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Clinical Practice
Infection prevention
Hand hygiene

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In this article...

- The latest findings on the effective application of alcohol-based hand rubs
- Nurses' crucial role in improving hand hygiene in healthcare
- The challenges with the appropriate use of alcohol-based hand rub

Best practices for effective hand hygiene using alcohol-based hand rubs

Key points

Hand hygiene is a critical intervention for preventing the transmission of microorganisms

The six-step technique effectively reduces bacterial load but compliance in practice is low

A palmful of alcohol-based hand rub should be applied to all hand surfaces for at least 20 seconds

World Health Organization's hand hygiene research agenda emphasises access, technique and product efficacy in hand hygiene

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Abstract Correct hand hygiene, performed at the right time and using appropriate technique, is essential for preventing healthcare-associated infections. This article discusses current evidence on the effective application of alcohol-based hand rubs, including the optimal application technique, the volume of alcohol-based hand rub, and hand-rubbing duration. It also highlights the key role of nurses in promoting and sustaining effective hand hygiene practices. By understanding evidence-based protocols, nurses can improve hand hygiene compliance, reinforce patient safety, and lead initiatives aligned with global infection control standards.

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Hand hygiene is a critical public health intervention aimed at preventing the transmission of microorganisms, including those responsible for healthcare-associated infections (HCAIs) (World Health Organization (WHO), 2009). Despite its importance, the absence of correct hand hygiene at critical moments during care delivery remains a significant health behaviour problem (Lotfinejad et al, 2021). To remove some of the behavioural barriers and improve compliance with hand hygiene, a reliable and uninterrupted provision of alcohol-based hand rubs (ABHR) at the point of care is needed, along with a continuous supply of clean water, soap, single-use towels, and an adequate number of functioning sinks (Afework and Tamene, 2025).

Hand hygiene research, training, audits and improvement initiatives often focus on improving compliance with hand hygiene opportunities (Clancy et al, 2021; Price et al, 2018). These opportunities are defined by the WHO as the 'Five Moments for Hand Hygiene', which provide specific guidance on when hand hygiene should be performed:

- Before touching a patient;
- Before a clean or aseptic procedure;
- After body fluid exposure risk;
- After touching a patient;
- After touching a patient's surroundings (WHO, 2009).

While the timing of performing hand hygiene is crucial, it is equally important to recognise that, for hand hygiene to be effective in breaking the chain of infection, it needs to be performed in the correct way, and compliance with both hand hygiene opportunities and correct ABHR application techniques are essential for optimal infection prevention (Lotfinejad et al, 2021).

Such aspects of improving hand hygiene are covered in the WHO's 'multimodal hand hygiene improvement strategy', which features five key elements:

- System change;
- Training and education;
- Monitoring and feedback;
- Reminders and communication;
- A culture of safety (WHO, 2009).

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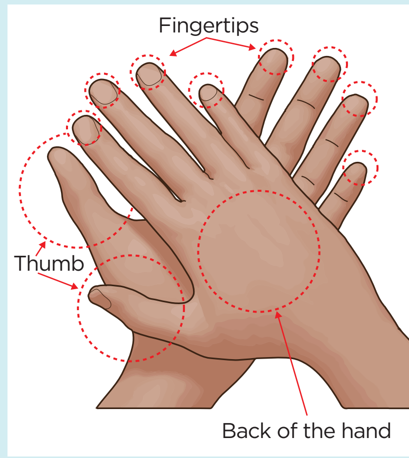
Fig 1. **Commonly missed areas during hand hygiene**



System change focuses on achieving a continuous availability of the necessary infrastructure, materials and equipment to effectively perform hand hygiene at the point of patient care (WHO, 2009). This approach highlights that achieving reliable and uninterrupted provisions of ABHR, as well as its use within busy clinical settings, can be more complex than it first appears.

Although hand hygiene can be performed using either soap and water or ABHR, this article focuses on ABHR because its introduction in healthcare has transformed hand hygiene practices at the point of care, driving substantial improvements in behaviour and practices on a global scale (Lotfinejad et al, 2021). Hand rubbing with ABHR is a preferred method in most clinical situations, due to its ease of use, effectiveness and accessibility at the point of care (Vermeil et al, 2019; WHO, 2009). However, for hand rubbing to be effective, it needs to be performed in the correct way.

