An Roinn Sláinte
Department of Health

Infection Prevention and Control (IPC)

National Clinical Guideline No. 30

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Volume 1

NATIONAL CLINICAL EFFECTIVENESS COMMITTEE

This National Clinical Guideline has been developed by the Infection and Prevention Infection Prevention and Control Guideline Development Group (GDG).

Using this National Clinical Guideline

This National Clinical Guideline applies to all health and social care workers because the control of healthcare associated infection is everyone's responsibility. It is particularly relevant to Infection Prevention and Control (IPC) Practitioners. IPC Practitioners are those health and social care workers with specific training and expertise in the prevention and control of infection and who provide training, guidance and leadership to others on IPC. Please note: that reference to a document as a source of additional information does not represent an endorsement of the entire document cited as a part of this National Clinical Guideline. Due to size, this full version guideline is presented in two volumes. Both should be cross-referenced as needed. A summary version is also available.

Disclaimer

NCEC National Clinical Guidelines do not replace professional judgment on particular cases or particular circumstances, whereby the clinician or health professional decides that individual guideline recommendations are not appropriate in the circumstances presented. It may also happen that an individual patient declines a recommendation as a course of action in their care or treatment plan. In these circumstances the decision not to follow a recommendation should be appropriately recorded in the patient's healthcare record (individual patient) or elsewhere if the issue is not related to a specific patient.

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www.gov.ie/clinicalguidelines

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Membership of the Guideline Development Group (GDG)

The GDG was chaired by Professor Martin Cormican, Professor of Bacteriology, University of Galway, formerly Clinical Lead HSE, Antimicrobial Resistance and Infection Control Team (until 30th April 2022).

Membership nominations were sought from a variety of clinical and non-clinical backgrounds. This was to ensure the group was as representative as possible of key stakeholders.

Table 1 Guideline Development Group membership

Name	Job title and affiliation
Professor Martin Cormican (Chairperson)	Professor of Bacteriology, School of Medicine, University of Galway (former National Clinical Lead Antimicrobial Resistance and Infection Control (AMRIC))
Dr Eimear Brannigan	Consultant in Infectious Diseases and National Clinical Lead, HSE Antimicrobial Resistance and Infection Control Team (AMRIC)
Shirley Keane	Head of Service, AMRIC
Dr Anne Sheahan	Area Director of Public Health, Area D
Dr Caroline Fielding	Representative from Faculty of Pathology, Royal College of Physicians in Ireland (RCPI)
Bernie O'Reilly	Voluntary member of Patients For Patient Safety Ireland (PFPSI), and patient representative
Josephine Galway	Director of Nursing, AMRIC
Therese Dalchan	Head of Service, HSE Acute Operations
Helen Murphy	Infection Prevention and Control Lead Nurse Advisor Manager AMR HCAI Health Protection Infection, HPSC
Carmel Hooton	Surveillance Scientist, SSAI representative
Lenora Leonard	Infection Prevention and Control Nurse, IPCI representative
Margo Leddy	Health and Safety representative
Niamh Galvin	HSE National Oral Health Office, Dental representative
Dr Bernard Murphy	Dental Council representative
Shane Keane	Principal Environmental Health Officer, Environmental Health representative
Dr Nuala O'Connor (until Oct 2021)	HCAI/AMR GP Lead, Irish College of General Practitioners (ICGP) representative
Dr Edel Doorley (from Oct 2021)	General Practitioner Advisor, AMRIC

Marie Philbin	Chief Antimicrobial Pharmacist, AMRIC
Ann Marie Howard	Occupational Health representative
Kathryn Hanly	Inspector, Health Information Quality Authority (HIQA) representative
Dr Jerome Fennell	Consultant Microbiologist, Irish Society Clinical Microbiology (ISCM) representative
Dr Rob Cunney	Consultant Microbiologist, HSE, HPSC representative
Marie Cregan	Representative for Patients For Patient Safety Ireland (PFPSI) and Féileacáin
Marguerite Kelly (until 2021)	IPC Ireland Community representative
Dorothy Kealy (from Juanry 2022	IPC Ireland Community representative
Caroline Conneely	Quality Improvement Division, National Decontamination Safety Programme representative
Cornelia Stuart (until Oct 2021)	Assistant National Director, HSE Quality & Patient Safety representative
Mary Mc Kenna (until Oct 2021)	Assistant Director of Nursing (ADON), AMRIC
Emer O'Donovan (from Oct 2021)	Assistant Director of Nursing, AMRIC
Gwen Regan (from Oct 2021)	Director of Nursing, IPC Community Healthcare, Quality & Patient Safety Representative
Margaret Culliton (from Oct 2021)	Project Manager, AMRIC

Credits

The role of the NCEC is to prioritise, quality assure and recommend clinical guidelines to the Chief Medical Officer for endorsement by the Minister for Health. It is intended through Ministerial endorsement that full implementation of the guideline will occur through the relevant service plans.

The NCEC and the Department of Health acknowledge and recognise the Chair and members of the Guideline Development Group (GDG) for development of the guideline; and the external reviewers for their contribution. The NCEC and Department of Health wish to express thanks and sincere gratitude to all persons contributing to this National Clinical Guideline; especially those that gave their time on a voluntary basis.

Acknowledgments

The Chair of the GDG wishes to acknowledge the following for their particular contribution to the development of this guideline:

- The members of the GDG for their commitment through the development of this particularly important and complex guideline
- The National Health and Medical Research Council of Australia for permission to use and adapt the Australian Guidelines for the Prevention and Control of Infection in Healthcare (2019) to support development of this guideline. This guideline differs in a number of points from the Australian Guidelines (2019). The Australian Guidelines for the Prevention and Control of Infection in Healthcare (2019) was updated in 2021 and is available at the following link: https://www.safetyandquality.gov.au/publications-and-resources/resource-library/australian-guidelines-prevention-and-control-infection-healthcare
- The HSE Antimicrobial Resistance and Infection Control team for their outstanding support for the work of the GDG throughout the process and in particular for work on the Budget Impact Analysis and the Implementation Plan
- The Health Protection Surveillance Centre for access to facilities and support
- Health Research Board - Collaboration in Ireland for Clinical Effectiveness Reviews (HRB-CICER) for work on Evidence Review, Budget Impact Analysis and the Implementation Plan
- Those who contributed formal feedback through the public consultation process
- The great many IPC practitioners and other healthcare workers who have informed the development of this guideline through sharing their vast practical experience with the Chair and members of the GDG through questions, conversations and email.

External review acknowledgement

The following are acknowledged for providing an external review of the guideline:

- Prof. Charles Van der Henst, PhD. Professor. VIB-VUB Group Leader-Microbial Resistance and Drug Discovery Group, Flanders Institute for Biotechnology (VIB), Vrije Universiteit Brussels (VUB)
- Louis Palen, Multi-Site Director, Infection Prevention & Control, Advocate Christ Medical Center, South Suburban Hospital, Trinity Hospital, 4440 W. 95th Street, Oak Lawn, IL 60453. USA
- Dr. Susanne Surman Lee, BSc, PhD, C Biol, FRSB, FRSPH, FIHEEM, FWMSoc. Director. Legionella Ltd.

Signed by the Chair(s) Date: 6/5/2023

Prof. Martin Cormican

National Clinical Guidelines

Providing standardised clinical care to patients in healthcare is challenging. This is due to a number of factors, among them diversity in environments of care and complex patient presentations. It is self-evident that safe, effective care and treatment are important in ensuring that patients get the best outcomes from their care.

The Department of Health is of the view that supporting evidence-based practice, through the clinical effectiveness framework, is a critical element of the health service to deliver safe and high quality care. The National Clinical Effectiveness Committee (NCEC) is a Ministerial committee set up in 2010 as a key recommendation of the report of the Commission on Patient Safety and Quality Assurance (2008). The establishment of this Commission was prompted by an increasing awareness of patient safety issues in general and high profile health service system failures at home and abroad.

The NCEC on behalf of the Department of Health has embarked on a quality assured National Clinical Guideline development process linked to service delivery priorities. Furthermore, implementing National Clinical Guidelines sets a standard nationally, to enable healthcare professionals to deliver safe and effective care and treatment while monitoring their individual, team and organisation's performance.

The aim of these National Clinical Guidelines is to reduce unnecessary variations in practice and provide an evidence base for the most appropriate healthcare in particular circumstances. As a consequence of Ministerial mandate, it is expected that NCEC National Clinical Guidelines are implemented across all relevant services in the Irish healthcare setting.

The NCEC is a partnership between key stakeholders in patient safety. NCEC's mission is to provide a framework for national endorsement of clinical guidelines and clinical audit to optimise patient and service user care. The NCEC has a remit to establish and implement processes for the prioritisation and quality assurance of clinical guidelines and clinical audit so as to recommend them to the Minister for Health to become part of a suite of National Clinical Guidelines and National Clinical Audit. The aim of the suite of National Clinical Guidelines is to provide guidance and standards for improving the quality, safety and cost-effectiveness of healthcare in Ireland. The implementation of these National Clinical Guidelines will support the provision of evidence-based and consistent care across Irish healthcare services.

NCEC Terms of reference

1. Provide strategic leadership for the national clinical effectiveness agenda.
2. Contribute to national patient safety and quality improvement agendas.
3. Publish standards for clinical practice guidance.
4. Publish guidance for National Clinical Guidelines and National Clinical Audit.
5. Prioritise and quality assure National Clinical Guidelines and National Clinical Audit.
6. Commission National Clinical Guidelines and National Clinical Audit.
7. Align National Clinical Guidelines and National Clinical Audit with implementation levers.
8. Report periodically on the implementation and impact of National Clinical Guidelines and the performance of National Clinical Audit.
9. Establish sub-committees for NCEC work streams.
10. Publish an annual report.

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1 National Clinical Guideline recommendations

1.1 Summary of recommendations

Recommendations are based on systematic reviews performed in the preparation of the Australian Guidelines for the Prevention and Control of Infection in Healthcare (2019) or performed in development of this Guideline. Recommendations use the GRADE (Grading of Recommendations Assessment, Development and Evaluation) approach providing the evidence to a decision framework. For each recommendation, there is an indication of the strength of the recommendation, reflecting the practical importance of the recommendation and an indication of the strength of the evidence for the recommendation. This approach is used because in some instances there is a near universal consensus that a practice is very important but the evidence base may be limited. This may happen because it is very difficult to design or perform a relevant high-quality study for practical and or ethical reasons. For each recommendation, there is also consideration of the harms and benefits of the intervention.

Please note the 2019 Australian Guidelines were updated in July of 2021 and available at https://www.safetyandquality.gov.au/publications-and-resources/resource-library/australian-guidelines-prevention-and-control-infection-healthcare

Table 2 Summary of recommendations

No.	Section	Recommendation	*Grade/level
1	Hand hygiene	Routine hand hygiene is performed according to the World Health Organisation technique: • Before touching a patient • Before a clean or aseptic procedure • After body fluid exposure • After touching a patient • After touching a patient's surroundings Hand hygiene must also be performed before putting on gloves and after the removal of gloves.	Strong recommendation, strong evidence
2	Hand hygiene	Alcohol-based hand rubs that contain between 60% and 80% v/v ethanol or equivalent should be used for all routine hand hygiene practices.	Strong recommendation, strong evidence
3	Hand hygiene	Soap and water should be used for hand hygiene when hands are visibly soiled.	Strong recommendation, strong evidence

4	Hand hygiene	In the presence of known or suspected *Clostridioides difficile* and viruses such as norovirus hand hygiene must be performed as follows: • If gloves are worn and appear intact on removal, then alcohol-based hand rub remains the agent of choice for hand hygiene • If gloves have not been worn, if gloves have been breached or if there is visible contamination of the hands despite glove use, use soap and water to facilitate the mechanical removal of spores • After washing, hands should be dried thoroughly with a single-use towel.	Strong recommendation, weak evidence
5	Routine management of physical environment	Sites/surfaces should be cleaned and disinfected after spills of blood or other potentially infectious materials.	Strong recommendation, weak evidence
6	Routine management of physical environment	The use of sodium hypochlorite disinfection in addition to cleaning with a detergent solution is recommended for terminal disinfection of healthcare facilities when terminal disinfection is required for example in seeking to end *C. difficile* and norovirus outbreaks. Note: terminal disinfection must always occur in the context of a process of terminal cleaning and disinfection.	Strong recommendation, weak evidence
7	Emerging disinfection methods	**Recommendation AGAINST:** Hydrogen peroxide vapour disinfection is **not recommended** as a routine adjunct in healthcare facilities as the evidence of added value compared with conventional cleaning and disinfection is not well established.	Strong recommendation, weak evidence

8	Emerging disinfection methods	**Recommendation AGAINST:** Ultraviolet light disinfection, ultraviolet light in combination with sodium hypochlorite and other novel approaches to healthcare environment disinfection are **not recommended** as routine adjuncts in healthcare facilities as the evidence of added value compared with conventional cleaning and disinfection is not well established.	Strong recommendation, weak evidence
9	Emerging disinfection methods	**Recommendation AGAINST:** The use of surfaces, fittings or furnishing containing materials with antimicrobial properties in healthcare facilities is **not recommended** as the evidence of added value compared with conventional cleaning and disinfection is not well established.	Strong recommendation, weak evidence
10	Aseptic technique	Sterile gloves are used for surgical aseptic procedures and contact with sterile sites.	Strong recommendation, weak evidence
11	Contact precautions	Contact precautions, in addition to standard precautions, are implemented routinely in the acute hospital setting in the presence of known or suspected infectious microorganisms that are spread by direct or indirect contact with the people cared for or their environment. The principles of contact precautions are relevant in all settings but the application must be appropriate to the context in which care is delivered and the needs of the person cared for.	Strong recommendation, weak evidence
12	Contact precautions	Hand hygiene be undertaken and personal protective equipment (PPE) be used as appropriate when healthcare workers have contact with people or with body fluids of people who require contact precautions. This principle is relevant in all settings but the application must be appropriate to the context in which care is delivered.	Strong recommendation, weak evidence

13	Contact precautions	Where possible patient-dedicated equipment or single-use patient-care equipment be used for people on contact precautions. If common use of equipment for multiple people on contact precautions is unavoidable, clean the equipment, disinfect/sterilise if appropriate and allow it to dry before use on another person.	Strong recommendation, weak evidence
14	Droplet precautions	Healthcare workers implement droplet precautions when caring for people known or suspected to be infected with microorganisms transmitted by respiratory droplets. This includes wearing a surgical mask in the patient-care environment when a minimum distance from a person on droplet precautions cannot be maintained.	Strong recommendation, weak evidence
15	Airborne precautions	Airborne precautions, in addition to standard precautions, are implemented in the presence of known or suspected infectious microorganisms that are transmitted from person-to-person by the airborne route and when Aerosol Generating Procedures (AGPs) associated with an increased risk of infection are performed on people with known or suspected infectious microorganisms normally transmitted by the droplet route.	Strong recommendation, weak evidence
16	Airborne precautions	Wear correctly fitted and fit checked respiratory protection (FFP2 respirator) when entering the patient-care area when an airborne-transmissible infectious microorganism is known or suspected to be present and when entering the patient care area where AGPs associated with an increased risk of infection are performed on people with known or suspected infectious microorganisms normally transmitted by the droplet route.	Strong recommendation, weak evidence

17	Personal protective equipment	PPE including use of gloves, respiratory protection, face protection, aprons or gowns should be used as required by the task being performed and in line with standard or transmission-based precautions.	Strong recommendation, weak evidence
18	Personal protective equipment	Wear personal protective equipment to protect the face and eyes during procedures that generate splashes or sprays of blood and body substances into the face and eyes, when entering the patient-care area when an airborne-transmissible infectious microorganism is known or suspected to be present and when entering the patient care area where AGPs associated with an increased risk of infection are performed on people with known or suspected infectious microorganisms normally transmitted by the droplet route.	Strong recommendation, weak evidence
19	Personal protective equipment	Single-use, gloves are worn for: • Each invasive procedure • Direct contact with sterile sites and non-intact skin or mucous membranes • Any activity that has been assessed as carrying a risk of exposure to blood and body substances. Routine use of gloves for all clinical contact with people cared for is not appropriate. Use of gloves is not an alternative to hand hygiene.	Strong recommendation, weak evidence
20	Multidrug-resistant microorganisms	In the acute hospital in-patient setting, contact precautions should generally be applied in caring for people colonised or infected with specific multidrug resistant organisms (MDROs). Contact precautions in this context are generally not appropriate in healthcare settings other than acute hospital in-patient settings.	Strong recommendation, weak evidence

21	Facilities design	When determining the number and type of single rooms in a health care facility, project planning teams should consider: • Trends in disease in the general population and the particular population served • Demographic trends in the population served • Specialties of the health care facility • Projected changes in future clinical activities.	Strong recommendation, weak evidence

1.2 Summary of good practice statements

Practice Statements: Are used for areas which are not covered by a systematic review of the evidence but where the provision of clinical guidance is deemed important. The development of practice statements is primarily based on best practice as advised by expert consensus and aligned with the GRADE approach where available evidence and judgements are considered together. However, a strength is not assigned.

