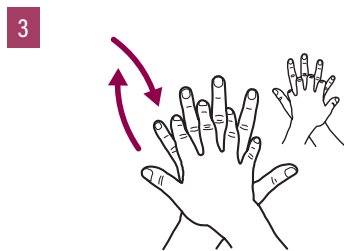
 Duration of the entire procedure: 20-30 seconds



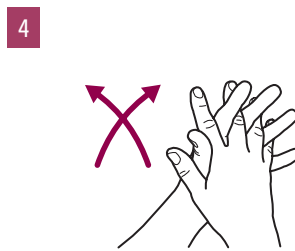
Apply a palmful of the product in a cupped hand, covering all surfaces



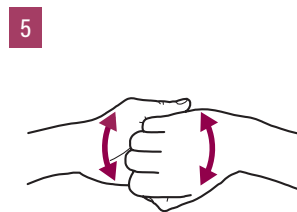
Rub hands palm to palm



Right palm over left dorsum with interlaced fingers and vice versa



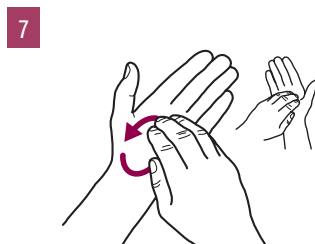
Palm to palm with fingers interlaced



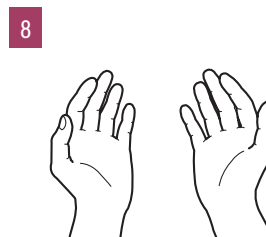
Backs of fingers to opposing palms with fingers interlocked



Rotational rubbing of left thumb clasped in right palm and vice versa



Rotational rubbing, backwards and forwards with clasped fingers of right hand in left palm and vice versa



Once dry, your hands are safe

(Adapted from World Health Organization 2009a)

concerning the use of alcohol-based hand gel in people from countries such as the United Arab Emirates (Ng et al 2019). More research is required in this area.

WHO (2009b) has noted that there are various interpretations concerning alcohol prohibition among various religions, and among people with the same religious affiliation. According to some faiths, using alcohol-based hand gels does not present an issue. In general, those religions that observe alcohol prohibition in everyday life demonstrate a pragmatic attitude to the use of alcohol-based hand

gels, accepting the importance of optimal patient care (WHO 2009b). It would also be overly simplistic to conclude that religious and cultural aspects of hand hygiene focus purely on alcohol. This is a wider topic and incorporates other areas such as the concept of 'dirty hands', which may be linked to beliefs around purity, and the inclusion of handwashing in religious practice.

Conclusion

Effective hand hygiene practice remains one of the most useful tools in the prevention of healthcare-associated infections,

cross-infection and the spread of antimicrobial resistance. The subject of handwashing is a deceptively complex issue and compliance is affected by a range of factors, including accurate knowledge, the correct decontamination technique, human factors, the environment and effective leadership.

The COVID-19 pandemic has emphasised the importance of effective hand hygiene practice. However, it is important to stress that healthcare staff should maintain hand hygiene standards at all times, not simply during challenging circumstances.

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