Given the critical nature of correct hand hygiene and the effective use of ABHR, this article explores the current evidence on best practices for ABHR application and the key role of nurses in ensuring and improving hand hygiene. By examining evidence-based practices, nurses can contribute to more effective hand hygiene protocols, improved hand hygiene actions at the right times, and, ultimately, enhanced patient safety in healthcare environments.

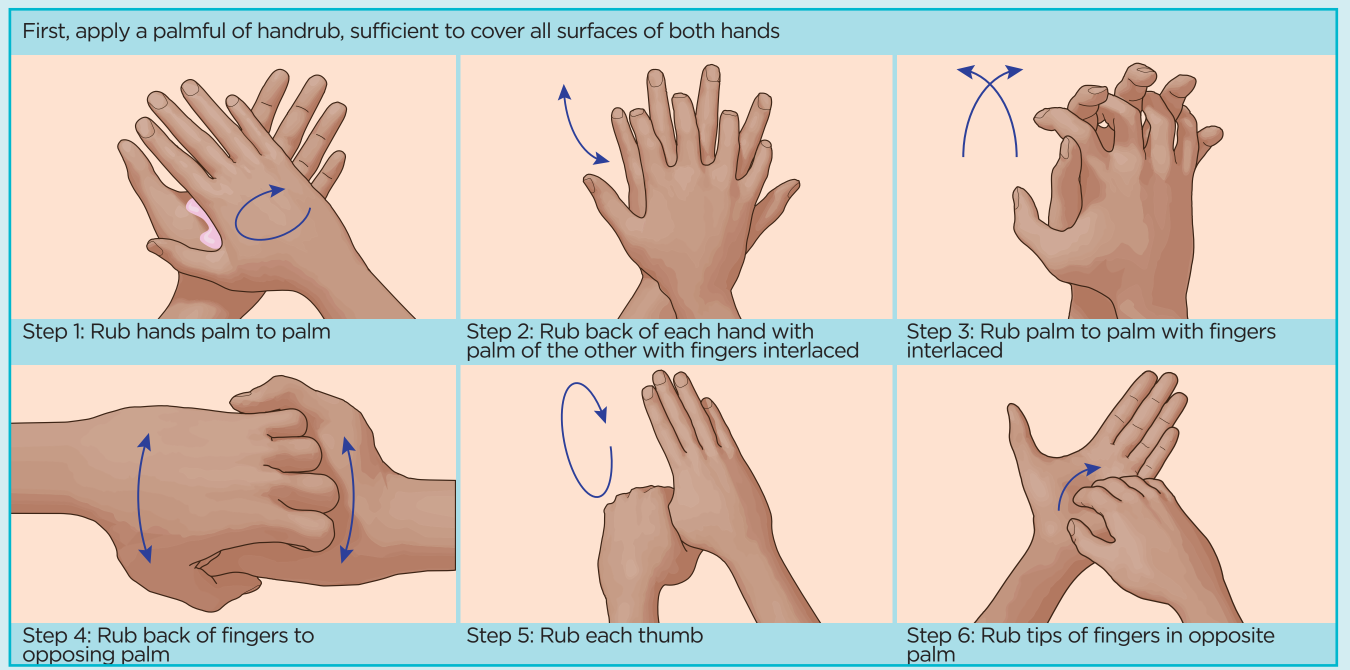
Hand hygiene technique

Hand hygiene technique can be defined as a structured approach to applying hand hygiene products, involving defined steps, which help ensure that all surfaces of both hands are covered with the product. Optimal coverage is important, because missed areas on hands could remain contaminated and result in transmission of microorganisms (Price et al, 2022a). Yet, health professionals often miss key areas when cleaning their hands. Evidence has consistently identified the fingertips, thumbs and backs of the hands as the most commonly missed areas during hand hygiene (Fig 1) (Gniadek et al, 2021, Reilly et al, 2016, Szilágyi et al, 2013). This has been a longstanding issue in practice, highlighting the need for a greater focus on the quality of the hand rubbing.

To address this gap, the WHO recommends a standardised, six-step technique (WHO, 2009). (Fig 2) This technique, also known as the Ayliffe technique, was developed by Professor Graham Ayliffe and his nurse colleague Linda Taylor in 1978 to standardise the application of hand hygiene products in a research study testing their effectiveness (Ayliffe et al, 1978), and has been adopted as standard practice globally, including in healthcare in the UK (NHS England, 2025; NHS Scotland, 2025).

