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Infection prevention and control: understanding the fundamentals

Oonagh McCloy, Ashley McGuinness and Stephanie Craig

Abstract

Infection prevention and control is crucial to prevent patients and healthcare staff from being harmed by avoidable infections, including healthcare-associated infections. This article outlines the main elements of standard precautions for infection prevention and control, as set out by the World Health Organization. Nurses and other healthcare professionals can use this information to refresh their knowledge of infection prevention and control, understand the appropriate practices that should be adopted to reduce the risk of infection transmission, and increase their awareness of the importance of sustainability and education.

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Keywords

clinical, hand hygiene, healthcare-associated infections, infection, infection control, infection prevention, patient safety, patients, professional

The World Health Organization (WHO) (2024a) states that infection prevention and control is an evidence-based approach aimed at preventing patients and healthcare staff from being harmed by avoidable infections. Infection prevention and control underpins practice in all disciplines of healthcare and is fundamental to patient safety (Cattini and Kiernan 2020). It requires constant actions by everyone in the healthcare organisation to reduce the risk of patients and staff coming to harm as a result of avoidable infections (Burnett 2018). This is advocated by The Code: Professional Standards of Practice and Behaviour for Nurses, Midwives and Nursing Associates (Nursing and Midwifery Council (NMC) 2018), which states that to preserve patient safety nurses must 'keep to and promote recommended practice in relation to controlling and preventing infection'.

In this context, the term avoidable infection refers to healthcare-associated infections (HCAIs); that is, infections that were not present before the current healthcare episode and developed while the patient was receiving healthcare or within 30 days of receiving it. Common HAIs include urinary tract infections post-operative wound infections, skin infections and infections that can cause vomiting and/or evidence-based approach aimed at preventing diarrhoea, and they pose a significant threat to patients, family members, carers and healthcare professionals (Haque et al 2018).

This article explores the WHO (2022a) standard precautions for infection prevention and control and how to apply them in practice. When applying the standard precautions, nurses need to follow their organisation's local policy and they can seek advice from the infection prevention and control team. Nurses need to be mindful that there are limitations to standard precautions for specific microorganisms, such as those transmitted via droplets or airborne routes, which will require additional precautions; however, it is beyond the scope of this article to discuss these in detail.

Standard precautions

Standard precautions are actions that all healthcare staff must undertake to protect everyone from infection (Cattini and Kiernan 2020). Adhering to standard precautions can reduce the transmission of microorganisms between healthcare staff, patients and the environment (Loveday et al 2014, WHO 2022a). Inadequate infection prevention and control can cause harm and lead to death, so it is crucial that healthcare professionals perform actions such as hand hygiene at specific times during patient care (Taneja and Mishra 2015). Damani (2019) stated that standard precautions should be undertaken in all care settings to assist with preventing adverse events and promoting patient safety.

A cross-sectional study by Al-Faouri et al (2021) suggested that high workloads and inadequate knowledge of infection prevention and control are among the main barriers to staff adherence to standard precautions. In addition to knowledge, other factors can also affect staff adherence, including culture, support from the organisation and resources (Donaghy 2022). Curryer et al (2021) emphasised that achieving adherence to infection prevention and control measures requires intensive team effort and lifelong learning. Furthermore, in acute healthcare settings, the concentration of large numbers of potentially vulnerable people increases the risks of exposure to infection and cross-infection, making it more challenging for staff to mitigate those risks (Cattini and Kiernan 2020).

The WHO (2022a) produced an aide-mémoire outlining the standard precautions for infection prevention and control, which are shown in Box 1. The main elements of these standard precautions will be the focus of this article.

Box 1. Standard precautions for infection prevention and control

- » Risk assessment
- » Hand hygiene
- » Respiratory hygiene and cough etiquette
- » Patient placement
- » Personal protective equipment (PPE)
- » Aseptic technique
- » Safe injections and sharps injury prevention
- » Environmental cleaning
- » Handling of laundry and linen
- » Waste management
- » Decontamination and reprocessing of reusable patient care items and equipment

(Adapted from World Health Organization 2022a)

Risk assessment

Applying standard precautions begins with ensuring that appropriate risk assessments are undertaken. When a patient arrives at a healthcare setting, a healthcare professional should check or assess their risk of acquiring and transmitting an infection (Cattini and Kiernan 2020). If an individual is identified as infected or colonised with an infectious agent, a risk assessment should be undertaken to determine how to prevent transmission to others. If additional precautions are required, these will vary according to the infectious agent's mode of transmission, such as via contact, droplets or airborne routes (Cattini and Kiernan 2020). For example, additional precautions for a patient who has contracted severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) may include caring for them in isolation according to local policy and staff wearing additional personal protective equipment (PPE) such as a fluid-resistant mask or FFP3 mask, visor and long-sleeve gown (NHS England 2024).