Table 3 Summary of good practice statements

No.	Section	Good Practice Point	*Grade/level
1	Hand hygiene	People who use healthcare services should be educated about the benefits of hand hygiene and how to perform hand hygiene.	Practice statement
2	Hand hygiene	Alcohol-based hand rubs that meet the requirements of European Standard EN 1500 should be used for routine hand hygiene practices.	Practice statement
3	Use and management of sharps, safety engineered devices and medication vials	Dispose of single-use sharps immediately after use into an approved sharps container at the point-of-use. The person who has used the single-use sharp is responsible for its immediate safe disposal. Sharps containers must not be filled above the mark that indicates the maximum fill level.	Practice statement
4	Routine management of physical environment	Maintain a minimum distance of 1m between healthcare service users in the healthcare setting to the greatest extent practical. This reduces the risk of contact and droplet transmission from people with unrecognised contact or droplet transmitted colonisation or infection.	Practice statement

5	Routine management of physical environment	Clean surfaces routinely as follows: • Clean frequently touched surfaces with detergent solution at least daily, when visibly soiled and after every known contamination • Clean general surfaces and fittings when visibly soiled and immediately after spillage • Ensure that water drainage points in sinks and showers drain freely and completely and that surfaces are kept clean and dry.	Practice statement
6	Routine management of physical environment	Clean shared clinical equipment that comes into contact with skin, but not with mucosa, blood or body fluids, (that is non-critical equipment in the Spaulding classification) with a detergent solution between use on different people. Disinfection is also appropriate where indicated (for example colonisation with a Multidrug Resistant Organism). Exceptions to this should be justified by risk assessment.	Practice statement
7	Routine management of physical environment	Use surface barriers to protect surfaces such as examination couches that are in contact with a person's skin particularly if those surfaces are likely to be touched frequently with gloved hands during delivery of care or are likely to be contaminated with blood or body fluids or are difficult to clean. If release of body fluids is expected, the barrier should be impermeable. If the surface beneath the barrier is dirty or wet on removal of the barrier, the underlying surface should be cleaned and if appropriate disinfected. Exceptions to this should be justified by risk assessment.	Practice statement

8	Routine management of physical environment	Perform disinfection using a chlorine-based product such as sodium hypochlorite or another appropriate disinfectant in addition to standard cleaning in specific circumstances as required based on institutional guidance or risk assessment. For routine use, a chlorine-based disinfectant should be used with available chlorine at 1000-parts per million. If a non-chlorine-based disinfectant is used it should be a product suitable for use in a healthcare environment.	Practice statement
9	Droplet precautions	People who require transmission-based precautions (contact, droplet or airborne) should be accommodated in a single-patient room. Where this is not possible, people colonised or infected with the same organism should be cohorted in a discrete area with a minimum distance maintained between the people receiving care in the cohort area. Consistent with the persons care needs, minimise the number of healthcare workers and the time healthcare workers are exposed to an infectious patient.	Practice statement
10	Airborne precautions	Place people on airborne precautions in a room with bathroom facilities and with appropriate controlled ventilation or in a room from which air does not circulate to other areas. Exceptions to this should be justified by risk assessment. Consistent with the persons care needs it is good practice to minimise the number of healthcare workers and the time healthcare workers are exposed within shared airspace with a person on airborne precautions.	Practice statement
11	Multidrug-resistant microorganisms	Healthcare facilities should operate a surveillance system to monitor healthcare associated infections and specific multidrug resistant microorganisms.	Practice statement

12	Outbreak prevention and management	Healthcare service providers should have processes in place to identify people with a communicable infectious disease before attendance/at presentation to the service or as soon as possible after presentation. This is to ensure that such people are cared for with appropriate IPC precautions from the outset. These processes are particularly important during an epidemic/pandemic.	Practice statement
13	Outbreak prevention and management	All residential healthcare facilities (hospitals, residential care facilities, hospices and rehabilitation facilities) should have plans in place for detection and management of outbreaks of infectious disease or colonisation with specific MDROs. Outbreaks should be investigated promptly and thoroughly and a brief outbreak report should be prepared at the conclusion of the outbreak. The outcomes of the investigations should be documented. It is good practice to notify the Medical Officer of Health promptly in writing (for example by email) of the closure of the outbreak and to provide a copy of the outbreak report when completed.	Practice statement
14	Outbreak prevention and management	Consider the use of early bay closures to control known or suspected outbreaks of norovirus and other agents causing gastrointestinal infection rather than immediate closure of entire wards/units.	Practice statement
15	Invasive medical devices	Healthcare facilities should develop, implement and review processes to address the insertion, use, maintenance, and removal of invasive medical devices. These processes should be centred on the principles of only using devices if they are deemed essential, removing them as soon as they are no longer needed and using care bundles while they are in place.	Practice statement

16	Clinical communication in infection prevention and control	Healthcare facilities should have effective clinical communication processes in place that reflects the NCEC Guidelines NCG No 5 Communication (Clinical Handover) in Maternity Services (DOH 2014) and NCG No 11 Communication (Clinical Handover) in Acute and Children's Hospital Services (DOH 2015). This communication should address infection risks and MDROs and include communication when people are transferring between healthcare facilities and when transferring from healthcare facilities to residential care facilities or to home.	Practice statement
17	Skin disinfection	Skin disinfectants including chlorhexidine should only be used when clinically indicated. Chlorhexidine-containing products, devices or solutions must never be used on or around patients with known chlorhexidine hypersensitivity.	Practice statement
18	Vaccinations	All healthcare workers should be appropriately vaccinated in accordance with current national recommendations (Immunisation Guidelines for Ireland at https://www.rcpi.ie/Healthcare-Leadership/NIAC/Immunisation-Guidelines-for-Ireland).	Practice statement (supported by strong evidence of the effectiveness and safety of vaccines)
19	Avoiding work when potentially infectious for others	Healthcare workers must exclude themselves from work and visitors must stay away from healthcare facilities when they have symptoms of a communicable infectious disease. They must adhere to exclusion periods related to all infectious diseases.	Practice statement
20	Continuous professional development for IPC practitioners	Infection prevention and control professionals should participate in ongoing professional development in order to maintain the necessary expertise to fulfil their role. IPC staff at all levels should be supported to access formal and informal education and training relevant to their role.	Practice statement

1.3 Summary of statutory requirements

Statutory requirement: These are used where there is a requirement in Irish or EU law to comply with the statement. Compliance is a legal obligation.

Table 4 Summary of statutory requirements

No.	Section	Statutory requirement	*Grade/level
1	Use and management of sharps, safety engineered devices and medication vials	Statutory requirement SI 135 of 2014 Healthcare workers should adhere to good practice related to safe sharp handling including: • Not passing sharps directly from hand to hand • Keep handling to a minimum • Not recapping, bending or breaking needles after use. *Healthcare workers must also comply with all legislation that controls the management of healthcare risk waste (including sharps) and healthcare non risk waste as well as workplace health and safety.*	Statutory requirement
2	Outbreak prevention and management	Principal Regulation is the Infectious Diseases Regulations 1981 (S.I. No. 390 of 1981). There are subsequent amendments. All outbreaks of infectious disease and individual cases of notifiable infections must be notified promptly to the Medical Officer of Health (in the relevant Department of Public Health).	Statutory requirement

Supporting Resources

Note: that supporting resources are available for healthcare workers, patients and health facility managers on the Austrailian National Health and Medical Research Council (NHMRC) website (https://www.safetyandquality.gov.au/publications-and-resources/resource-library/australian-guidelines-prevention-and-control-infection-healthcare) to support implementation of the Australian Guidelines for the Prevention and Control of Infection in Healthcare (2021). These resources may be helpful for those implementing these Irish NCEC National Clinical Guidelines. Supporting resources specifically relevant to Ireland are also identified in the text.

2 Development of the National Clinical Guideline

Note on terminology: people who use healthcare services may identify themselves or may be referred to as patients, service users, clients, residents, person, supported individual as appropriate to the setting. The preferences of those who access services and of healthcare workers for the term they consider appropriate to their context is important but it is not practical to use all the terms in each instance in this document. For convenience, the default term generally used in this document is patient. The term service user, is also used in some instances.

2.1 Background

Healthcare associated infections (HCAIs) are infections that can develop either as a direct result of healthcare interventions such as medical or surgical treatment, or from being in contact with a healthcare setting. The term HCAIs includes any infection acquired as a direct result of treatment in any health or social care setting or as a result of healthcare delivery in the community (HIQA 2017).

In order to prevent HCAIs, it is important to understand how infections occur in healthcare settings and then put in place measures to prevent them. If effectively implemented, the two-tiered approach of standard and transmission-based precautions recommended in these guidelines provide high-level protection to patients, healthcare workers and other people in healthcare settings.

While the specific risks of HCAI differ with the setting in which healthcare is delivered the basic principles of IPC apply regardless of the setting.

Effective IPC is central to providing high quality healthcare for people who use healthcare services and a safe working environment for those that work in healthcare settings. It has long been apparent healthcare systems can play a major role in accelerating the spread of newly emerging infection diseases. The COVID-19 pandemic brought the importance of IPC into very sharp focus. However, there is nothing fundamentally new about control of spread of COVID-19 compared with control of many other infections that spread in healthcare systems. Control of spread is based on the same principles and precautions (including standard precautions and transmission-based precautions) used to control other infectious diseases.

This document was developed using Australian Guidelines for the Prevention and Control of Infection in Healthcare (2019) as a starting point. The Australian Guidelines were chosen as a starting point in preference to other documents for a number of reasons. They are in the English language. They were the most up-to-date guidelines available at the time. They are comprehensive. They emphasise a risk based approach to IPC practice. The evidence base for recommendations is clearly set out. There are similarities between the structure of healthcare professions and delivery between Australia and Ireland.

2.1.1 IPC is everybody's business

Understanding the way infectious organisms spread and knowing how and when to apply the basic principles of IPC is critical to the success of an IPC programme. The overall responsibility for the success of the IPC programme rests primarily with the health service management team. Everybody working in a healthcare facility, using services or visiting the facility has a responsibility to support the programme. This includes all staff, people using healthcare services and visitors. Good IPC is essential to good clinical care. IPC services in healthcare facilities exist to support everyone in delivering clean, safe care. IPC is not a discrete set of practices owned by IPC practitioners.

Successful approaches for preventing and reducing harms arising from HCAIs involve applying a risk-management framework to manage 'human' and 'system' factors associated with the transmission of infectious microorganisms. This approach ensures that infectious microorganisms, whether common (for example, gastrointestinal viruses), uncommon or associated with a pandemic can be managed effectively. In addition to prevention of transmission of infectious microorganisms the harm associated with transmission can be reduced by reducing the vulnerability of people to infection. Reducing the vulnerability of people using healthcare services to infection includes promoting appropriate vaccination, minimising use of invasive devices as well as personal care, nutrition and mobilisation.

Involving people who use healthcare services and their carers is essential to successful IPC in clinical care. People using healthcare services and those who visit them need to be sufficiently informed to be able to participate in reducing the risk of transmission of infectious microorganisms.

2.1.2 Basics of IPC: IPC in the healthcare setting

Summary

- Infectious microorganisms (also called pathogens) are biological organisms that frequently cause human infection. Infection refers to the invasion of body tissues by a microorganism. Microorganisms may only cause infection in a proportion of people to whom they are transmitted and infection may only cause disease in a proportion of people who are infected.
- Colonisation, in this context, refers to a situation in which a microorganism is established on a person's body (for example on skin, mucous membrane or wound) but is not causing infection at that time. Although the person who is colonised is not infected, the organism may spread from a colonised person to others and or subsequently cause infection in the colonised person.
- Infection that does not result in any illness or disease is referred to as asymptomatic infection. Asymptomatic infection is a common phenomenon with some infectious microorganisms and has become a focus of much attention during the COVID-19 pandemic. Although people who are colonised do not have disease, the organism may spread to others from them.
- Many different infectious microorganisms are present in healthcare settings.
- For infection to spread, 6 elements are required - causative microorganism (pathogen), reservoir, means of transmission, portal of entry, susceptible host, portal of exit. These 6 elements form what is commonly referred to as The Chain of Infection, Figure 1.
- People who use healthcare services and healthcare workers are most likely to be sources of infectious microorganisms and are also the most common susceptible hosts. Other people visiting and working in healthcare may also be at risk of infection and may be a source of transmission.
- In healthcare settings, the main ways that infectious microorganisms spread are by contact (direct and indirect) and by spread through the air. Spread through the air is categorised as either droplet or airborne transmission.

2.1.3 Healthcare associated infection (HCAI)

Almost all infectious disease is associated with microorganisms including bacteria, virus and protozoa. Notable exceptions are those associated with larger parasites (worms, fleas, lice and scabies mites) and those associated with prion proteins. In general, this document will refer to microorganisms except when reference to other infectious agents is specifically required. The broad principles of IPC that apply are similar for all infectious microorganisms.

Microorganisms exist naturally everywhere in the environment. Most microorganisms do not cause infection in otherwise healthy people (for example 'good' bacteria present in the body's normal flora). However, some microorganisms can cause infection and disease in a proportion of otherwise healthy people and almost any microorganism can cause infection in some very vulnerable people.

Microorganisms including bacteria, viruses, fungi and protozoa – can be involved in causing either colonisation or infection, depending on the susceptibility of the host:

- With colonisation, there is a sustained presence of replicating microorganisms on or in the body, without causing infection or disease
- With infection, invasion of infectious microorganisms into the body results in an immune response, with or without symptomatic disease.

Transmission of infectious microorganisms within a healthcare setting requires all of the following elements:

- Causative microorganism (pathogen)
- Reservoir
- Means of transmission
- Portal of entry
- A susceptible host
- Portal of exit.

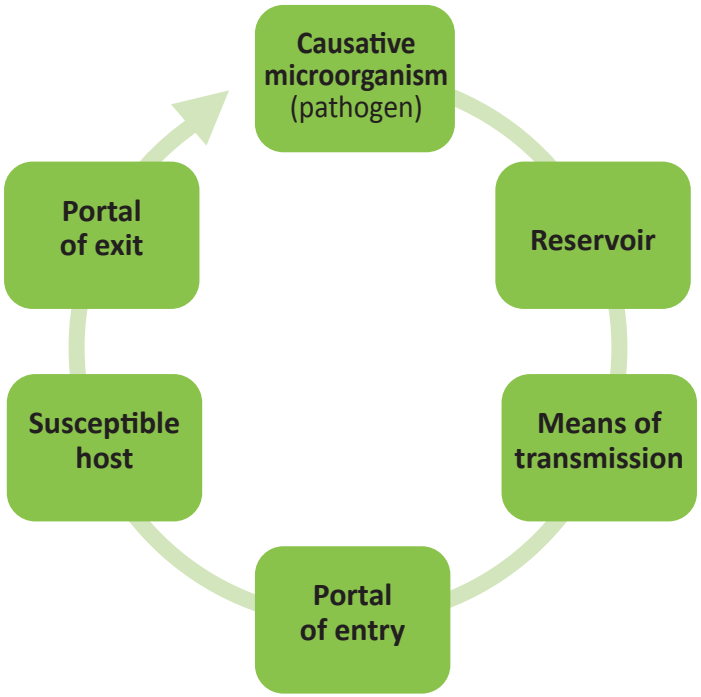

Figure 1 The chain of infection

Infectious microorganisms transmitted during healthcare come primarily from human sources, including people who use healthcare services, healthcare workers and visitors. Source individuals may be actively ill, may have no symptoms but be in the incubation period of a disease or may be temporary or long-term carriers of an infectious microorganism with or without symptoms. Infectious microorganisms may also reside in the healthcare environment.