Evidence supports the effectiveness of the six-step technique in reducing the bacterial load on hands (Price et al, 2022b). However, compliance with this approach in clinical practice is very low (Tschudin-Sutter et al, 2019; Tschudin-Sutter et al, 2015), with one study reporting only 2.7% compliance (Barry et al, 2021). A possible explanation of such low compliance with the six-step technique is its complexity, and the length of time required to perform all six steps. Therefore, it is likely that a simpler technique that requires less time to perform may effectively reduce behavioural barriers and improve compliance. In recognition of this, alternative, simpler technique variations have been proposed. One such technique is called a 'self-responsible application' and involves rubbing hands without any particular method (Sakmen et al, 2019).

Fig 2. **The six-step technique for using alcohol-based hand rub**



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A similar, unstructured approach for applying ABHRs is currently recommended by the Centers for Disease Control and Prevention (CDC) (2024) in the US, which advises applying ABHR to hands and rubbing them together until dry, with attention to commonly missed areas such as thumbs, fingertips and spaces between the fingers. Evidence demonstrates that, although this approach is well complied with and requires less time than the six-step approach, it is significantly less effective in reducing bacterial load on hands when compared with the six-step technique (Reilly et al, 2016).

Another simplified hand-rubbing technique, proposed by Tschudin-Sutter et al (2017), is the three-step approach, consisting of covering all surfaces of the hands, followed by rubbing the fingertips against the opposite palm and rubbing both thumbs. However, evidence on its effectiveness is inconsistent. Research showed that the three-step technique was more effective than the six-step technique when tested in a laboratory setting (Tschudin-Sutter et al, 2017), but no significant difference was found in a clinical setting (Chen et al, 2024; Tschudin-Sutter et al, 2019).

Some studies show the rates of compliance with the three-step technique are higher than with the six-step technique (Chen et al, 2024; Tschudin-Sutter et al, 2019), but there is also some evidence demonstrating that the three-step technique was followed correctly in only 1.8% of cases (Valim et al, 2024). Thus, current evidence is insufficient to recommend a change to the hand-rubbing technique for clinical practice. As such, until more evidence is available, health professionals should continue following current guidelines and use the recommended six-step technique.

Volume of alcohol-based hand rub

Another important factor that affects the quality of hand rubbing is the volume of ABHR applied to the hands. The volume should be sufficient to cover all surfaces of both hands (WHO, 2009). However, while the evidence demonstrates that the larger the ABHR volume used, the greater the reduction in bacterial load on hands is observed, it is not possible to recommend a specific volume of ABHR to use universally (Price et al, 2022a). The optimal volume depends on other factors, such as the formulation of the ABHR product or the size of the hand, with larger hands requiring larger volumes (Voniatis et al, 2023; Bellissimo-Rodrigues et al, 2016).

Furthermore, the volume of ABHR delivered by the dispensers is not standardised and the volume of product delivered by a dispenser with a single-pump press can vary, depending on the formulation, amount of ABHR present in the dispenser and the amount of time since the last use (Bánsághi et al, 2020). Yet, evidence shows that the volume of ABHR used in clinical practice is often insufficient (Kenters et al, 2020; Martinello et al, 2019), and nurses prefer using smaller volumes that dry more quickly (Boyce, 2023). To support health professionals in using the optimal volume of ABHR tailored to their hand size, the WHO recommends using a palmful of the product, sufficient to cover all hand surfaces (WHO, 2009). A palmful of ABHR is shown in Fig 3.

Fig 3. **A palmful of alcohol-based hand rub**

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The national infection prevention and control manual (NIPCM) for England aligns with this guidance, advising a palmful of ABHR (NHS England, 2025), while NHS Scotland's NIPCM suggests following the manufacturer's instructions for the ABHR volume or using approximately 3ml of the product (NHS Scotland, 2025), which would correspond to a palmful of ABHR for an average hand size. Adherence to these recommendations is essential for ensuring sufficient coverage of the hands and sufficient contact time with ABHR.

Duration of hand rubbing

To be effective, hands need to be in contact with the ABHR for a sufficient amount of time, and the duration of the hand-rubbing needs to be long enough to cover all hand surfaces with the product. However, inconsistencies exist across guidelines in relation to the duration of hand rubbing. The WHO and the Scottish NIPCM both recommend 20-30 seconds application time (NHS Scotland, 2025; WHO, 2009), while England's NIPCM does not specify the optimal duration of hand rubbing (NHS England, 2025), and the CDC (2024) recommends rubbing hands until dry for around 20 seconds.