Hand hygiene

Hand hygiene is a simple practice that should be common in healthcare settings to assist in preventing the transmission of microorganisms such as viruses, bacteria and fungi, all of which can lead to HCAs (Ridley 2020). Nurses should undertake hand hygiene at certain moments during patient care, shown in Box 2. However, although this is recognised globally as best practice, hand hygiene is not always carried out at these recommended moments. According to the WHO (2021a), compliance with hand hygiene among healthcare staff in high-income countries rarely exceeds 70% despite optimal hand hygiene facilities. It is important to improve staff compliance with hand hygiene through formal education, clinical observation and performance feedback, methods which Wilson et al (2023) found to be beneficial in practice.

When the healthcare professional's hands are visibly dirty or soiled, they should wash them with water and soap. This involves wetting one's hands with water, applying soap and rubbing one's hands together for 15-30 seconds, which enables the soap to lather. It is that mechanical rubbing action along with the lather that will remove the dirt and debris from the hands, which should then be rinsed with running water (Damani 2019). The healthcare professional should particularly attend to the thumbs and fingertips because these areas frequently come into contact with patients and the environment (WHO 2009). Thorough drying of the hands is essential because a wet surface will encourage bacterial growth (Gammon and Hunt 2020). A comprehensive handwashing procedure developed by the WHO (2009) is available at: www.who.int/docs/default-source/patientsafety/how-to-handwash-poster.pdf?sfvrsn=7004a09d_2

When the healthcare professional's hands are not visibly dirty or soiled, they should use an alcohol-based hand rub because this is efficient, effective and better tolerated by the hands than washing them with soap and water (WHO 2024b)

Box 2. Five moments for hand hygiene

- Moment 1 – Before touching the patient**
- Moment 2 – Before a clean/aseptic procedure**
- Moment 3 – After risk of exposure to bodily fluid**
- Moment 4 – After touching a patient**
- Moment 5 – After touching patient surroundings**

(World Health Organization 2021b)

Respiratory hygiene and cough etiquette

Respiratory hygiene has been defined as containing respiratory secretions to limit the spread of microorganisms transmitted by droplets or airborne routes (Antimicrobial Resistance and Healthcare Associated Infection (ARHAI) Scotland 2021). Its importance has been emphasised by the coronavirus disease 2019 (COVID-19) pandemic, which demonstrated the need for effective respiratory hygiene and cough etiquette, for example ensuring one's mouth and nose are covered with a face mask, tissue,

sleeve or the inner elbow during coughing or sneezing then performing hand hygiene (WHO 2014, Calcagni et al 2023).

The WHO (2014) has recognised that the quality of evidence for respiratory hygiene is low, which was supported by a Cochrane review by Jefferson et al (2023), indicating that there is uncertainty about whether wearing a face mask slows the spread of respiratory viruses. However, the WHO (2014) still recommends that respiratory hygiene is carried out since it could potentially reduce the exposure to respiratory pathogens in healthcare settings. Staff who have symptoms of a respiratory condition should maintain a social distance of at least one metre (Chu et al 2020), ensure their mouth and nose are covered with a tissue or mask when coughing or sneezing, and adhere to local policies regarding wearing a face mask. Used tissues and face masks should be disposed of in a clinical waste bag and hand hygiene should be performed to reduce the spread of pathogens (WHO 2014, Damani 2019).

Personal protective equipment

Two of the most commonly used forms of PPE in healthcare are disposable gloves and aprons. The inappropriate use of gloves should be avoided because it has the potential to transmit microorganisms and lead to cross-infection (Royal College of Nursing (RCN) 2020). However, glove use in healthcare has become conventional and habitual (RCN 2023). Healthcare professionals require education and information so they can ascertain whether or not there is a need to wear gloves during particular tasks, with recommendations stating that non-sterile disposable gloves should be worn for procedures that may involve contact with blood or body fluids (Damani 2019).