Infection is the result of a complex interrelationship between a host and an infectious microorganism. People vary in their response to exposure to an infectious microorganism:

- Some people exposed to infectious microorganisms become infected quite quickly and then become severely ill and may die
- Some people exposed to infectious microorganisms become infected but have a very mild illness or no illness
- Some people may become temporarily or permanently colonised but never become infected
- Some people develop colonisation at first but go on to develop infection either soon after exposure or weeks or months after they become colonised.

Important predictors of an individual's outcome after exposure to a microorganism or infectious microorganism include:

- Their immune status at the time of exposure. For some infectious microorganisms' previous infection or vaccination may confer lasting immunity **(acquired immunity)** to infection and or to disease caused by the microorganism (for example measles virus). For other infectious microorganisms lasting immunity does not occur reliably and there may be no vaccine
- In a pandemic of a newly emerged infectious microorganism the fact that no one in the population has acquired **immunity** means that everyone is vulnerable to infection with that microorganism and therefore the control of spread of the microorganism is more difficult to achieve

In addition to the effect of previous infection and vaccination, immune status depends on other factors and may be compromised by medical treatment (such as immunosuppressive drugs or irradiation). Examples of other factors include:

- The persons age (for example new-borns and older people are generally more susceptible)
- Their general health status (when a person has other underlying disease such as diabetes or is a smoker there are 'comorbidities' that increase risk of infection)
- The virulence of the infectious microorganism (virulence means the ability of the microorganism to cause illness)
- Other factors that increase the risk of developing infection (for example undergoing surgery, requiring an indwelling device such as a catheter or remaining in hospital for lengthy periods).

Figure 2 summarises key factors that influence the occurrence of healthcare associated infection in an individual following exposure to a microorganism.

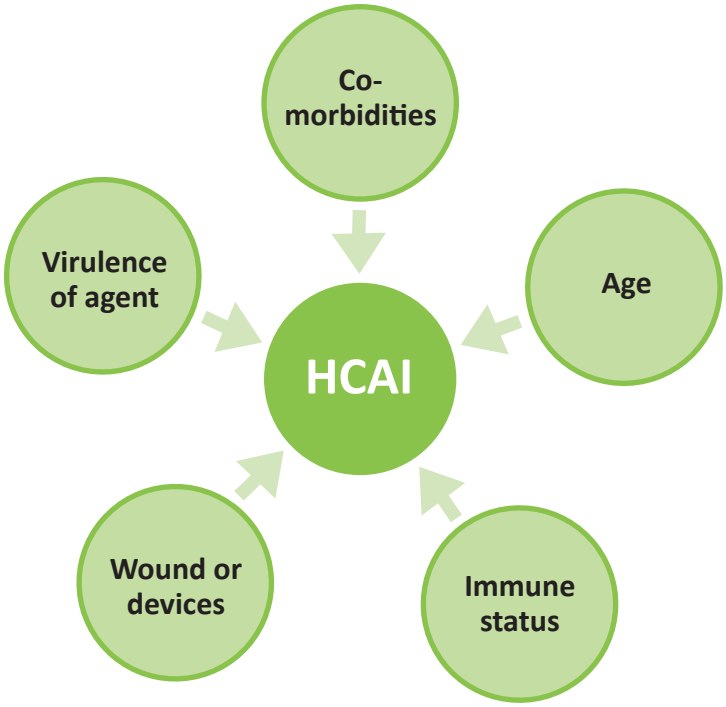

Figure 2 Factors influencing healthcare associated infection

In healthcare settings, the most common susceptible hosts are people who use healthcare services and healthcare workers:

- People who use healthcare services may be exposed to microorganisms from themselves (endogenous infection). These microorganisms include bacteria residing on their skin, in the respiratory or gastrointestinal tract. They may be exposed to microorganisms from other people, from instruments and equipment, or the environment (exogenous infection). The level of risk of being exposed to microorganisms relates to the healthcare setting (specifically, the type of microorganism's present), the type of healthcare procedures performed, adherence to hand hygiene, vaccination status of people who use healthcare services and staff and the general susceptibility of the person
- Healthcare workers may be exposed to microorganisms from infected or colonised people who use healthcare services, instruments and equipment, or the environment. The level of risk relates to the type of clinical contact healthcare workers have with potentially infected or colonised people, instruments or environments, adherence to standard and transmission-based precautions, and the health status of the healthcare worker (for example immunised or immunocompromised).

In healthcare settings, the main modes of transmission of microorganisms are contact (including blood borne) and spread through the air (droplet and airborne transmission). The modes of transmission vary by type of microorganism. In some cases, the same microorganism may be transmitted by more than one route (for example norovirus, influenza and respiratory syncytial virus (RSV) can be transmitted by contact and droplet routes).

Routes of transmission

Contact transmission

Contact is the most common mode of transmission and usually involves transmission by touch, in particular contact with blood or body substances. Contact may be direct or indirect:

- *Direct contact transmission* occurs when microorganisms are transferred directly from one person to another – for example, the blood of a person using healthcare services entering a healthcare workers body through an unprotected cut in the skin
- *Indirect contact transmission* involves the transfer of microorganisms through a contaminated intermediate object or person – for example, a healthcare workers hands transmitting microorganisms to a person using healthcare services after touching an infected body site on another person, or a healthcare worker coming into contact with fomites (for example bedding) or faeces and then with a person using healthcare services.

Examples of microorganisms transmitted by contact include multidrug resistant organisms (MDROs), *Clostridioides difficile* (formerly *Clostridium difficile*), bacteria (*Streptococcus pyogenes/Staphylococcus aureus*) which can cause highly contagious skin infections (for example impetigo) and mites that cause infestations (for example scabies).

Droplets and aerosols

Respiratory viruses, including SARS-CoV-2 and Influenza virus are present in oral and respiratory fluids. Transmission of these viral agents occurs mainly as a consequence of shedding of virus in liquid respiratory particles into the air from the respiratory tract of an infectious person. These particles are shed when coughing, sneezing, talking and breathing. Respiratory particles shed from the respiratory tract can cause infection if the virus in the particles reaches the respiratory mucosa of a susceptible person. This is much more likely to occur in indoor and other enclosed settings. The virus can reach the respiratory tract mucosa (eyes, nose and mouth) of a susceptible person in two ways:

(1) travelling directly through the air to the respiratory tract or

(2) indirectly as a result of contamination of hands or other surfaces and subsequent transfer to the respiratory mucosa (see above regarding contact transmission).

Transmission directly through the air to the respiratory tract

In relation to IPC theory and practice, direct transmission of infectious microorganisms through the air to the respiratory tract is represented as being comprised of two categories of droplet and airborne transmission.

The standard theoretical background to droplet and aerosol transmission

Within this framework liquid respiratory particles are considered as droplets (larger liquid particles) or aerosols (smaller particles). A cut-off value of 5 microns diameter is applied to differentiate between the two categories. Liquid particles with a diameter of more than 5 microns are considered droplets and those with a diameter of less than 5 microns are considered aerosols.

Droplets are expected to land on surfaces or to fall out of the air on to surfaces, including respiratory mucosa, quickly and within a short distance of where they are generated. Spread in this way is known as droplet transmission.

Aerosols are expected to stay suspended in the air for an extended period and to travel throughout the air space within which they are generated. Transmission in this way is airborne transmission.

Some infectious agents including (*Neisseria meningitidis*, Influenza virus, Respiratory Syncytial Virus) are considered as predominantly droplet transmitted and others including *Mycobacterium tuberculosis*, chickenpox and measles are considered as classically airborne transmitted. Within that standard framework of droplet and airborne transmission the distinction between droplet and airborne transmission is not absolute. While some infectious microorganisms are predominantly droplet transmitted they can be airborne transmitted in some circumstances. One example is when aerosol generating procedures (AGPs) with an increased risk of transmission of infection are performed. AGPs are certain medical procedures for example endotracheal intubation.

The COVID-19 pandemic prompted extensive research and review of evidence regarding the physics of liquid particles generated from the respiratory tract and pathways of direct transmission of virus through the air. Liquid particles are generated from the respiratory tract when breathing, talking, singing, shouting or laughing. It is increasingly accepted that the division of these particles into two discrete categories of droplets and aerosols is not well supported. There is a continuous range in size of particles from those large enough to see with the naked eye to those that are invisible. Some are so small that they are measured in nanometres. How long any individual respiratory particle stays in the air and how far it travels before landing on a surface depends on a range of factors. Amongst other factors, these include the size of the particle, the force with which it is scattered from the nose or mouth and the extent of air movement in the air space. Particles, including those greater than 5 microns in diameter, may be borne upwards on warm, turbulent airflow from exhaled human breath, rather than fall directly to the ground under the influence of gravity. Subsequent intensity of exposure of an individual to particles will depend on the rate of settling of particles and air exchange in the air space both of which are influenced by factors such as prevailing air currents and ventilation. Based on these considerations the distinction between droplets and aerosols and between droplet transmission and airborne transmission may be considered as useful for practical purposes but considered as overlapping categories rather than discrete categories. This is well summarised in a recent paper by Randall and others (Randall *et al*. 2021). The relative importance long-range airborne transmission of SARS-CoV-2 is the subject of ongoing discussion. However, there is persuasive evidence that transmission over longer distances in smaller respiratory particles occurs in some circumstances (Duval *et al.* 2022).

The likelihood of transmission of infection from liquid respiratory particles in any setting will depend on the proportion of particles that carry infectious organisms, how much organism they carry and on the quantity of organism required to establish infection (infectious dose). Lower infectious dose is associated with a higher probability of infection at lower intensity of exposure. In the case of SARS-CoV-2, variants emerged in the course of the pandemic (for example alpha and delta variants) that are more readily transmissible than the original form of the virus and that were reported as more commonly associated with transmission in indoor, poorly ventilated places over a longer range. Variation in patterns of transmission between different variants of a specific virus (such as SARS-CoV-2) supports the view that droplet and airborne transmission are overlapping rather than discrete categories.

Although the categories are not discrete, IPC practitioners find that the categories of **droplet** and **airborne** transmission have a practical utility for concise communication with healthcare workers regarding the set of IPC precautions recommended for specific circumstances. For this reason, these terms are retained in this guidance. However, it is important that those who use and communicate regarding those categories understand their limitations.

Limitations of categories of droplet and aerosol and of droplet transmission and aerosol transmission

An understanding of transmission of infectious agents through the air should be based on the continuum of risk associated with potentially infectious liquid particles from the respiratory tract. The basis for using the general categories "droplet" and "airborne" categories are more soundly based on observed patterns of transmission rather than on the physics of respiratory particles. Some agents are predominantly transmitted to susceptible people in close proximity to the source. A distance of 1m is widely used as a guide in this context although some authorities use distances of 1.5, 1.8 or 2m. This pattern of relatively short range transmission is generally referred to as droplet transmission. Some agents are readily transmitted to susceptible people anywhere within an enclosed air space that is shared with the source of infection. This pattern of transmission is generally referred to as airborne transmission. Organisms with an airborne pattern of transmission have also been observed to transmit readily to susceptible people who enter the air space soon after the infectious person has vacated the space.

For a susceptible person in shared air space with a person shedding an infectious organism in respiratory particles the risk of transmission through the air is very complex.

Factors influencing the risk are likely to include the following:

- How much infectious organism is being shed by the infectious person
- How infectious the organism is (infectious dose)
- How long the susceptible person is in the shared air space
- How close they are to the nose and mouth of the infectious person
- Their orientation towards the infected person (are they directly facing the infectious person)
- How forcefully the infectious person is scattering respiratory particles
- What barriers (including masks) are in place that impede the particles
- The degree to which air movement and ventilation keep the particles suspended and/or dilute the particles.

Recognising that droplet and airborne transmission are not discrete categories has practical implications in that it points to a general requirement for increased emphasis on capacity for adequate ventilation in healthcare facilities. Any healthcare facility may deal with infectious agents transmitted through the air and infectious people may not always be easy to recognise. Ventilation, either natural ventilation or mechanical ventilation depending on the nature of the healthcare service should be appropriate for the setting. Furthermore, IPC practitioners will frequently need to carry out risk assessments to manage the risk of transmission through the air within the available facilities.

In addition to the typical pattern of transmission associated with the infectious agent (droplet or airborne patterns) the risk assessment will consider:

- The likelihood that infectious people are present
- The susceptibility to infection of potentially exposed people
- The likely intensity of exposure in any given situation
- The available built environment.

In circumstances where transmission of infection through the air is identified as a risk, the following core components for risk reduction should be considered:

- Vaccination of susceptible individuals against the infectious disease when an effective vaccine is available
- Minimise the number of people who share air space with an infectious person by patient placement in a place that supports limiting the number of other people exposed (ideally closed room with controlled ventilation)
- In so far as consistent with good patient care, minimise the duration of exposure of those people who must enter the space where the patient is placed
- Minimise the shedding of microorganisms by the infectious person (anti-infective agents where these are of proven benefit)
- Minimise the scattering of microorganisms by the infectious person (respiratory and cough etiquette and wearing mask if tolerated)
- Maintain as much distance as is reasonably practical while in the shared air space
- Maintain ventilation (often natural, mechanical where required) as much as practical to dilute infectious particles
- Use of appropriate personal protective equipment including an appropriate face mask.

Some agents are associated with variable or intermediate patterns of spread in different contexts. These can be particularly challenging to manage in terms of assessing and managing the risks in particular circumstances.

In day-to-day practice IPC practitioners may continue to use the terms droplet transmission and airborne transmission as labels for general patterns of transmission but with an awareness of the limitations of these terms and the extent to which patterns of transmission may vary with circumstances and virus variants. In general, where there is doubt, a higher level of transmission-based precautions should apply. This must take account of what is practical within the limits of available facilities although these issues should inform future new building and refurbishment.

2.1.4 Standard and transmission-based precautions

Successful IPC involves implementing work practices that reduce the risk of transmission of microorganisms through a two-tiered approach, including:

- Routinely applying basic IPC strategies to minimise risk to both people who use healthcare services and healthcare workers, such as hand hygiene, respiratory hygiene, appropriate use of personal protective equipment, cleaning and safe handling and disposal of sharps (standard precautions)
- Effectively managing microorganisms where standard precautions may not be sufficient on their own – these specific interventions control infection by interrupting the mode of transmission (transmission-based precautions).

2.1.5 Standard Precautions

All people potentially harbour infectious microorganisms. Standard precautions refer to those work practices that are applied to everyone, regardless of their perceived or confirmed infectious status. Standard precautions ensure a basic level of IPC. Implementing standard precautions as a first-line approach to IPC in the healthcare environment minimises the risk of transmission of microorganisms from person to person, even in high-risk situations.

Standard precautions are used by healthcare workers to prevent or reduce the likelihood of transmission of microorganisms from one person or place to another and to render and maintain objects and areas as free as possible from infectious microorganisms. Guidance on implementing standard precautions is given in Sections 3.1, 3.3, 3.11, 7.2 and 7.3.

2.1.6 How standard precautions are implemented:

- Personal hygiene practices, particularly hand hygiene, aim to reduce the risk of contact transmission of microorganisms (see sections 3.1.1)
- Appropriate use of personal protective equipment, which may include gloves, gowns, disposable aprons, masks/face shields and eye protection, aims to prevent exposure of the healthcare worker and people who use healthcare services to infectious microorganisms (see section 3.3)
- Safe handling and disposal of sharps assist in preventing transmission of blood borne virus to people who use healthcare services and to healthcare workers (see section 3.1.2)
- Environmental controls including cleaning and spills management, assist in preventing transmission of microorganisms from the environment to people who use healthcare services and healthcare workers (see sections 3.1.3 and 3.11.1)
- Single use equipment and appropriate reprocessing of reusable equipment and instruments including appropriate use of disinfectants, aims to prevent person to person transmission of microorganisms (see section 3.1.4)
- Practising respiratory hygiene and cough etiquette reduces the risk of transmission of infectious microorganisms spread by droplets and aerosols (see section 3.1.5)
- Aseptic technique aims to prevent microorganisms on hands, surfaces or equipment from being introduced into a susceptible site (see section 3.1.6)
- Appropriate handling and disposal of waste and linen assists in reducing transmission of microorganisms (see sections 3.1.7 and 3.1.8).