Clinical and laboratory-based randomised controlled trials have found that rubbing hands for 15 seconds was as effective as rubbing for 30 seconds (Harnoss et al, 2020; Pires et al, 2019; Kramer et al, 2017; Pires et al, 2017). However, such short application time raises concerns about the quality of hand hygiene, because evidence shows that health professionals take 38.5-42.5 seconds to perform the six-step technique (Reilly et al, 2016; Chow et al, 2012).

Furthermore, the duration of hand rubbing is closely related to the volume of the product applied, with 2-3ml of ABHR requiring between 27-67 seconds to dry (Voniatis et al, 2023; Price et al, 2022a). There are limits to the amount of time that can be saved without compromising the quality and effectiveness of hand rubbing. Health professionals should follow current recommendations and apply ABHR for at least 20 seconds, until their hands are dry.

Research agenda and the nurse's role going forward

Despite progress in improving hand hygiene practices (Lotfinejad et al, 2021), certain gaps persist. To address these, the WHO (2023) has published a research agenda for hand hygiene in healthcare. One of the key research priorities that was identified was the need to determine effective strategies for ensuring sustained access to hand hygiene facilities and products at the point of care, particularly within a multimodal improvement strategy.

Furthermore, there is a need to evaluate the efficacy of hand hygiene products against various HCAI-causing microorganisms, including *C difficile* spores and respiratory viruses, and to investigate how the use of gloves affects hand hygiene practices and transmission of microorganisms (WHO, 2023). For hand rubbing specifically, there is a need to:

- Identify the most effective and feasible hand-rubbing technique;
- Determine the optimal hand-rubbing duration;
- Better understand how ABHR volumes could be standardised or customised for the individual to achieve the best results (Tartari et al, 2024).

Nurses play a key role in ensuring and improving hand hygiene, which is essential for preventing HCAIs and promoting patient safety. Nurses are critical to the success of hand hygiene improvement programmes going forward (Peters et al, 2020). Considering the hand hygiene research agenda (WHO, 2023), nurses offer unique insights into practical challenges and can act as enablers in clinical settings. They can also influence future activities with

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Box 1. Nurse's role in supporting a multimodal hand hygiene improvement strategy

- Understanding and implementation of evidence-based hand hygiene guidelines and best practices, helping to deliver high-quality care
- Reviewing how the physical environment influences health professionals' behaviour, including the availability and placement of alcohol-based hand rub (ABHR) bottles
- Ensuring timely training updates and the type of training that would best ensure evidence-based hand hygiene action is implemented in the busy day-to-day workflow
- Identifying gaps in infrastructure and practices, for example, by using different approaches to auditing and monitoring, and providing timely feedback, with consideration of how patients and visitors will be informed of results
- Using effective approaches to promote hand hygiene, including cues at the point of care for use of ABHR
- Demonstrating support for hand hygiene investment and action, including the appropriate use of ABHR to create a culture of safety

different leaders, policymakers and academia. When considering the WHO's recommended multimodal improvement strategy (WHO, 2009) – which is a behaviour change intervention in itself – there are many aspects where nurses can take the lead in their day-to-day activities (Box 1).

Conclusion

Compliance with both hand hygiene opportunities and the correct technique is essential for optimal infection prevention. The six-step technique for the application of ABHR remains the recommended approach, due to its proven efficacy in reducing bacterial load on health professionals' hands. To maximise the effectiveness of the procedure, a palmful of ABHR or a manufacturer-recommended volume should be applied to all surfaces of the hands using the six-step technique for at least 20 seconds, or until hands are dry (this technique often takes longer than 20 seconds to complete effectively).

Nurses play a pivotal role in hand hygiene as one part of critical, day-to-day infection prevention patient care interventions. By advocating for necessary resources, engaging in continuous education on emerging hand hygiene evidence and influencing the research agenda, nurses can solidify their role as both implementers and champions of best practices. Nurses can significantly contribute to improving practices to reduce HCAIs and help improve patient safety and outcomes. In their everyday practice, nurses can enhance compliance and contribute to a safer environment. **NT**

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