Wearing gloves does not mean that hand hygiene is unnecessary; it is vital that hand hygiene is performed immediately before donning gloves and immediately after removing them. The correct removal and disposal of gloves are also important. They involve pulling each glove off at the wrist and turning them inside out as they are removed, then placing them in a foot-pedal-operated clinical waste bin (Cattini and Kiernan 2020).

Disposable single-use aprons are donned to protect one's clothing and should be worn when performing tasks that may lead to its contamination, for example cannulation and the insertion or removal of urinary catheters (Wigglesworth 2019). The healthcare professional should remove the apron and dispose of it appropriately once they have completed the task; they should not keep it on when they attend to other patients.

The inappropriate use of plastic aprons could potentially transmit microorganisms and cause crossinfection (Weston et al 2017). Phan et al (2020) concurred that contaminated PPE can assist pathogen dissemination throughout the healthcare environment. It is important that nurses act as role models for patient safety, as per the Code (NMC 2018), through positive practices such as the appropriate wearing of PPE.

Aseptic technique

According to Clare and Rowley (2018), an aseptic technique enables a procedure to take place in a way that reduces the risk of contamination and the introduction of pathogens in susceptible sites. For this to occur, healthcare staff need to take measures to reduce pathogens in the immediate vicinity of where the procedure will be performed and ensure that they do not touch particular elements, such as needle tips, catheter tips or the inside surface of sterile dressings, since these will directly or indirectly come into contact with the patient and therefore pose a risk of infection (Cattini and Kiernan 2020).

Aseptic technique is an essential competency required of nurses who undertake routine procedures such as catheterisation and wound dressings (Loveday et al 2014, Damani 2019). A literature review by Kent et al (2018) found no significant difference in the rate of wound infection when using either an aseptic or a clean technique, suggesting that aseptic technique may not be required for all wound dressings; however, not all types of wounds were included in the review. Nurses should make a clinical assessment to decide whether an aseptic or a clean technique is required. An aseptic technique aims to completely prevent the transfer of microorganisms using sterile equipment, whereas a clean technique aims to reduce the transmission of microorganisms using appropriate hand hygiene and clean gloves (Joint Commission 2013).

Safe injections and sharps injury prevention

Gloves are not always required when administering injections because this is a minimal contact procedure; however, nurses should assess their risk of harm and decide whether or not they need to wear gloves when carrying out injections (RCN 2023).

Sharps injuries remain a known risk for healthcare professionals, despite measures being put in place to reduce their occurrence (RCN 2023). Healthcare staff need to be vigilant when handling sharps such as needles and ensure that the appropriate sharps container is at hand for disposal immediately after use. The handling of sharps should be kept to a minimum and needles should not be re-capped because of the risk of harm. Various safety-engineered devices – for example, a retractable needle or a mechanism attached to cover the needle – may be used to reduce the risk of sharps injury. Staff need to be familiar with the safety-engineered devices used in their area, since these can vary (Jackson et al 2020).

Environmental cleaning

The environment in healthcare settings can serve as a reservoir for microorganisms (Suleyman et al 2018), including areas such as sinks, drains and medical equipment, where biofilms can form. Biofilms are usually composed of a multispecies microbial community embedded in an extracellular polymeric matrix. They have a reduced susceptibility to antimicrobials and are associated with HCAs (Maillard and Centeghe 2023).

Cleaning surfaces and medical equipment, many of which are frequently touched by patients and healthcare staff, is an important step in reducing the transmission of infection (Doll et al 2018). Cleaning may be undertaken using detergents or disinfectants, and healthcare professionals need to be familiar with the difference between the two. Detergents do not kill microorganisms and should be used to remove visible contaminants before undertaking disinfection (Dancer and Kramer 2019). Disinfectants are approved chemicals used to inactivate or kill microorganisms; however, this is becoming increasingly challenging because biofilms can be resistant to some disinfectants (Maillard and Centeghe 2023).

Healthcare staff need to receive training from their organisation in using approved chemicals to clean surfaces and medical equipment, since concentrations may vary and products may change to ensure appropriate disinfection. All patient care areas should be cleaned in accordance with local policies, with the frequency of cleaning depending on factors such as level of clinical risk, patient turnover and visible contamination (Dancer 2014).

Handling of laundry and linen

The three main categories for linen are 'clean or unused', 'used' and 'infectious'. According to ARHAI Scotland (2020), clean linen should be covered with an impervious protective covering and stored

above floor level to protect it from contamination. When transported, clean linen should be physically separated from used and infectious linen. When handling used and/or infectious linen, healthcare professionals should wear disposable gloves and a disposable apron.