2.1.7 Transmission-based precautions

Any IPC strategy should be based on the use of standard precautions as a minimum level of control. Transmission-based precautions are recommended as additional work practices in situations where standard precautions alone may be insufficient to prevent transmission. This includes the use of transmission-based precautions in the event of an outbreak (for example gastroenteritis) to assist in containing the outbreak and preventing further infection.

Transmission-based precautions should be tailored to the particular infectious microorganisms involved and its mode of transmission. This may involve a combination of practices.

Guidance on when and how to implement transmission-based precautions is given in sections 3.2, 3.5 and section 7.3.

2.1.8 Types of transmission-based precautions

- **Contact precautions** are used when there is a known or suspected risk of direct or indirect transmission of infectious microorganisms that is not effectively contained by standard precautions alone (see Section 3.2.2).

- **Droplet precautions** are used for people who use healthcare services who are known or suspected to be infected with microorganisms transmitted over short distances by large respiratory droplets (see section 3.2.3).
- **Airborne precautions** are used for people who use healthcare services who are known or suspected to be infected with microorganisms transmitted from person to person by the airborne route and for microorganism transmitted by droplets when (AGPs) aerosol generating procedures associated with an increased risk of infection are performed. (see section 3.2.4).

2.1.9 Strategies for implementing transmission-based precautions:

- HCWs perform an assessment of risk when a person first presents to a service in any setting in order to anticipate and communicate the potential need for transmission-based precautions at every step of subsequent care
- Allocating a single room inclusive of bathroom facilities to any person with a suspected or confirmed infection that requires transmission-based precautions and closing the door (source isolation)
- Placing people colonised or infected with the same infectious microorganism in a room together (cohorting). Note: for this purpose "the same infectious microorganism" means that there is no difference of clinical consequence between the microorganisms. For this purpose, a patient with infection with *M. tuberculosis* fully sensitive to anti-tuberculosis agents does not have "the same organism" as a patient with infection with *M. tuberculosis* resistant to anti-tuberculosis agents
- Wearing specific personal protective equipment and removal after use
- Providing patient dedicated equipment
- Providing a clean environment and using sodium hypochlorite or other appropriate disinfectant as required
- Using specific air handling techniques when required
- Restricting the movement of both people who use healthcare services and healthcare workers in so far as possible consistent with meeting care needs.

2.1.10 Overview of risk management in IPC

Summary

- Identifying and analysing risks associated with healthcare is an integral part of successful IPC
- Adopting a risk-management approach at all levels of the facility is necessary. This task is primarily the responsibility of the facility's management. It requires cooperation between management, healthcare workers and support staff and the support of people using healthcare services and visitors
- Differing types and levels of risk exist in different healthcare settings. In adapting this guidance, each healthcare facility should conduct its own risk assessment (that is to consider how to avoid, identify, analyse, evaluate and treat risks in that setting) and also refer to discipline-specific guidance where relevant.

2.1.11 Risk management basics

In the context of these guidelines, the principal risk is the possibility for microorganism colonisation or infection in people using healthcare services or healthcare workers arising from activities within a healthcare service. Effective risk management is key for preventing and reducing harm arising from healthcare associated infection.

A successful approach to risk management occurs on many levels within a healthcare service:

- Service/facility wide – for example, providing support for effective risk management through an organisational risk-management policy, staff training, follow up of outcomes, monitoring and reporting
- Ward, department or practice based – for example, embedding risk management into all policies so that risks are considered in every situation
- Individual – for example, considering the risks involved in carrying out a specific procedure and questioning the necessity of the procedure as part of clinical decision making, attending education sessions (for example hand hygiene or respirator fit testing). Note: that it is valuable to support patients/service users to contribute to risk assessments that relate to their care.

As healthcare settings differ greatly in their day to day function, it is not possible to provide a one size fits all approach to risk management. Even within a single setting (for example primary care), increasingly complex care is delivered by a range of health professionals with diverse qualifications and training. All healthcare services and facilities need to be able to determine the risks in their own context and select the appropriate course of action. Therefore, it is necessary for services and facilities to regularly conduct IPC risk assessments and ensure that all staff understand their responsibility in managing these risks.

The HSE Integrated Risk Management Policy 2017 provides additional information on risk management in the healthcare system in Ireland. https://www.hse.ie/eng/about/who/riskmanagement/risk-management-documentation/hse-integrated-risk-management-policy-part-2-risk-assessment-and-treatment.pdf

The risk management process as outlined in the document is summarised below:

1. Establishing the context – means defining the external and internal factors that must be considered when managing risk for example key stakeholders, the legal and regulatory framework, type of health service/facility, extent of and support for the facility's IPC programme.
2. Risk assessment is comprised of three steps:
   (a) Risk identification – a risk is something that may happen that could impact on the delivery of clean safe care. Ideally a risk should be identified before an incident has happened
   (b) Risk analysis – is a process that is used to gain a better understanding of the risk identified and the level of risk associated with it. Assessing the level of associated risk takes account of controls in place to mitigate the risk
   (c) Risk evaluation – this a process to determine if the level of risk is acceptable. If the risk is not acceptable it is essential to consider how to treat the risk.
3. Risk treatment - this is the process of selecting and implementing measures to modify the risk.

Monitoring and review is an essential component of the risk management process. This ensures that:

- New risks are identified
- Risk assessment is reviewed in the context of data on incidents (if possible)
- Risk treatment is implemented effectively.

Communication and consultation are also key elements of clinical risk management. An interactive exchange of information between management, healthcare workers, people who use healthcare services and other stakeholders provides the basis for increased awareness of the importance of IPC, identification of risks before they arise and prompt management of risks as they occur.

Using an impact and likelihood scoring risk matrix as outlined in the HSE Integrated Risk Management Policy may assist with risk analysis and provide input into evaluation and decision making on whether the risks need action and what the most appropriate risk treatment strategies and methods may be.

An important part of reducing risk is the appropriate management and learning from incidents. The HSE Incident Management Framework (2020) provides a comprehensive approach to incident management. https://www.hse.ie/eng/about/who/nqpsd/qps-incident-management/incident-management/hse-2020-incident-management-framework-guidance.pdf

Applying the risk management process

The following case study gives an example of applying the risk-management process in a primary care setting. Case studies giving examples of how to use this process in primary, acute and long-term care settings, including relevant considerations in specific situations are included Appendix 7. While the basic process of risk management applies regardless of setting, all healthcare facilities should develop risk management policies and procedures that are appropriate to the setting.

2.1.12 Case study: Measles virus outbreak

The Department of Public Health inform a general practice of an outbreak of measles. The Department of Public Health will assist the practice with advice about management of potential exposures. Information about the outbreak is communicated to all practice staff.

1. **Establish the context**
   The context is a large general practice in the outer suburbs of Dublin, which caters for a diverse group of patients including disadvantaged groups and many young families.
2. **Risk assessment**
   a) Risk identification

   The risk is transmission of measles virus in the practice.

   b) Risk analysis

   Measles is a highly transmissible infection; routes of transmission include airborne transmission. The degree of risk depends on the number of non-immune patients or staff in the general practice and community, and also the appropriateness of IPC practices in place. There is a risk of transmission of measles, primarily from infectious patients in the waiting room. The infection can be transmitted to any susceptible person breathing the same air as the infectious patient while the patient is present and for up to two hours after the patient has left the area. The infection also has the potential for indirect contact transmission if droplets settle on to surfaces. If appropriate IPC measures are already in place, then the risk may already be adequately addressed (treated).

c) Risk evaluation

If it is assessed as likely that a patient with measles will attend the practice and be in contact with a susceptible person and the consequence of transmission of measles is assessed as moderate to major, this is not an acceptable level of risk and additional risk treatment is required promptly.

3. Risk treatment

Suspected cases and cases of measles should be identified as quickly as possible and be managed from an IPC perspective as infectious cases whilst awaiting laboratory results.

Intermediate responses may include:

- Establish if all staff members are immune to measles
- Placing signs at the entrance to the practice advising people to phone if they suspect they have measles or if they have a skin rash and temperature
- Examine suspected cases in their own home where possible or arrange for them to be seen when the surgery is otherwise empty, for example at the end of a clinical session
- Communicate with the public by local media and or social media and display information for people coming to the practice at reception warning about suspected measles cases
- Identifying and managing any person that presents at the practice with suspected measles or similar symptoms for example suspected cases should avoid the waiting room
- Suspected cases should be given surgical mask to wear and if at all possible taken to a separate room where they can be assessed by staff who are known to be immune to measles. If there is no separate room and they travelled to the surgery by car, it may be possible for them to wait in the car until they are seen
- Perform the consultation in a room which can remain vacant for two hours post consultation with suspected cases
- Identify any known high-risk patients (for example infants and unvaccinated children, immunocompromised patients) who may have an appointment at the general practice and consider potential for exposure
- Respiratory etiquette and hand hygiene can be encouraged through communication / information resources and staff
- Thorough surface and environmental cleaning and disinfection
- Clinically suspected and confirmed cases should be notified to the Medical Officer of Health promptly.

Long-term measures may include:

- Providing additional education to staff on measles identification and management including the process for reporting this notifiable disease to the Medical Officer of health and use of airborne precautions
- Review staff vaccination policy and records
- At risk staff who are not known to be immune and have not been vaccinated can be identified and encouraged to be immunised.

Consider which risks need to be actively managed, how this will be achieved, and prioritise which actions to take based on the impacts. A tabular format for evaluation of risk treatment options such a illustrated in Table 5 below may help to determine the ease and impact of possible strategies when deciding which to implement. Note: that priority must be given to activities that address risks that are high and which could have a potentially catastrophic outcome.

Table 5 Examples of evaluation of risk treatment options

Example	Ease	Analysis	Impact
Ensure all staff have been immunised against measles	Easy	Measles vaccine is highly effective and safe	High
Ensure all staff have been trained in appropriate infection prevention and control including use of appropriate personal protective equipment	Moderate	Good IPC practice helps protect staff from measles and all other infectious disease	High
Clean and disinfect surfaces	Easy	Potential for measles contact transmission if droplets settle on surfaces	High
Isolation of suspected cases and use of surgical mask	Easy	Isolation of suspected case reduces the risk of exposure of others to infectious aerosols. Use of a surgical mask by patient may reduce dispersal of aerosols	High
Provide alcohol-based hand rub (ABHR) in waiting, clinical rooms and consultation rooms	Easy	Shown to improve compliance with hand hygiene, which has an impact on the spread of HCAI	High
Consider if people travelling by car can wait in their car until called to be seen	Easy	May reduce number of people exposed and duration of exposure	High

4. Monitor and review

- Each clinical suspected and confirmed case of measles identified should be notified to the Medical Officer of Health promptly.
- Monitor and/or follow up with any known at-risk patients for example immunocompromised.
- Provide feedback to staff.

Source: Adapted from Australian Guidelines for the Prevention and Control of Infection in Healthcare (2019).

2.1.13 A person centred approach

Summary

- Healthcare services and facilities need to take an organisational approach to involving people who use healthcare services in their care.
- A person-centred healthcare system is known to be associated with safer and higher quality care.
- A two-way approach that encourages participation by people who use healthcare services is essential to successful IPC.

Person-centred healthcare

Person-centred healthcare is respectful of, and responsive to, the preferences, needs and values of people who use healthcare services. Care of children must facilitate the central role of parents and guardians in their care. People receiving healthcare, and in the case of children, their parents and guardians, increasingly expect to be given information about their condition and treatment options and this extends to their rights and responsibilities as users of healthcare services. The best possible outcomes are more likely where person-centred health care is a priority of the healthcare facility and a strong and consistent effort is made to respect the rights and expectations of people who use healthcare services.

The National Healthcare Charter 2012, You and Your Health Service sets out what patients and families can expect in this regard when using healthcare services in Ireland and what patients and families can do to help the health service deliver more effective and safe services.
https://www.hse.ie/eng/services/yourhealthservice/hcharter/

2.1.14 How does person centred care relate to IPC?

The purpose of IPC is to support people's access to appropriate care that is clean and safe. Effective IPC is central to providing high quality person-centred healthcare.

Putting people who use healthcare services at the centre of IPC and enabling them to participate in the care process is not just about explaining the risks of treatments but involves considering the person's needs at every level. This has to be balanced with the requirement to maintain an environment for everyone (other service users and staff) where care can be delivered in a safe manner, which minimises the spread of infection. This ranges from designing the facility to maximise comfort and safety for service users to having a range of processes to engage people in their care. Healthcare workers need to listen and act on feedback from service users as well as provide the person with education and support so that they can be involved in looking after themselves.

To support a two-way approach to IPC and encourage the participation of people using the service in actions to minimise cross-infection or transmission of infectious microorganisms, it is important to:

- Take perspectives of people who use healthcare services into account when developing policies and programmes
- Familiarise people who use healthcare services with the IPC strategies that are employed in healthcare facilities to protect them, the people caring for them and the healthcare environment
- Discuss with people who use healthcare services the specific risks associated with their medical and/or surgical treatment

- Encourage people who use healthcare services to disclose their health or risk status to healthcare workers or others within the healthcare facility if there is a potential risk or source of infection
- Provide opportunities for people who use healthcare services to identify and communicate risk and encourage them to use feedback procedures for any concerns that they have about IPC practices
- Provide educational materials about IPC using a variety of media (for example posters in waiting rooms, printed material and educational videos)
- Inform people who use healthcare services about the protocols for protecting their privacy and confidentiality.

2.1.15 Involving people who use healthcare services in their care

People who use healthcare services and visitors should be informed of what they can do to prevent the spread of infection and keep themselves safe from infection in healthcare settings. Healthcare organisations should provide specific information to people who use healthcare services to assist them in becoming involved in identifying and reducing risks.

Healthcare workers should, where possible:

- Explain the processes of IPC (for example the importance of hand hygiene, reasons for wearing personal protective equipment (PPE), importance of appropriate handling and disposing of sharps) to people who use healthcare services and their carers
- Engage people who use healthcare services and their carers in the decision-making process regarding their care and how it is delivered
- Ensure all people who use healthcare services and their carers are aware that they are welcome to ask questions of healthcare professionals.

Written material (such as brochures and posters) can be used to reinforce verbal discussions with people who use healthcare services as part of their care. This information aims to inform people who use healthcare services, visitors, families and carers about healthcare associated infection, what activities healthcare facilities may have in place to reduce the risk of infections as much as possible and what they, as people who use healthcare services, can do to limit the number of infections. Information for people who use healthcare services is available at www.hse.ie/infectioncontrol. There is also information available on a number of specific microorganisms associated with HCAI. Information developed for patients and service users should be developed with regard to ensuring the materials are accessible to most people. The National Adult Literacy Agency (NALA at https://www.nala.ie) provide support for ensuring that written information is user friendly. Where standardised materials are available at national level it is generally preferable to use those materials to ensure that messages are consistent. A number of such materials are available at https://bit.ly/3CRmRaI.

Some examples of the types of information that should be provided to people who use healthcare services are below:

- Wearing of gowns, gloves and masks, when required for the task being performed, is a common part of IPC in healthcare – it is used for everybody's safety. Healthcare workers sometimes use the term PPE for these items
- Healthcare workers should clean their hands before putting on and after removing gowns, gloves and masks. When gloves are required this is always in addition to cleaning hands and not instead of cleaning hands

- Items of PPE are used in the patient care area – healthcare workers usually remove the PPE before they leave the area to reduce the risk of spreading infection. There may be some exceptions to this when PPE is removed after leaving the patient care area
- Gowns or aprons are used so that the healthcare workers skin or clothing does not become contaminated
- Healthcare workers may wear a mask if there is a risk that they may be exposed to infection through the air or if there is risk that they may shed an infectious microorganism from their nose or mouth (for example the SARS-CoV-2 virus)
- Eye protection (eye goggles or face shield) is worn by a healthcare worker in situations where fluid from the person cared for may splash on to their eyes and face or droplets from the nose or mouth of the person cared for may land in their eye
- Healthcare workers wear gloves when they will have direct hand contact with blood or body fluid, mucous membranes or wounds or if there is a substantial risk that touching the person cared for could transmit infection
- People who are sensitive or allergic to latex should tell their healthcare workers to ensure that latex containing products are not used. Nitrile gloves are now generally used in Ireland which helps to protect people who use healthcare services and staff from risk of reaction to latex
- IPC practices may change at different times during care depending on the situation at that time
- People who use healthcare services are welcome to ask a healthcare worker about whether the healthcare worker has performed hand hygiene and if they should be using PPE or whether they are using it properly
- Healthcare workers are at risk of injury and infection when using sharp equipment such as needles and scalpel
- Healthcare workers take steps to handle sharp devices in a way that prevents injury to the user and to others who may come across the device during or after a procedure
- Special containers, often called sharps bins, are used for the disposal of sharp devices
- People who use healthcare services are welcome to ask a healthcare worker about the way in which they are handling or disposing of sharp devices
- People who need to use sharps after going home should check that they have been told how to use them and dispose of them safely.