Linen should be segregated correctly to ensure it goes through the appropriate laundering process. Infectious linen should be placed in a water-soluble bag before being placed in the correct fabric linen bag (ARHAI Scotland 2020). Staff need to be aware of the local policies and procedures regarding the colour coding of bags for segregation, since this may vary. However, the overall handling of linen will remain the same, along with the purpose of reducing the transmission of infection.

Waste management

A literature review by Li et al (2021) identified that around 75-80% of healthcare waste is classed as general waste and 20-25% is deemed hazardous. Hazardous waste would include items that have come into contact with blood, body fluids or reagents and cytotoxic waste. Disposal methods for hazardous waste include incineration, autoclaving, steam treatment and microwaving (Duong 2023).

It is essential that hazardous waste is disposed of correctly to minimise the risk of transmitting infection. If hazardous waste is disposed of with general waste, it could end up in landfills and pathogens and toxic substances could be released into the environment, potentially leading to infection transmission via sharps injuries, drinking water pollution or air pollution (Robat et al 2022). Conversely, if all healthcare waste is disposed of as hazardous waste, this can be expensive for healthcare organisations and have a negative effect on the environment due to the potential release of toxins (WHO 2018). Nurses need to be aware of, and follow, the relevant procedures for waste segregation and management in their local area to minimise the risk of infection transmission (WHO 2022a).

Decontamination and reprocessing of reusable patient care items and equipment

The decontamination and reprocessing of reusable patient care items and equipment involves cleaning, disinfecting and in some cases re-sterilising. The WHO (2022b) recommends using Spaulding's risk classification system (Table 1) when considering which decontamination method to use for a medical device. This is a widely used system that divides medical devices into three categories based on the possible risk of infection to the patient from their use (Rowan et al 2023). Healthcare staff should receive education and training to ensure safe practice in the decontamination of equipment such as flexible endoscopes, which may be carried out by medical device manufacturers (Medicines and Healthcare products Regulatory Agency 2013). Staff need to be aware that single-use items are not suitable for decontamination and should dispose of them accordingly.

The environment where decontamination takes place should be clean and fit for purpose, with a one-way flow of working, access to soft water with a low salt and mineral content, and separation of dirty and clean activities (WHO 2022b). Dirty activities include preparing used devices for decontamination; clean activities involve handling medical devices that have been decontaminated and are ready for re-use. When decontaminating equipment, staff should wear appropriate PPE, for example disposable gloves, an apron, and possibly a face mask and visor when undertaking dirty activities involving the use of chemicals.

Table 1. Spaulding's classification

Classification	Definition	Decontamination method	Examples
High risk (critical)	Medical devices that are involved with a break in the skin or mucous membrane or enter a sterile body cavity	Sterilisation	» Surgical instruments » Delivery sets » Dental instruments
Intermediate risk (semi-critical)	Medical devices in contact with mucous membranes or non-intact skin	High-level disinfection	» Respiratory and anaesthetic equipment » Reusable vaginal specula » Endoscopes
Low risk (non-critical)	Items in contact with intact skin	Low-level disinfection, for example, cleaning with detergent and disinfectant	» Blood pressure cuffs » Stethoscopes » Electrocardiogram leads

(World Health Organization 2022b)

Further considerations

Beyond the standard precautions outlined in this article, further considerations regarding infection prevention and control include education and sustainability. Eslamian et al (2015) stated that healthcare organisations have a duty to ensure time is allocated for infection prevention and control education and that the education meets the needs of staff and is relevant to their roles. NHS England (2023a) has introduced an infection prevention and control education framework for all healthcare professionals. However, due to the current staff shortages, it may be challenging to allocate time and resources to enable staff to complete training and update their knowledge. Addressing this issue needs to be a priority to ensure the provision of safe, effective and evidence-based care in line with the Code (NMC 2018).

Staff education should be expanded to include information about sustainability and reducing carbon emissions from inappropriate use of PPE and improper disposal of waste (Haque et al 2021). According to a systematic review by Keil et al (2024), healthcare significantly contributes to carbon emissions. This is highly relevant to infection prevention and control, since the methods used for waste disposal and the use of disposable single-use PPE contribute to the carbon emissions of healthcare organisations.

Annually, NHS providers in England produce around 156,000 tonnes of clinical waste that requires incineration or alternative treatment (NHS England 2023b). Clinical waste should consist of PPE that has come into contact with contaminated substances and other waste deemed hazardous to health. However, the COVID-19 pandemic has led to an unprecedented use of disposable single-use PPE, which has become habitual rather than based on an assessment of the risk of infection (Haque et al 2021). Healthcare organisations and staff need to ensure that PPE is used appropriately and that all equipment used to mitigate the risk of infection is manufactured locally using sustainable materials and is reusable whenever possible. This will reduce waste production and assist in reducing carbon emissions without compromising patient care (Nash 2021).

Conclusion

Adherence to standard precautions is crucial for effective infection prevention and control and can support patient safety. For example, hand hygiene is essential to infection prevention and control and should be performed at the appropriate times, while the risk of infection should be assessed every

time patient contact is made. PPE, such as disposable gloves and aprons, must be used appropriately and not out of habit. Ensuring the environment and patient equipment are regularly cleaned as per local policies is paramount. Education and training programmes on infection prevention and control need to be made available to staff and provide them with the necessary knowledge to apply standard precautions in practice. Finally, it is important that healthcare professionals and organisations consider ways to enhance sustainability in healthcare, notably by reducing the inappropriate use of disposable single-use PPE.

References

Al-Faouri I, Okour SH, Alakour NA et al (2021) Knowledge and compliance with standard precautions among registered nurses: a cross-sectional study. *Annals of Medicine and Surgery*. 29, 62, 419-424. doi: 10.1016/j.amsu.2021.01.058

Antimicrobial Resistance and Healthcare Associated Infection Scotland (2020) Safe Management of Linen: Standard Infection Prevention & Control and Transmission Based Infection Control Precautions. www.nipcm.hps.scot.nhs.uk/media/1671/2020-09-11-sicp-lr-linen-v3.pdf (Last accessed: 24 July 2024.)

Antimicrobial Resistance and Healthcare Associated Infection Scotland (2021) Standard Infection Precautions Literature Review: Cough Etiquette. Version 3.0. www.nipcm.hps.scot.nhs.uk/media/1648/2021-09-13-sicp-lr-cough-etiquette-v3.pdf (Last accessed: 24 July 2024.)

Burnett E (2018) Effective infection prevention and control: the nurse's role. *Nursing Standard*. 33, 4, 68–72. doi: 10.7748/ns.2018.e11171

Calcagni N, Venier AG, Nasso R et al (2023) Respiratory infection prevention: perceptions, barriers and facilitators after SARS-CoV-2. *Infection, Disease & Health*. 28, 1, 54-63. doi: 10.1016/j.idh.2022.08.001

Cattini P, Kiernan M (2020) Infection prevention and control. In Lister S et al (Eds) *The Royal Marsden Manual of Clinical Nursing Procedures*. Tenth edition. Wiley Blackwell, Oxford, 64-122.

Chu DK, Akl EA, Duda S et al (2020) Physical distancing, face masks, and eye protection to prevent person-to-person transmission of SARS-CoV-2 and COVID-19: a systematic review and meta-analysis. *The Lancet*. 395, 10242, 1973-1987. doi: 10.1016/S0140-6736(20)31142-9

Clare S, Rowley S (2018) Implementing the Aseptic Non-Touch Technique (ANTT®) clinical practice framework for aseptic technique: a pragmatic evaluation using a mixed methods approach in two London hospitals. *Journal of Infection Prevention*. 19, 1, 6-15. doi: 10.1177/1757177417720996

Curryer C, Russo PL, Kiernan M et al (2021) Environmental hygiene, knowledge and cleaning practice: a phenomenological study of nurses and midwives during COVID-19. *American Journal of Infection Control*. 49, 9, 1123-1128. doi: 10.1016/j.ajic.2021.04.080

Damani N (2019) *Manual of Infection Prevention and Control*. Fourth edition. Oxford University Press, Oxford. Dancer SJ (2014) Controlling hospital-acquired infection: focus on the role of the environment and new technologies for decontamination. *Clinical Microbiology Reviews*. 27, 4, 665-690. doi: 10.1128/CMR.00020-14

Dancer SJ, Kramer A (2019) Four steps to clean hospitals: LOOK, PLAN, CLEAN and DRY. *Journal of Hospital Infection*. 103, 1, e1-e8. doi: 10.1016/j.jhin.2018.12.015