Outbreak situations may require people who use healthcare services to be aware of changes to IPC activities within the healthcare facility:

- An outbreak means that somebody has noticed that there is or probably is spread of an infectious microorganism between people or that more people than is usual are getting a particular type of infection. An outbreak may involve two people or many people. Outbreaks can be associated with any healthcare facility and can cause a lot of service disruption. Staff must act quickly if they know or suspect that there is an outbreak of an infection. Actions may include testing people to see who may be carrying the infectious microorganism, placing people in single rooms or with other people who have the infection and limiting movements of people around the facility
- Hand hygiene is the most important part of preventing spread in most outbreaks
- If people from a ward/unit who have certain kinds of infection are moving to other parts of a hospital/unit, they may be asked to wear a mask

- People who use healthcare services and who have an infection or are colonised with an infectious microorganism may be asked to avoid or limit movement around the building
- To lower the risk of spread of infectious microorganisms in healthcare facilities, visitors should clean their hands using an alcohol-based hand rub before coming into or leaving the patient care area. In particular circumstances, for example if they are assisting with care of the person, they may also be asked to wear gloves and a disposable apron / gowns
- There may be limits on the number of visitors or children and people at increased risk of infection may be advised not to visit.

2.2 Clinical and financial impact of healthcare associated infection

HCAIs are one of the most common complications affecting people who are hospitalised. As well as causing unnecessary pain and suffering for people using healthcare services and their families, these adverse events prolong hospital stays and are costly to the health system. Based on the 2017 Point Prevalence Survey of HCAI in Ireland slightly more than 1 in 20 of hospitalised patients in Ireland have a HCAI (Murchan *et al*. 2018). Australian data suggest that HCAI is associated with an estimated increase to the cost of a person's admission of 8.6% (IHPA 2017).

The impact of preventable healthcare associated infection on individuals is illustrated very well by cases of *S. aureus* blood stream infection associated with use of intravenous catheters. An example of this is a man admitted to hospital for surgery requiring a period of two days for pre-operative imaging and other assessments. He developed a high temperature on his second hospital day and was diagnosed with *S. aureus* blood stream infection originating from the site of an intravenous catheter inserted in his forearm shortly after admission. The catheter had not been used to administer any treatment in the interval between insertion and onset of fever. As a result of the infection he required more than two weeks of intravenous antibiotic treatment in hospital before his surgery could proceed. In addition to the direct suffering related to the infection, a hospitalisation expected to last 5 to 7 days extended to more than 3 weeks creating major challenges for him with respect to family and social commitments and lost time from work. For the healthcare services, a single such incident represents an additional 16 days of in-hospital care plus the cost of additional investigations and treatments related to the management of the infection. Looked at from another perspective an incident such as this represents a lost opportunity to provide essential elective procedures for other people awaiting care since it represents a minimum of 16 lost bed-days.

Many studies have attempted to estimate the financial costs associated with healthcare associated infection. These studies are very context dependent but it is quite clear that the financial impact of healthcare associated infection is very significant in all healthcare systems in which this has been studied. A study in Ireland considered costs associated with *Clostridium difficile* infection in one hospital in 2015. The authors estimated the incremental cost at €5,820 per patient with key cost drivers being cleaning, pharmaceuticals, and length of stay (Ryan *et al*. 2017).

The problem of HCAI is not limited to hospitals. HCAIs can occur in any healthcare setting, including general practice surgeries, dental clinics, residential services for older people and people with disabilities as well as the ambulance service and other settings in which paramedics work. There is evidence to suggest a considerable infection burden exists among long-term care residents in Ireland (HPSC European Point Prevalence Survey HCAI in Long-Term Care Facilities 2017). Any person working in or entering a healthcare facility is at risk of HCAI. It is possible to significantly reduce the number of HCAIs through effective IPC. Clear and authoritative national clinical guidance is important to support healthcare services to keep the number of HCAIs at the lowest practical level. This guideline was developed to meet that requirement.

2.3 Rationale for this National Clinical Guideline

Many HCAIs are preventable. A healthcare system has a duty to prevent HCAIs to the greatest practical extent. Prevention of HCAI is an element in the prevention and control of antimicrobial resistance (AMR). This is reflected in Ireland's second One Health National Action Plan on Antimicrobial Resistance (iNAP2). The surveillance and control of HCAI and of Antimicrobial Resistance more generally is universally accepted at European and global level as critical to the quality and patient safety and sustainability of healthcare delivery.

The purpose of IPC is to support the delivery of appropriate and safe healthcare, including care of those with infectious diseases while avoiding preventable HCAI. Decisions regarding the optimal approach to treatment required in a given situation are made by the treating clinician and the people using healthcare services. IPC then supports the implementation of that treatment decision to the greatest extent practical and with the least practical risk to people using healthcare services and staff. Good IPC practice therefore is an enabler of appropriate care. IPC must not become and must not be perceived to be a process that creates barriers to appropriate placement and care although in some circumstances IPC may point to the need for additional planning and preparation to minimise risk.

2.4 Aim and objectives

By assisting healthcare workers to improve the quality of the care they deliver, these Guidelines aim to promote and facilitate the overall goal of IPC: the creation of clean and safe healthcare environments through the implementation of evidence-based practices that minimise the risk of transmission of infectious microorganisms.

2.5 Guideline scope

This Guideline represents a national approach to IPC, focusing on core principles and priority areas for action. As this document provides overall guidance on infection prevention and as such it encompasses, amongst other things, control of Meticillin-Resistant *Staphylococcus aureus* (MRSA) and *Clostridioides difficile*. Therefore, it will replace pre-existing pathogen-specific national IPC guidelines including Prevention and Control of Meticillin-Resistant *Staphylococcus aureus* (MRSA) NCEC National Clinical Guideline No. 2 (2013) and Surveillance, Diagnosis and Management of *Clostridium difficile* Infection in Ireland NCEC National Clinical Guideline No. 3 (2014). However, some pathogen specific content in certain existing guidelines that has not yet been incorporated into this document may remain relevant.

These guidelines provide a basis for healthcare workers and healthcare facilities to develop detailed protocols and processes for IPC specific to local settings where they are required to address specific needs at the service level. However, hospitals and other services providers are advised that investing time and resources in developing site specific IPC guideline documents that reiterate or reformat this document should not be done routinely and should be limited to situations in which the site specific document adds additional value.

The approach taken in this document is underpinned by a risk-management framework to ensure the basic principles of IPC can be applied to a wide range of health and social care settings. This includes hospitals and community healthcare services including GP surgeries, dental clinics, community pharmacies, vaccination services, residential services for older people and people with disabilities, home care and ambulance services. The level of risk of HCAI differs according to the different types of services.

The evidence base for the IPC guidelines is drawn predominantly from the acute-hospital setting. There is generally less evidence available for other health services settings. The recommendations should be read in the context of the evidence base. Some recommendations in this guideline may not be applicable in all settings. When implementing these recommendations all healthcare facilities need to consider the risk of HCAI and implement the guideline according to their specific setting and circumstances and advice on the practical application of the recommendations. Case studies giving examples of risk assessments have been included to help illustrate how these recommendations can be applied to different settings.

The Guidelines make reference to but do not include detailed information on:

- The reprocessing of reusable medical instruments or devices
- Hospital hotel services such as food services, laundry services or waste disposal
- Comprehensive information on many specific infectious diseases
- Health facility design and engineering
- Workspace health and safety
- Pandemic planning.

Target Audience

The Guidelines are for use by all those working in healthcare - this includes healthcare workers, healthcare students, management and support staff. They are also relevant to people using healthcare services. Sections of particular relevance to people using healthcare services are highlighted as such in the text.

2.6 Conflict of interest statement

The guideline development process followed the conflict of interest policy set out by NCEC. All members of the GDG were required to complete a Conflict of Interest (CoI) Declaration on appointment to the group, and on an annual basis, which were managed by the Chair. There were no conflicts of interest stated.

2.7 Sources of funding

No external funding was received for the development of this guideline. The Budget Impact Analysis conducted by the Health Research Board-Collaboration in Ireland for Clinical Effectiveness (HRB-CICER) and the work to support development of an Implementation Plan was funded by the Department of Health. HSE-AMRIC and HPSC who supported the GDG are funded by the Health Service Executive (HSE).

2.8 Guideline methodology

This guideline was developed by taking the Australian Guidelines for the Prevention and Control of Infection in Healthcare (2019) as a starting point. Almost all of the 21 recommendations in the Guideline are based on the recommendations in that Guideline with no change or with editorial changes to fit the context in Ireland. In those cases the evaluation of the evidence presented in the Australian Guidelines has been accepted as the basis for the recommendation.

The recommendations in the Australian Guideline, and by extension in this guideline, are based on systematic reviews, with the GRADE (Grading of Recommendations Assessment, Development and Evaluation) approach providing the evidence to decision framework. This supported the structure and wording of each recommendation. The recommendation has an accompanying strength reflecting the quality of the evidence and additional factors relating to the harms and benefits of the intervention.

The Australian Guideline uses the following terms -

Strong Recommendation: Confident that the desirable effects of adherence to a recommendation outweigh the undesirable effects. Overall the recommendation is based on high quality evidence and is strongly recommended for implementation.

and

Weak/Conditional Recommendation: Concludes that the desirable effects of adherence to a recommendation probably outweigh the undesirable effects. Overall the recommendation is based on supportive evidence and a strong theoretical rationale and is recommended for implementation.

The GDG in Ireland agreed that healthcare workers may be inclined to view a weak recommendation as indicating that the GDG was suggesting that there was substantial individual or institutional discretion regarding the adherence to the recommendation. For that reason, the GDG in each case makes a distinction between the strength of the evidence (which follows the Australian Guideline grading) and the strength of the recommendation reflecting the consensus view of the GDG regarding the importance of adherence to the recommendation. In general, the GDG took the view that it could give a strong recommendation based on established international and experience although indicating that the evidence base for the recommendation is weak at present.

Recommendation 21 which relates to Facilities Design is based on a systematic review prepared by HRB-CICER which is provided as an annex to this guideline document.

The response to the COVID-19 pandemic resulted in a specific focus on IPC. In response to practitioners requests for support the HSE issued an interim IPC guideline based on work done on developing this guideline up to that point. This represented an opportunity to gain insight into how the main elements of this guideline were likely to be accepted and used by the health and social care services. Informal feedback was that the guideline was used as a desktop reference, that it generally reflected established practice based on international norms and represented a valuable resource as an authoritative reference for practice in Ireland. The volume and detail of feedback received on public consultation (see section 2.9) most likely reflects that the interim guidance document was in daily use and therefore people in the services were taking note of points that required clarification or question.

Two clinical and cost effectiveness systematic reviews and a budget impact analysis were conducted by HRB-CICER. The first systematic review was an update of the Cochrane review of interventions to improve adherence to hand hygiene recommendations among healthcare workers (to support section 3.8.1 of the clinical guideline). The second was a *de novo* systematic review of the effectiveness of single patient rooms in reducing the incidence of healthcare-associated infection (to inform Recommendation 21). The budget impact analysis focused on quantifying the resource implications of ensuring the ongoing implementation of, and adherence to, the recommendations within the guideline.

2.9 Consultation summary

An advanced draft of this document was made available for public consultation in January 2022. During the consultation period more than 50 individuals or groups provided feedback varying from brief observations on individual points to comprehensive line by line feedback extended in some cases to almost 30 pages of detailed feedback. As discussed in section 2.8 the feedback most likely informed by the practical experience of using the HSE Interim guidance as a desk top reference for more than a year in advance of the public consultation. There was positive feedback on the strong emphasis on risk assessment and a risk based approach to managing risks of HCAI.

A number of points that represent a change in practice or emphasis emerged as a focus for particular attention. These include recommendation 4 that alcohol hand rub is now acceptable for hand hygiene when caring for people with *C. difficile* or norovirus infection. Some concerns were expressed regarding detailed text accompanying recommendation 5 regarding a change in one aspect of the traditional management of spills of blood and body fluids to conform to current WHO guidance. Concerns were also expressed from a number of sources regarding recommendations 7 to 9 against general adoption of emerging disinfection technologies. In the context of the pandemic there was a significant focus in feedback on aspects of transmission though the air (droplet and airborne) and related precautions including appropriate use of personal protective equipment and protection of staff. There was substantial comment in the feedback regarding the challenges of fully implementing this guideline in the context of existing infrastructure challenges and high occupancy. Feedback from people working in community based healthcare and social care services suggested rebalance of the guideline so as to be less hospital focused.

Given the volume of feedback this short summary of main themes represents a subjective assessment by the chair of the GDG of key themes and it cannot reflect all of the issues important to each person or group that contributed to feedback. Inevitably there were differences of emphasis and contrasting opinions in the feedback. All feedback was considered carefully in developing the final document and provided the basis for substantial improvement in the pre-consultation draft document.

2.10 External review

Initially, a small number of individual external reviewers who were recognised as experts were approached with a request to review the document in June to July 2022. This process failed to identify reviewers who were willing to undertake the review. In July 2022 the ESCMID Study Group on Nosocomial Infection (ESNGI) of the European Society for Clinical Microbiology and Infectious Diseases (ESCMID) were asked to issue a request to all members for volunteers who were willing to review the document. Several ESGNI members from Europe, North America and Asia offered to review the document and were provided with copies of the draft document as of June 2022. The reviewers were asked to answer the following questions and to provide their review by early September 2022.

1. Has the appropriate evidence been identified and reviewed in line with the scope and clinical questions posed by this guideline?
2. Are there specific links between decisions and the available scientific evidence?
3. Have the risks and potential harms of recommendations been fully considered in the context of clinical practice?
4. Is the guideline clearly written, user friendly and allow for individual clinician decisions?
5. Is the guideline suitable for routine use as intended (in so far as you are able to comment on the Irish situation)?
6. Are there relevant international or well referenced guidelines (recommendations) on the same topic that these guidelines conflict with, and if yes are the reasons for this justified in the guidelines?

As of September 26th 2022 three external reviewers had responded with reviews. One reviewer expressly answered the six questions posed. The reviewer answered yes to questions one to five and no to question six. The reviewer suggested changes to text in relation to two points. These were addressed. A second reviewer provided positive feedback on the draft guideline with five specific suggestions for improvements. These suggestions were addressed. A third reviewer expressed a number of reservations about aspects of the draft guideline. Specifically the reviewer indicated that there was a lack of clarity as to whether the guideline was focused primarily on meticillin-resistant *S. aureus* and *C. difficile*, suggested greater emphasis on water-borne infection in the healthcare setting and considered that different formatting of the guideline would make it more readable. The reviewer also provided more than 40 individual suggestions for improvement to the draft guideline. Each of the points were addressed in developing the final guideline and in particular the document was revised to avoid any misunderstanding about its scope, additional content was included on water-borne infection. The document was reviewed to improve readability but the overall structure was not changed as the structure conforms to the NCEC template.

2.11 Implementation

The implementation process for this Guideline is somewhat atypical. Although there has been no previous general IPC guideline much of what is recommended in this report is established practice in the healthcare system in Ireland based on application of international guidance and accepted practice. Furthermore, given the necessity to respond to the COVID-19 pandemic, a preliminary version of this guideline was made available as a HSE-Interim Infection Prevention and Control Guideline in mid-2020. Therefore much of what is in this guideline is already widely implemented in whole or in part. The implementation process for this guideline then is primarily to deliver more consistent and more uniform implementation of good IPC practice. Further detail is provided in the Implementation Plan (Appendix 6).