Doll M, Stevens M, Bearman G (2018) Environmental cleaning and disinfection of patient areas. *International Journal of Infectious Diseases*. 67, 52-57. doi: 10.1016/j.ijid.2017.10.014

Donaghy J (2022) Organisational support improves adherence to infection prevention and control guidelines. *Evidence-Based Nursing*. 25, 1, 10. doi: 10.1136/ebnurs-2020-103305

Duong D (2023) Improper disposal of medical waste costs health systems and the environment. *Canadian Medical Association Journal*. 195, 14, E518-E519. doi: 10.1503/cmaj.1096046

Eslamian J, Moeini M, Soleimani M (2015) Challenges in nursing continuing education: a qualitative study. *Iranian Journal of Nursing and Midwifery Research*. 20, 3, 378-386. Gammon J, Hunt J (2020) COVID-19 and hand hygiene: the vital importance of hand drying. *British Journal of Nursing*. 29, 17, 1003-1006. doi: 10.12968/bjon.2020.29.17.1003

Haque M, Sartelli M, McKimm J et al (2018) Health care-associated infections – an overview. *Infection and Drug Resistance*. 11, 2321-2333. doi: 10.2147/IDR.S177247

Haque Mds, Sharif S, Masnoon A et al (2021) SARS-CoV-2 pandemic-induced PPE and single-use plastic waste generation scenario. *Waste Management & Research*. 31, Suppl 1, 3-17. doi: 10.1177/0734242X20980828

Jackson AP, Almerol LA, Campbell J et al (2020) Needlestick injuries: the role of safety-engineered devices in prevention. *British Journal of Nursing*. 29, 14, S22-S30. doi: 10.12968/bjon.2020.29.14.S22

Jefferson T, Dooley L, Ferroni E et al (2023) Physical interventions to interrupt or reduce the spread of respiratory viruses. *Cochrane Database of Systematic Reviews*. Issue 1. CD006207. doi: 10.1002/14651858.CD006207 Joint Commission (2013) Central Line-Associated Bloodstream Infections Toolkit and Monograph. www.jointcommission.org/CLABSIToolkit (Last accessed: 24 July 2024.)

Keil M, Frehse L, Hagemeister M et al (2024) Carbon footprint of healthcare systems: a systematic review of evidence and methods. *BMJ Open*. 14, 4, e078464. doi: 10.1136/bmjopen-2023-078464

Kent DJ, Scardillo JN, Dale B et al (2018) Does the use of clean or sterile dressing technique affect the incidence of wound infection? *Journal of Wound, Ostomy, and Continence Nursing*. 45, 3, 265-269. doi: 10.1097/WON.0000000000000425

Li H, Dietl H, Li J (2021) Identifying key factors influencing sustainable element in healthcare waste management using the interval-valued fuzzy DEMATEL method. *Journal of Material Cycles & Waste Management*. 23, 5, 1777-1790. doi: 10.1007/s10163-021-01233-4

Loveday HP, Wilson JA, Pratt RJ et al (2014) epic3: national evidence-based guidelines for preventing healthcare associated infections in NHS hospitals in England. *Journal of Hospital Infection*. 86, Suppl 1, S1-S70. doi: 10.1016/S0195-6701(13)60012-2

Maillard JY, Centeleghe I (2023) How biofilm changes our understanding of cleaning and disinfection. *Antimicrobial Resistance & Infection Control*. 12, 95. doi: 10.1186/s13756-023-01290-4

Medicines and Healthcare products Regulatory Agency (2013) Top Ten Tips: Endoscope Decontamination. assets.publishing.service.gov.uk/media/5a7e22c440f0b62305b8108a/Endoscope_deconamination.pdf (Last accessed: 24 July 2024.)

Nash C (2021) Time to act: what nurses can do to reduce the environmental burden of PPE. *Nursing Times*. 117, 8, 18-20.

NHS England (2023a) Infection Prevention and Control Education Framework. www.england.nhs.uk/long-read/infectionprevention-and-control-education-framework (Last accessed: 24 July 2024.)

NHS England (2023b) NHS Clinical Waste Strategy. www.england.nhs.uk/estates/nhs-clinical-wastestrategy (Last accessed: 24 July 2024.)

NHS England (2024) National Infection Prevention and Control Manual (NIPCM) for England. www.england.nhs.uk/wp-content/uploads/2022/04/PRN00908-national-infection-preventionand-control-manual-for-england-v2.10.pdf (Last accessed: 24 July 2024.)