2.12 Monitoring and audit

Monitoring and audit play a central role in ensuring that the recommendations in this guideline are implemented. Many larger health care institutions already have well embedded institutional programmes for audit that address key recommendations including for example many of those recommendations that relate to hand hygiene and cleaning. There is also a national programme for audit of hand hygiene performance. Given the nature of the recommendations the audits that relate specifically to the recommendations are audits of process. Monitoring of outcomes are also critical to assess if the guidelines overall are being implemented in a way that improves patient care. Within the HSE for example all hospitals are required to report monthly on the incidence of hospital acquired *Staphylococcus aureus* blood stream infection and on healthcare associated *Clostridioides difficile* infection. The HSE has key performance indicators (KPIs) that represent ambitious goals for improvement in these outcomes. When an institution is assessing its implementation of this guidance it should consider both the process audits outlined in Appendix 8 and these and other relevant indicators of outcome.

2.13 Plan to update this National Clinical Guideline

This guideline will be due for update 2 years after the date of initial publication.

3 National Clinical Guideline

3.0 Key questions and evidence statements

Key questions and evidence statements related to all but 1 recommendation are as presented in the Australian Guidelines for the Prevention and Control of Infection in Healthcare (2019) and are not reproduced here. The key question and evidence statement related to Recommendation 21 is included as an annex to this document.

Recommendation 1:

Routine hand hygiene should be performed according to the World Health Organization technique:

- Before touching a patient
- Before a clean or aseptic procedure
- After body fluid exposure
- After touching a patient
- After touching a patients surroundings.

Hand hygiene must also be performed before putting on gloves and after the removal of gloves.

Quality/level of evidence: strong evidence
+ Strength of recommendation: strong recommendation

The following are responsible for implementation of recommendation:

- All healthcare managers and healthcare workers.

Standard and transmission-based precautions

Summary

- The use of standard precautions is the primary strategy for minimising the transmission of healthcare associated infections.
- Standard precautions apply to the delivery of healthcare to everyone and must be used regardless of known or suspected pathogens.
- Transmission-based precautions are used in addition to standard precautions, where the suspected or confirmed presence of infectious microorganisms represents an increased risk of transmission.
- The application of transmission-based precautions plays a key part in outbreak management and during a pandemic.
- Medical and dental procedures increase the risk of transmission of infectious microorganisms. Effective work practices to minimise risk of transmission of infection related to procedures require consideration of the specific situation, as well as appropriate use of standard and transmission-based precautions.

This section covers:

3.1 Standard precautions

3.2 Transmission-based precautions

3.3 Personal protective equipment (PPE)

3.4 Management of multidrug resistant organisms and outbreak situations

3.5 Applying standard and transmission-based precautions during procedures.

The information presented in this part is particularly relevant to healthcare workers and support staff. It outlines effective work practices that minimise the risk of transmission of infectious microorganisms.

Patient care tip

In applying standard and transmission-based precautions as part of day to day practices, healthcare workers should ensure that people using healthcare services understand why certain practices are being undertaken and that these practices are in place to reduce the risk of infection for everyone. People using healthcare services and visitors should also be aware of their role in minimising infection risks by following basic hand hygiene, respiratory hygiene and cough etiquette. They should also talk to staff caring for them about information they have about thier own condition that is relevnat to control of infection.

3.1 Standard precautions

Summary

Section 3.1 describes standard precautions used at all times to minimise the risk of transmission of infectious microorganisms. A checklist of standard precautions for procedures is in Section 7.2. It is essential that standard precautions are applied at all times. This is because:

- People may be placed at risk of infection from others who carry infectious microorganisms
- People may be infectious before signs or symptoms of disease are recognised or detected, or before laboratory test results are available
- People may be at risk from infectious microorganisms present in the surrounding environment including environmental surfaces or from equipment
- There may be an increased risk of transmission associated with specific procedures and practices.

Standard precautions consist of:

- Hand hygiene according to the WHO 5 moments for hand hygiene
- The use of appropriate personal protective equipment (PPE)
- Respiratory hygiene and cough etiquette
- Safe injection practices (safe use and disposal of sharps)
- Aseptic technique
- Management of patient care equipment (single use devices and reprocessing of reusable medical equipment and instruments)
- Environmental hygiene
- Safe handling and disposal of waste
- Management of laundry and linen.

Standard precautions should be used in the handling of blood (including dried blood), all other body substances, secretions and excretions (excluding sweat), non-intact skin and mucous membranes.

3.1.1 Hand hygiene

Effective hand hygiene is the single most important strategy in preventing healthcare associated infections (HCAIs) (World Health Organisation 2009). Ease of access to alcohol-based hand rubs and hand washing facilities (soap, water and paper towels) can reduce the transmission of HCAIs. Washing hands with soap and water is required if hands are visibly soiled while either product can be used if hands are visibly clean. Each hand hygiene method is discussed in further detail in Recommendations 1 - 6.

What are the risks?

Infectious microorganism transmitted by the contact or droplet route can potentially be transmitted by touch.

Some microorganisms are present on the hands most of the time (resident flora) while others are temporarily acquired during the performance of healthcare activities (transient flora). Hands can become contaminated through contact with respiratory secretions when coughing or sneezing. Contaminated hands can lead to the cross-transmission of infectious microorganisms in non-outbreak situations and contribute to outbreaks involving organisms such as meticillin resistant *Staphylococcus aureus* (MRSA), vancomycin resistant enterococci (VRE) and multi drug resistant Gram-negative (MDRGN) microorganisms such as *Acinetobacter spp* (Boyce and Pittet 2002, Loveday HP *et al*. 2014).

Improved hand hygiene practices have been associated with:

- Sustained decreases in the incidence of infections caused by MRSA and VRE (Pittet *et al.* 2000)
- Reduction in healthcare associated infections of up to 45% in a range of healthcare settings
- Greater than 50% reduction in the rates of hospital infection associated with MRSA and other MDROs after 1-2 years (Hand Hygiene Australia 2018, Johnson *et al.* 2005).

Hand hygiene practices alone are not sufficient to prevent and control infection and need to be used as part of a multi-factored approach to IPC.

Hand hygiene education and training

Hand hygiene education and training is vital to ensure that healthcare workers have the knowledge and skills to identify opportunities for hand hygiene and to perform hand hygiene using an effective technique. Education and training may be provided in a variety of formats including e-learning however direct face-to-face training with opportunities for demonstration and questions and answers is frequently preferred by trainers and trainees (Gould *et al.* 2017). A programme of train the trainers is a practical option for supporting face-to-face training delivered by a peer in many settings.

Practical information

What is the minimum requirement of hand hygiene training?

Staff who are working in healthcare should complete hand hygiene training on induction and at least every 2 years. Training should be recorded on staff files/training records. Training records should be available locally for external inspections and should be available by category of health care worker. The percentage of people in compliance with the requirement should be assessed annually with respect to those people in active employment on the 31st of December each year. Those staff that are on career breaks, maternity leaves and any other extended long-term leave as at 31/12/year end are not included in assessing the % compliance.

These following hand hygiene training approaches are recommended:

- Face to face learning theory and practical from an Infection Prevention and Control Nurse (IPCN) or other trained hand hygiene trainer
- Blended approach theory online e-learning module and practical learning from hand hygiene trainer or IPCN.

When should hand hygiene be performed?

Hands can become contaminated with infectious microorganisms through contact with a person cared for, their surroundings, the environment, or contact with other healthcare workers. Cross contamination can occur from one site to another in the same person, between healthcare worker and the person cared for, between person cared for or healthcare worker and the environment or between healthcare workers. Practising hand hygiene before every episode of contact with a person cared for (including between caring for different people and between different care activities for the same person) and after any activity or contact that potentially results in hands becoming contaminated (such as removal of gloves) reduces the risk of cross contamination.

The 5 moments of hand hygiene

The 5 moments for hand hygiene developed by the WHO:

- Help to protect people who use healthcare services from acquiring infectious microorganisms from the hands of the healthcare worker
- Help to protect people who use healthcare services from infectious microorganisms (including their own) entering their bodies during procedures
- Help to protect healthcare workers and the healthcare surroundings from acquiring infectious microorganisms from people who use healthcare services.

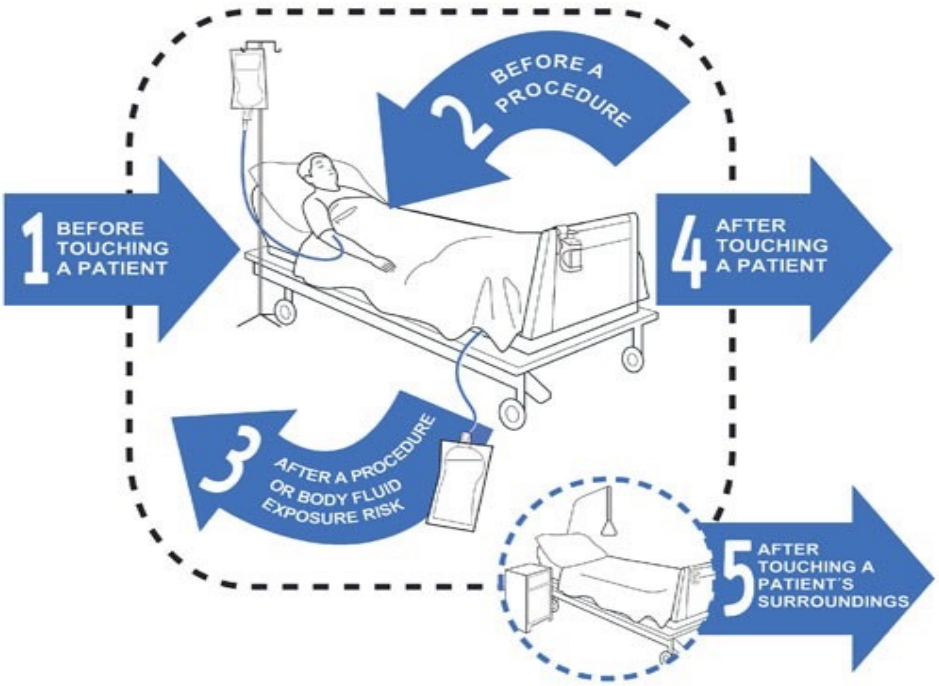

Figure 3 Five moments for hand hygiene

Note: hand hygiene is also performed before putting on and after the removal of gloves. While figure 3 above illustrates application of the 5 moments in an acute care setting, the 5 moments are applicable to other healthcare settings including residential care, general practice and other primary care settings. The key emphasis in any setting is to perform hand hygiene before and after any procedure and after each consultation with a patient.

In addition to the 5 moments, hand hygiene should be performed in a range of other situations (see Table 6).

Table 6 Some situations when hand hygiene should be performed

Before	After
Starting or leaving work	Hands become visibly soiled
Eating or handling of food or drinks	Eating or handling of food or drinks
Using computer keyboards, tablets or mobile devices in a clinical area	Visiting the toilet
Putting on gloves	Removing gloves
Contact with patients particularly immune-compromised patients	Being in patient care areas during outbreaks of infection/epidemic
	Using a computer keyboard, tablet or mobile device in a clinical area
	Handling laundry/equipment/waste
	Blowing/wiping/touching nose and mouth
	After touching a person, particularly people who are cared for in isolation and are on transmission based precaution
	Touching surfaces or items in clinical areas (for example equipment items around the patient) and the patient environment, particularly if a person is in isolation and/or on transmission-based precautions
	Blood or body substance contamination

Individual actions for reducing risk:

- Follow the 5 moments for hand hygiene, even when it is difficult to make time for it
- Become familiar with good practice on hand hygiene and follow it
- Use the appropriate product for your situation and use it as directed
- Follow facility policy on cuts and abrasions, fingernails, nail polish and jewellery
- Use hand-care products provided by your organisation- your own products may not be compatible with the hand hygiene products provided
- Minimise physical contact with patient surroundings
- Lead by example and champion hand hygiene in your setting
- Attend hand hygiene education sessions regularly to refresh your knowledge and skills
- Contact your doctor or the person with designated responsibility for occupational health if you have a reaction to hand hygiene or hand care products used in your workplace
- If alcohol-based hand rub is not available at key points of care in a care setting, bring this to the attention of a senior member of staff or the unit manager.

Other aspects of hand hygiene

The wearing of jewellery, artificial fingernails or nail polish by healthcare workers can compromise performance of optimal hand hygiene. Healthcare facilities should ensure compliance with the following:

- Intact skin is a natural defense against infection. Cuts and abrasions reduce the effectiveness of hand hygiene practices. Breaks or lesions of the skin are possible sources of entry for infectious microorganisms and may also be a source of infectious microorganisms (Larson EL 1995). Similarly, the presence of fingernail disease may reduce the efficacy of hand hygiene and result in the transmission of pathogens (Boyce JM and Pittet D 2002). To reduce the risk of cross-transmission of infectious microorganisms, cuts and abrasions should be covered with waterproof dressings
- The type and length of fingernails can have an impact on the effectiveness of hand hygiene (Boyce and Pittet, 2002). Artificial or false nails have been associated with higher levels of infectious microorganisms, especially Gram-negative bacilli and yeasts, compared to natural nails (Foca *et al*. 2000, Hedderwick SA *et al*. 2000). Fingernails should therefore be kept short (the length of the finger pad) and clean, and artificial fingernails should not be worn. Nail polish/varnish should not be used; particularly as chipped nail polish may support the growth of microorganisms on the fingernail (Hand Hygiene Australia 2018)
- Health care workers should wear short sleeved clothing when delivering patient care as this ensures their hands can be decontaminated effectively (Loveday *et al*. 2014). This concept is widely referred to as 'bare below the elbows". Some staff members may wish to cover their forearms. In this case, the minimum requirement is that the forearm is bare for about 5 to 10cm above the wrist when working in patient care areas to ensure that clothing does not interfere with performance of hand hygiene. For this reason, the expression "bare above the wrists" may be preferred
- Although there is less evidence concerning the impact of jewellery on the effectiveness of hand hygiene, rings can interfere with the technique used to perform hand hygiene resulting in higher total bacterial counts (Boyce and Pittet, 2002). Hand contamination with infectious microorganisms is increased with ring wearing although no studies have shown that this is associated with healthcare worker to patient transmission of microorganisms (Boyce and Pittet, 2002; Trick *et al.* 2003).

The consensus recommendation is to strongly discourage the wearing of watches, rings or other jewellery during health care. If jewellery must be worn in clinical areas it should be limited to a plain band (for example a wedding ring) and this should be moved about on the finger during hand hygiene practices. In high risk settings such as operating suites or rooms, no jewellery (even a plain band), should be worn.

Hand care

The main type of skin irritation associated with hand hygiene is irritant contact dermatitis. Irritant contact dermatitis results in symptoms such as dryness, irritation, itching and sometimes cracking and bleeding. Allergic contact dermatitis is rare and represents an allergy, which may be due to some ingredient in a hand hygiene product.

Generally, alcohol-based hand rubs cause significantly less skin reaction or irritation than hand hygiene with soaps (Pittet D and Boyce JM 2001). Expert opinion concludes that:

- Common causes of irritant contact dermatitis includes skin cleaners, antiseptic washes, repeated exposure to water, sweating and glove powder
- Damaged skin can lead to easier penetration of allergens and increased likelihood of infection transmission
- The irritant and drying effects of hand preparations are one reason why healthcare workers fail to adhere to hand hygiene guidelines
- Appropriate use of hand lotion or moisturisers added to hand hygiene preparations is an important factor in maintaining skin integrity, encouraging adherence to hand hygiene practices and assuring the health and safety of healthcare workers
- Healthcare workers should be educated about the risk of irritant contact dermatitis and other skin damage and should have access to appropriate healthcare if they experience a workplace related skin condition.

Use of hand cream

An emollient hand cream should be applied regularly, such as after performing hand hygiene before a break or going off duty. Hand hygiene technique should be reviewed if skin irritation occurs. If the irritation persists or it is caused by a particular soap, antiseptic or alcohol-based product you should discuss with your manager or the person with designated responsibility for occupational health. Hand cream should be provided in an manner that reduces the risk of spread of microorganisms as a result of contamination of the cream or the container.