Nursing and Midwifery Council (2018) *The Code: Professional Standards of Practice and Behaviour for Nurses, Midwives and Nursing Associates*. NMC London

Phan LT, Sweeney DM, Maita D et al (2020) Respiratory viruses in the patient environment. *Infection Control and Hospital Epidemiology*. 41, 3, 259-266. doi: 10.1017/ice.2019.299

Ridley N (2020) Effective hand hygiene—wash your hands and reduce the risk. *British Journal of Nursing*. 29, 1, 10. doi: 10.12968/bjon.2020.29.1.10

Robat DS, Sany SB, Siuki HA et al (2022) Impact of an educational training on behavioural intention for healthcare waste management: application of health action model. *International Quarterly of Community Health Education*. 42, 3, 299-307. doi: 10.1177/0272684X20982595

Rowan NJ, Kremer T, McDonnell G (2023) A review of Spaulding's classification system for effective cleaning, disinfection and sterilization of reusable medical devices: viewed through a modernday lens that will inform and enable future sustainability. *Science of the Total Environment*. 878, 162976. doi: 10.1016/j.scitotenv.2023.162976

Royal College of Nursing (2020) *Essential Practice for Infection Prevention and Control: Guidance for Nursing Staff*. RCN, London.

Royal College of Nursing (2023) *Sharps Safety: RCN Guidance for the Prevention and Management of Sharps Injuries in Health and Social Care Settings*. RCN, London.

Suleyman G, Alangaden G, Bardossy AC (2018) The role of environmental contamination in the transmission of nosocomial pathogens and healthcare-associated infections. *Current Infectious Disease Reports*. 20, 6, 12. doi: 10.1007/s11908-018-0620-2

Taneja J, Mishra B (2015) Promotion of successful hand hygiene practices in the intensive care units of a tertiary care hospital. *Journal of Patient Safety and Infection Control*. 3, 3, 130-133. doi: 10.1016/j.jpsic.2015.11.004

Weston D, Burgess A, Roberts S (2017) *Infection Prevention and Control at a Glance*. Wiley Blackwell, Oxford.

Wigglesworth N (2019) Infection control 3: use of disposable gloves and aprons. *Nursing Times*. 115, 7, 34-36.

Wilson KB, Satchell L, Smathers SA et al (2023) The power of feedback: implementing a comprehensive hand hygiene observer program. *American Journal of Infection Control*. 51, 2, 142-148. doi: 10.1016/j.ajic.2022.06.003

World Health Organization (2009) *How to Handwash?* www.who.int/docs/default-source/patient-safety/how-to-handwash-poster.pdf (Last accessed: 24 July 2024.)

World Health Organization (2014) *Infection Prevention and Control of Epidemic- and Pandemic-Prone Acute Respiratory Infections in Health Care: WHO Guidelines*. iris.who.int/bitstream/handle/10665/112656/9789241507134_eng.pdf (Last accessed: 24 July 2024.)

World Health Organization (2018) HealthCare Waste. www.who.int/news-room/fact-sheets/detail/health-care-waste (Last accessed: 24 July 2024.)

World Health Organization (2021a) Key Facts and Figures: World Hand Hygiene Day 2021. www.who.int/campaigns/world-handhygiene-day/2021/key-facts-and-figures (Last accessed: 24 July 2024.)

World Health Organisation (2021b) Five Moments for Hand Hygiene. www.who.int/publications/m/item/five-moments-for-hand-hygiene (Last accessed: 24 July 2024.)

World Health Organization (2022a) Standard Precautions for the Prevention and Control of Infections: Aide-Memoire. www.who.int/publications/i/item/WHO-UHL-IHS-IPC-2022.1 (Last accessed: 24 July 2024.)

World Health Organization (2022b) Decontamination and Reprocessing of Medical Devices for Health Care Facilities: Aide-Memoire. www.who.int/publications/i/item/WHO-UHL-IHSIPC-2022.4 (Last accessed: 24 July 2024.)

World Health Organization (2024a) Infection Prevention and Control. www.who.int/healthtopics/infection-prevention-and-control (Last accessed: 24 July 2024.)

World Health Organization (2024b) Infection Prevention and Control: Hand Hygiene. www.who.int/teams/integrated-health-services/infection-prevention-control/hand-hygiene (Last accessed: 24 July 2024.)