Good practice point: 1
People who use healthcare services should be educated about the benefits of hand hygiene and how to perform hand hygiene

People who use healthcare services should be educated on the benefits and techniques involved in hand hygiene and offered the opportunity to clean their hands when appropriate, including before meals and after using the toilet, commode or bedpan/urinal. People who use healthcare services and their carers' preferences for hand hygiene products may differ, and they should be provided with the option of alcohol-based hand rubs, hand wipes or access to hand wash basins, based on any specific needs.

Practical information

Involving people who use healthcare services in hand hygiene.

Healthcare facilities are encouraged to take a person centred approach to IPC, as outlined in Section 2.1. Appropriate hand hygiene is one of the most well-established and supported measures for reducing HCAIs. Extending education on hand hygiene practices and involving people who use healthcare services in this aspect of their care is encouraged.

The following information may be provided to people who use healthcare services to assist them in becoming involved in identifying opportunities to improve hand hygiene:

- Hand hygiene is the most important aspect of reducing the risk of infection – this applies to everyone including healthcare workers, people who use healthcare services and visitors
- The WHO 5 moments for hand hygiene advise healthcare workers, people who use healthcare services and visitors when hand hygiene should be performed to reduce the risk of infection
- Healthcare workers generally use alcohol-based hand rub as it is effective and easy to use but, if their hands are visibly dirty, they need to use soap and water
- Performing hand hygiene regularly reduces the risk of infection to you and others. If you are in hospital or other healthcare setting, it is good to remind your visitors to use alcohol-based hand rub when they come in to your room and when they leave
- No matter what product you use to clean your hands, the solution should come into contact with all surfaces of the hand
- After hand hygiene, the hands should be dry. If alcohol-based hand rub is used, the solution will dry on the hands. After cleaning hands with soap and water, hands should be patted dry with a single use towel
- Healthcare workers should have short, clean fingernails and not wear artificial fingernails or nail polish. Generally, healthcare workers should not wear any jewellery but a single plain band ring may be permitted in settings outside of a theatre environment
- It is OK to ask healthcare workers if they have cleaned their hands before they touch you.

Recommendation 2:
Alcohol based hand rubs that contain between 60% and 80% v/v ethanol or equivalent should be used for all routine hand hygiene practices

Quality/level of evidence: strong evidence

+ Strength of recommendation: strong recommendation

Practical information

Note on hand sanitisers and disinfectants

Human hygiene biocidal products such as hand sanitisers and other disinfectants are considered biocidal products and MUST by law be registered prior to making them available on the market and using them in Ireland. The Pesticide Registration and Control Divisions (PRCD) of the Department of Agriculture, Food and the Marine (DAFM) (this is the competent authority for biocides in Ireland) has produced a register of approved products. Only biocidal products listed on the DAFM biocide product register are legal to market and use in Ireland.

All hand sanitisers and disinfectants should carry a label in the format of PCS 9xxxx, PCS 1xxxxx, IE/BPA 7xxxx or an EU-000xxx-xx. Each product registered by DAFM will carry a unique registration number specific to that particular product. If the product label does not contain any of these number formats you should not purchase or use the product.

You can check the registers of products online at: http://www.pcs.agriculture.gov.ie/registers/biocidalproductregisters/

More information on Biocides can be found on at: https://www.pcs.agriculture.gov.ie/biocides/

Note: that hand hygiene products are marked with expiry dates. Good stock control is important to ensure that products in use are in date.

Alcohol-based hand rubs

One advantage of alcohol based hand rubs is that they are easily accessible at point of care. They have:

- Excellent antimicrobial activity against Gram-positive and Gram-negative vegetative bacteria, *Mycobacterium tuberculosis* and a wide range of fungi
- Generally good antimicrobial activity against enveloped viruses including SARS-CoV-2
- Some products may have lesser and/or variable antimicrobial activity against non-enveloped viruses (such as norovirus) (see below re EN14476)
- No activity against protozoan oocysts and bacterial spores (such as *C. difficile*).

An effective alcohol-based hand rub product should contain between 60% and 80% of alcohol and its efficacy should be proven according to the European Norm 1500 or the standards of ASTM International (formerly, the American Society for Testing and Materials). Most published clinical studies that have demonstrated reductions in healthcare associated infections with the use of alcohol-based hand rubs have been associated with products that contain at least 70% alcohol (isopropanol) however products that contain 60% and 80% alcohol are considered effective (Hand Hygiene Australia 2018). However, the efficacy of alcohol-based hand hygiene products is affected by a number of factors including the type of alcohol used, concentration of alcohol, contact time, volume of product used and whether the hands are wet when the product is applied. These factors are generally assessed through testing standards for skin disinfectants.

Choosing an alcohol-based rub

Alcohol-based hand hygiene products should conform to the specifications developed by the RCPI Hand Hygiene Group at the following link: https://www.hpsc.ie/a-z/microbiologyantimicrobialresistance/infectioncontrolandhai/handhygiene/publications/File,14574,en.pdf

The key points are as follows:

All alcohol based hand hygiene products (AHR) must have full documented compliance with relevant standards as follows:

- EN 1500: Hygienic Hand Rub (World Health Organization (WHO), 2009)
- In view of the burden of norovirus outbreaks in the Irish Healthcare settings products should comply with EN14476
- AHR for surgical hand preparation must be compliant with EN14476
- EN 12791 Surgical hand rubbing in acute settings (WHO, 2009).

Healthcare worker acceptance of alcohol-based hand rubs is a crucial factor of any programme to improve hand hygiene practice. Several studies showed that user acceptability tends to be determined by the overall hand rub composition (for example consistency as gel or rub, texture, fragrance) and by emollient additives but both are largely independent of a formulation's antimicrobial activity (Girard *et al*. 2006, Hand Hygiene Australia 2018).

Different healthcare workers and healthcare settings have different preferences and the choice between a gel or liquid needs to be evaluated on an individual basis (Loveday HP *et al*. 2014). In some healthcare facilities, it may be useful to offer both liquid and gel alongside each other, in order to provide a choice that suits a wide range of healthcare workers. Some studies have noted that gel and foam formulations have generally significantly less antimicrobial activity than alcohol-based liquid hand rub formulations, even if the total alcohol content is similar (Kramer A *et al*. 2002, Piechiansathian 2004, Pietsch H 2001). However, if gel and foam formulations are more acceptable to healthcare workers and more frequently used than liquid formulations this may be important in improving overall hand hygiene compliance. It is important to ensure effectiveness by choosing an appropriate product (as per standards noted above) using a sufficient amount of product which allows complete coverage of the hands and allowing the hands to remain wet for the recommended amount of time, as per manufacturer instructions (Hand Hygiene Australia 2018, Macinga DR *et al*. 2013).

Alcohol-based hand rub should be readily available in work areas and near patients to increase accessibility unless the ease of access to alcohol poses a specific risk to individual patients. The following alcohol-based hand rub features are important in influencing acceptability:

- Fragrance and colour – these may increase the initial appeal but may cause allergenic reactions and are therefore discouraged
- Emollient agents in the alcohol-based hand rub – these should prevent skin drying and irritant skin reactions, but not leave a sticky residue on hands
- Drying characteristics – in general, solutions have lower viscosity than gels and therefore tend to dry more quickly
- Risk of skin irritation and dryness – proactive and sympathetic management of this problem is vital.

There is some evidence to suggest that gels are preferred to solutions (Hand Hygiene Australia 2018). It is important for staff to evaluate products themselves before implementation where possible. Even where emollient agents are present in the product, ready access to a moisturising skin care product is essential. All hand hygiene products should be chemically compatible. It is advisable that hand hygiene and hand care products are from a range made by a single manufacturer as this can reduce risk of incompatibility between the products.

Other issues associated with alcohol-based hand rubs

Other factors that should be considered when choosing products include cost issues, availability, convenience and functioning of dispenser and ability to prevent contamination and crusting of material at the dispenser tip. Consideration should also be given to occupational health and safety issues associated with alcohol-based hand rubs. Alcohols are flammable and healthcare workers handling alcohol-based preparations should respect safety standards. Accidental and intentional ingestion and dermal absorption of alcohol-based products used for hand hygiene have also been reported. The risk of these issues can be mitigated by appropriate placement of dispensers within the facility.

Non-alcohol-based hand rubs

A variety of solutions/gels that are non-alcohol based are commercially available for performing hand hygiene. Clinical studies demonstrating the effectiveness of hand hygiene in control of healthcare associated infection have predominantly used alcohol-based hand rub therefore the highest quality evidence of the clinical effectiveness of non-alcohol-based hand rub is often limited or lacking. For these reasons as well as for reasons of consistency of practice alcohol-based hand rubs should be used when possible. Non-alcohol-based hand rub may have practical advantages in some specific situations where use of alcohol may be unacceptable because of the risk of ingestion or fire. However, note that in situations where access to large volume wall mounted or table top dispensers pose an unacceptable risk of ingestion or fire, small personal dispensers carried by healthcare workers may be a practical solution. When non-alcohol-based hand rubs are considered for use by a healthcare provider it is important at a minimum, to assess evidence that they have a comparable effect in achieving decontamination of the skin, that they are safe for healthcare workers to use and that they do not act as a medium that supports growth and transmission of organisms such as *P. aeruginosa*. Cost is also a significant consideration. From a practical point of view, it may be best to avoid use of both alcohol based and non-alcohol-based hand rub dispensers in the same clinical area.

Technique

Effective hand hygiene relies on appropriate technique as much as on selection of the correct product. Inappropriate technique can lead to failure of hand hygiene measures to appropriately remove or kill microorganisms on hands, despite the superficial appearance of having complied with hand hygiene requirements.

Key factors in effective hand hygiene and maintaining skin integrity include:

- The duration of hand hygiene measures
- The exposure of all surfaces of hands to the preparation used
- The use of rubbing to create friction
- Ensuring that hands are completely dry.

Use of alcohol-based hand rub: Clinical Hand Hygiene

- Apply the amount of alcohol-based hand rub recommended by the manufacturer on to dry hands.
- Rub hands together so that the solution comes into contact with all surfaces of the hand, paying particular attention to the tips of the fingers, the thumbs and the areas between the fingers.
- Continue rubbing until the solution has evaporated and the hands are dry.

Good practice point: 2
Alcohol-based hand rubs that meet the requirements of European Standard EN 1500 should be used for routine hand hygiene practices.

Recommendation 3:
Soap and water should be used for hand hygiene when hands are visibly soiled

Quality/level of evidence: strong evidence
+ Strength of recommendation: strong recommendation

Practical information
Plain soap and water

Hand washing refers to the appropriate use of a non-antimicrobial soap and water on the surface of the hands. Plain soaps act by mechanical removal of microorganisms and have no antimicrobial activity. They are suitable for performing hand hygiene and are required for cleansing of visibly soiled hands. They are also used for mechanical removal of certain organisms such as *C. difficile* and norovirus. Liquid soap dispensers are generally preferred to bar soap in healthcare settings. There are practical reasons for the preference and theoretical concerns regarding bar soap. However, there is a lack of evidence to indicate that there is a difference in effectiveness when used to perform hand hygiene.

Antimicrobial soaps are sometimes used to decontaminate hands. However, when alcohol-based hand rub is available in the healthcare facility for hand hygiene, the use of antimicrobial soap is not recommended. Antimicrobial soap is associated with skin care issues and it is not necessary for use in everyday clinical practice (Boyce and Pittet 2002 and Loveday *et al.* 2014).

Hand wipe products may be considered in instances where hygienic access to soap and water is not readily available, such as in some community care settings. Alcohol-based hand rubs are also suitable for use in resource limited or remote areas with lack of accessibility to sinks or other facilities for hand hygiene (including clean water and towels). As outlined above effective hand hygiene depends as much on technique as on the products used.

Using soap and water:

- Wet hands under tepid running water and apply soap
- Rub hands together for a minimum of 20 seconds so that the solution comes into contact with all surfaces of the hand paying particular attention to the tips of the fingers, the thumbs and the areas in between the fingers
- Rinse hands thoroughly under running water, then, pat dry with single use towels.

Recommendation 4:
In the presence of known or suspected *Clostridioides difficile* and viruses such as norovirus hand hygiene must be performed as follows:

If gloves are worn and appear intact on removal, then alcohol-based hand rub remains the agent of choice for hand hygiene.If gloves have not been worn, if gloves have been breached or if there is visible contamination of the hands despite glove use, use soap and water to facilitate the mechanical removal of spores. After washing, hands should be dried thoroughly with a single-use towel

Quality/level of evidence: weak evidence

+ Strength of recommendation: strong recommendation

Practical information

When *C. difficile* and viruses such as norovirus are suspected or known to be present and gloves have not been worn, a combination of hand hygiene strategies may be required to reduce transmission of these organisms. This should include hand washing with soap and water for at least 20 seconds to facilitate the mechanical removal of spores or virus (Hall et al. 2007; McDonald *et al*. 2018).

Longer hand washing is likely to be required if visible soiling is present. If gloves are worn during the care of patients in settings where *C. difficile* or viruses such as norovirus are suspected or known to be present, spore/virus contamination of the hands will be minimal and alcohol-based hand rub remains the agent of choice for hand hygiene (Traore 2007).

3.1.2. Use and Management of sharps, safety engineered devices and medication vials

This section should be read in association with the HSE policy on the management of sharps and prevention of sharp injuries available at: https://healthservice.hse.ie/filelibrary/staff/policy-on-the-management-of-sharps-and-prevention-of-sharp-injuries.pdf

What are the risks?

Sharps injuries in healthcare settings may result in the transmission of blood borne viruses (BBV) such as Hepatitis B (HBV), Hepatitis C (HCV) or Human Immunedeficiency Virus (HIV). Fortunately while the majority of sharps injuries don't lead to infections, the effects of the injury and anxiety about its potential consequences, including the side effects of post exposure prophylaxis can have a significant impact on an injured healthcare worker (National Health Service UK, Managing the Risks of Sharps Injuries, 2015).

Sharps injuries can occur in any healthcare setting, including non-hospital settings such as in home health care and long-term care facilities. Sharps Injuries most often occur:

- During a clinical procedure
- After the procedure and before disposal
- After the procedure

(Public Health England, 2014)

Hollow bore needles are of particular concern; especially those used for blood collection or intravascular catheter insertion as they are likely to contain residual blood and are associated with an increased risk for blood borne virus transmission. Non-hollow bore sharps such as glass vials and suture needles have also been involved in sharps incidents.

Table 7 Examples of hollow bore and non-hollow bore sharps

Examples of hollow bore sharps	Non-hollow bore sharps
Disposable needles or syringes	Glass vials
Steel winged (butterfly) needles	Dental probes
Intravenous catheter stylets	Scalpel blades
Multi sample blood collection needles	Suture needles
Arterial blood collection syringe needles	Retractors
Aspiration needles	Skin or bone hooks
Injector pen needles	Sharp electrosurgical tips

Eliminating workplace hazard and risk is a fundamental principle of all work health and safety legislation. In Ireland Statutory Instrument Number 135 of 2014, which may be cited as European Union (Prevention of Sharps Injuries in the Healthcare Sector) Regulations 2014 is the key element of legislation in this area (https://www.hsa.ie/eng/Legislation/New_Legislation/S_I_135_of_2014.pdf).

The hierarchy of controls method is a well-recognised approach used to prevent sharps injuries.

The first priority is to eliminate and reduce the use of needles and other sharps where possible. Next is to isolate the hazard, thereby protecting an otherwise exposed sharp, through the use of an engineering control.

When these strategies are not available or will not provide total protection, the focus shifts to work practice controls and personal protective equipment. An organisational approach to reducing sharps injuries is discussed in Section 3.6.5 and sharps injuries and post-exposure prophylaxis (PEP) in Section 3.73

Safety engineered devices

A broad range of devices have been designed with built in safety features that reduce the risk of injury involving sharps. Examples include devices such as needles with guards, sliding sheaths, shields, blunted tips or retracting needles, blunt suture needles and surgical blades with protective covers.

The use of safety engineered devices has been reported as associated with a reduction in the incidence of needlestick injuries (Chambers *et al*. 2015 and Jagger *et al*. 2008). However, a Cochrane Review in 2017 concluded that "the evidence on safety devices preventing needlestick injuries is of low quality and inconsistent" (Reddy *et al*. 2017). The use of devices with safety engineered protective features (for example safety or retractable devices) has been mandated in all European Union member countries.

Prior to introducing any safer sharps device, healthcare practitioners should evaluate the effectiveness of the device to ensure its suitability for use and to check that it does not create any additional hazard to the person cared for or the healthcare worker.

Needleless Devices

Needleless devices (for example connectors, vascular access devices, access ports) provide an easy access point for intravascular infusion connections. Needleless devices do not use needles for procedures such as the collection or withdrawal of body substances or administering medication or fluids after initial venous or arterial access is established.

Since their adoption in healthcare facilities, needleless devices have contributed to a decrease in percutaneous injuries amongst healthcare workers. While it is difficult to assess the overall effect of needleless devices because of the wide variety of devices and systems that are in use, some studies have shown an increased risk of bloodstream infections (BSI) among patients (Rupp *et al*. 2007; Salgado *et al.* 2007).

Unfamiliarity with the use of these complex devices, together with inadequate disinfection procedures, may contribute to increased BSI rates. US Guidelines for the prevention of catheter related infection recommend that (O'Grady *et al*. 2011):

- The needleless components are changed at least as frequently as the administration set
- Caps are changed no more frequently than every 3 days or according to manufacturer's recommendations
- All components of the system are compatible to minimise leaks and breaks

- Contamination risk is minimised by wiping the access port with an appropriate antiseptic and accessing the port only with sterile devices.

Disinfection of needleless connectors with chlorhexidine/alcohol or povidone-iodine has been shown to significantly reduce external contamination (Casey *et al*. 2003). Section 3.5.2.3 provides further information on caring for the patient's hub or insertion site.

Retractable devices

The use of retractable safety devices on sharps has been associated with a significant reduction in needle-stick injury in healthcare settings (Rogues *et al*. 2004; Tuma and Sepkowitz 2006). However, their direct impact is difficult to determine because their introduction is often accompanied by other interventions such as training and education, overarching hospital policies and other technologies that could also cause a reduction in needle-stick injuries (Whitby *et al*. 2008).

Retractable technology is only one example of the broad range of safety engineered medical devices that have been designed and produced to assist in reducing the risk of occupational exposure to blood borne pathogens in healthcare.

Implementation of safety engineered devices must be accompanied by appropriate training and education for health care workers in the use of the new technology to achieve successful reduction in percutaneous injury rates.

For information on the requirements for single-use sharps containers, see International Standard ISO 23907:2019.

Medication vials:

- **Single dose vials**
  Medications or solutions that come into contact with normally sterile tissue should be sterile. The most effective way to avoid cross infection via injection of medication is through the use of single dose vials or ampoules and single use sterile injecting equipment. Single dose vials or ampoules or prefilled syringes should be used wherever these are available. Note: the need for safe practice in opening glass vials or ampoules. These include the use of a sterile single use needle and syringe for each injection given and adherence to practices that prevent contamination of injection equipment and medication.
- **Multi dose vials**
  A multi-dose vial is one that contains more than one dose of medication. The most widely used multi-dose vials in the Irish healthcare setting are vials for insulin. These are intended for single patient use. Some other injectable products (for example the vaccine against SARS-CoV-2) may also only be available in multi-dose vials for periods of time.

When single dose vials or ampoules are not available, there is a higher risk of cross contamination. This is particularly so if the products are used on multiple patients. The risk of infectious disease transmission may be mitigated by (Provincial Infectious Diseases Advisory Committee: Ontario):

- Restricting the vial to single patient use whenever possible
- Establishing a separate secure area designated for the placement of these medications away from any work area
- Compliance with manufacturers recommendations (adhere to instructions for refrigeration, storage, use within a specified time, expiry date)
- Preparing to administer the injection in a physically separate clean controlled environment with minimal risk of distraction
- Using a new sterile needle and syringe to draw up the required dose from the vial or ampoule on every occasion
- Using a sterile needle to draw up all the contents of the container into individual syringes before administering to patients. For some solutions filter needles may be required
- Having only the current patient's medication in the immediate working environment
- Disposing of residual material and equipment in an area that is separate from the area used to prepare medications for administration
- Discarding any open ampules at the end of each procedure
- Discarding product if sterility or product integrity is compromised or questionable.

The use of multi dose vials has been associated with the transmission of infectious diseases including HIV, Hepatitis B, Hepatitis C and *Streptococcus pyogenes* (Katzenstein *et al*. 1999; Kokubo 2002; Massari 2001; Olson 1999; Samandari *et al*. 2005; Stetler 1985). International agencies such as the US CDC and WHO recommend that single dose vials be used for parenteral additives or medications whenever possible especially when medications will be administered to multiple patients (Hutin 2003; Siegel 2007).

There may be some exceptional circumstances where for short periods (for example a few months) multi dose vials may be the only way to deliver vaccines or drugs to a large proportion of the population in a timely fashion. An example is the COVID-19 pandemic.

Table 8 Summary of processes for appropriate use of devices

Device	Process
Injection equipment	• Avoid contamination of the needle
Single use items	• Do not use the same needle, cannula or syringe for more than one person nor to access a medication or solution that might be used for a subsequent patient
	• Do not administer medications from a single syringe to multiple persons, even if the needle or cannula on the syringe is changed
Single patient items	• Use single patient items for one person only and dispose of them appropriately
Single use medications	• Only use single dose vials when administering drugs, therapeutic agents and vaccines to multiple people other than in the most exceptional circumstances as above
	• Do not administer medications from single dose vials or ampoules to multiple people or combine leftover contents for later use
Multi dose vials	• Multi dose vials should not be used except where they are intended solely for the exclusive use of an individual person (for example insulin) other than in the most exceptional circumstances as above
Fluid infusions and administration sets (that is Intravenous bags, tubing and connectors)	• Use for one person only and dispose of appropriately after use
	• Do not use bags or bottles of intravenous solution as a common source of supply for multiple people
	• Consider syringes or needles/cannula as contaminated once they have been used to enter or connect to a person's intravenous infusion bag or administration set
	• Use closed intravenous delivery devices as standard practice
	• Use premixed intravenous bags of medication wherever possible, in order to reduce the risk of contamination during mixing, dilution or preparation
	• Avoid disconnection of administration sets if possible to minimise the potential of contamination of IV lines
	• Should be changed on a regular basis, depending on their use

Use and management of sharps, safety engineered devices and medication vials

Statutory requirement: 1

SI 135 of 2014

Health care workers should adhere to good practice related to safe handling of sharps including:

- Not passing sharps directly from hand to hand
- Keep handling to a minimum
- Not recapping, bending or breaking needles after use.

Healthcare workers must also comply with all legislation that controls the management of healthcare risk waste (including sharps) and healthcare non risk waste as well as workplace health and safety.

Practical information

Handling of sharps

All health care workers should take precautions to prevent injuries caused by needles, scalpels and other sharp instruments or devices during procedures, when cleaning used instruments, during disposal of used needles and when handling sharp instruments after procedures.

Safety devices should be considered where appropriate to minimise risk of injury to healthcare workers. Standard measures to avoid sharps injuries include handling sharps in a way that prevents injury to the user and to others who may encounter the device during or after a procedure.

Examples include (Anonymous 2008):

- Using instruments rather than fingers, to grasp needles, retract tissue, and load / unload needles and scalpels
- Giving verbal announcements when passing sharps
- Avoiding hand to hand passage of sharp instruments by using a basin or neutral zone
- Using round tipped scalpel blades instead of pointed sharp tipped blades.

The neutral zone is a designated space or device (for example a basin) that is used only for the placement and retrieval of sharps. The purpose is to avoid hand-to-hand transfer of sharps (Association of Surgical Technologists 2013). The neutral zone should be agreed by the team before a procedure.

The extent to which gloves protect healthcare workers from transmission of blood borne infectious microorganisms following a needle stick or other puncture that penetrates the glove has not been determined (Siegel *et al*. 2007). Although gloves may reduce the volume of blood on the external surface of a sharp the residual blood in the lumen of a hollow bore needle would not be affected therefore the effect on reduction of transmission risk is not quantifiable (Mast *et al*. 1993; Siegel *et al*. 2007).

In dentistry, recapping or disassembling sharps may be unavoidable in some instances. If this is necessary, a risk assessment must be undertaken, needles and other equipment used should have all applicable safety and protection mechanisms and must be used in such a way that the risk of injury and exposure is effectively managed.

In the context of a public health emergency recapping of needles that have been used to draw up vaccine from multi-dose vials (and therefore are sterile at the point of recapping) may be considered subject to comprehensive safeguards to minimise risk. If so, a risk assessment must be undertaken and safety devices should be used where appropriate (National Institute for Health and Care Excellence (UK)).

Healthcare facilities should have sharp safety programmes, which include consideration of incidents that should be reported as defined in legislation related to health and safety in the workplace. The Safety, Health and Welfare at Work (reporting Accidents and Dangerous Occurrences) Regulations 2016 is the relevant legislation in Ireland (https://enterprise.gov.ie/en/Legislation/SI-No-370-of-2016.html#:~:text=Regulations%202016%20%2D%20DETE-,SI%20No%20370%20of%202016%20Safety%2C%20Health%20and%20Welfare%20at,3)%20Regulations%202016&text=The%20Regulations%20set%20out%20the,the%20Health%20and%20Safety%20Authority).

Individual actions for reducing the risk:

- Explain to people who use healthcare services the risks to healthcare workers and others involved in the use and disposal of sharps and the measures taken to reduce these
- Become familiar with facility protocols on handling and disposal of sharps and relevant legislation
- Use the appropriate product for the situation and use it as directed - safety devices should be considered where appropriate to minimise risk of injury
- Avoid using needles where safe and effective alternatives are available
- Before using any sharp medical device such as needles or scalpels, always plan for their safe handling and immediate disposal at the point of use
- Make sure every used sharp medical device, such as needles and scalpels, is disposed of properly and that puncture resistant sharps containers are located at the point of use.
- Report any needle stick or sharps related injuries promptly in accordance with institutional policy and ensure that you receive proper follow up care
- Ensure that you are vaccinated against blood borne viruses such as hepatitis B and that your immune response has been checked
- Participate in education sessions and professional development sessions on handling sharps, as well as those on new safety devices and how to use them.

Good practice point: 3
Dispose of single use sharps immediately after use into an approved sharps container at the point of use.

The person who has used the single use sharp is responsible for its immediate safe disposal. Sharps containers must not be filled above the mark that indicates the maximum fill level.

Practical information

Disposal of single use sharps

The person who has used a disposable sharp instrument or equipment is responsible for its immediate safe disposal after use. People who use sharps in their own care (such as people with diabetes mellitus) should have immediate access to a suitable sharps container at or close to the point of use. The requirements for single use sharps containers are specified in ISO 23907:2019.

After they are used, single use syringes and needles, scalpel blades and other sharp items such as capillary tubes, glass and dental wires, should be placed in an appropriate container. These containers should be clearly labelled, puncture and leak proof, and conform to ISO 23907 2019. The container should be located at the point of use or, if this is not possible, as close as practical to the use area. Reusable sharps requiring transport to a reprocessing area must be placed in a puncture resistant lidded container. Note: that there are waste management service providers that use reusable sharps containers. This is a more sustainable approach to sharps management.

The GreenHealthcare website (https://greenhealthcare.ie/) provides useful information on sustainable waste management.

Sharps containers must be appropriately placed so that they are at an accessible height for the healthcare worker but out of reach of children and others to prevent hands and fingers entering the disposal unit. They should also be placed in a secure position or mounted on the wall to prevent tipping (approximately 1.3m minimum off the ground). Placement of wall mounted units should be away from general waste bins to minimise the risk of incorrect disposal. Note that wall mounting of sharps containers in areas occupied by patients or freely accessible to patients may represent a risk of injury. Waste management providers have many options available for the provision of brackets in appropriate locations. Sharps containers should not be filled above the mark that indicates the maximum fill level. The temporary closure should be in place when the container is not in use. When transporting a sharps bin it should be held by the handle.

There are numerous safety devices available that assist with safe removal and disposal of sharps (for example scalpel blade removers). Local protocol and procedures need to be developed to outline their appropriate use.

Reducing risks if a sharps injury is sustained: Please see Guideline for the Emergency Management of Injuries and Post-exposure Prophylaxis (PEP) at https://www.hpsc.ie/a-z/EMIToolkit/.

3.1.3 Routine management of the physical environment

What are the risks?

Infectious microorganisms can be found in healthcare settings and there is a body of clinical evidence derived from case reports and outbreak investigations suggesting an association between inadequate environmental hygiene and the transmission of infectious microorganisms in healthcare settings (Dancer 1999). The potential for water drains (sinks, showers, sluices) to serve as reservoirs of antimicrobial resistant organisms has emerged as an area of particular concern in recent years (Kanamori *et al*. 2016).

Transmission of infectious microorganisms from the environment to patients may occur through direct contact with contaminated equipment or indirectly for example from hands that are in contact with contaminated equipment or the environment and then touch a person (Dancer 2008).

Environmental surfaces can be safely decontaminated using less rigorous methods than those used on medical instruments and devices. The level of cleaning required depends on the objects involved and the risk of contamination. Surfaces that are likely to be contaminated with infectious microorganisms (for example shared clinical equipment) require cleaning between use on different people which is more often than is required for general surfaces and fittings. However, all surfaces require regular cleaning. Thorough cleaning of all surfaces is necessary after spills and in between uses of a patient room or care area for care of different people especially in acute care settings.

Managing the physical environment across healthcare settings

The cleaning practices discussed in these guidelines are applicable to all healthcare settings. In certain circumstances, such as the setting in which paramedics often work, care may be provided outside of a controlled environment. This should be considered when providing care. Clean surface barriers such as disposable sheets, may be used in an uncontrolled environment where environmental cleaning is difficult to perform prior to patient contact. Intensive care units and isolation areas require additional levels of cleaning especially where there is a risk of MDRO transmission.

Routine management of the physical environment

Good practice point: 4
Maintain a minimum distance of 1m between healthcare service users in the healthcare setting to the greatest extent practical. This reduces the risk of contact and droplet transmission from people with unrecognised contact or droplet transmitted colonisation or infection.

Practical information

Minimising exposure within a potentially contaminated zone

Although transmission-based precautions, including appropriate patient placement, are intended to manage the risk of transmission of infection from those where a specific infection or colonisation is suspected or confirmed it is clear that infection or colonisation is not always apparent when a person presents for healthcare. The immediate environment of a person with contact or droplet transmitted colonisation or infection is likely to be contaminated with infectious microorganisms in the intervals between environmental cleaning. Maintaining a minimum distance of 1m between all patients/service users at all times in so far as practical to do so reduces risk of contact and droplet transmission from people with unrecognised colonisation or infection.

Good practice point: 5 Clean surfaces routinely as follows:

- Clean frequently touched surfaces with detergent solution at least daily, when visibly soiled and after every known contamination
- Clean general surfaces and fittings when visibly soiled and immediately after spillage
- Ensure that water drainage points in sinks and showers drain freely and completely and that surfaces are kept clean and dry.

Practical information

Routine environmental cleaning

Surfaces that are cracked, chipped or otherwise damaged cannot be cleaned effectively and must be repaired or replaced promptly. Sinks and shower trays that are not draining freely cannot be effectively cleaned. All staff have a responsibility to ensure that cracked, chipped or otherwise damaged surfaces and non-draining sinks or shower trays are reported to the maintenance service. There should be a clearly defined and convenient process to support and encourage cleaners in reporting cracked, chipped or otherwise damaged surfaces and non-draining sinks or shower trays.

General surfaces and the cleaning requirements for each can be divided into 2 groups as illustrated in table 9. It is important to avoid using cleaning methods that disperse dust.

Table 9 Cleaning requirements for routine environmental cleaning

Minimally touched surfaces	Frequently touched surfaces
Floors, ceilings, walls and blinds	**Doorknobs, bed rails, table-tops, light switches and sanitary ware**
A detergent solution (diluted as per manufacturer's instructions) is adequate for cleaning general surfaces and non-patient care areas.	Should be cleaned more frequently than minimally touched surfaces.
Damp mopping is preferable to dry mopping. Flat mops are recommended for effective cleaning and these should be decontaminated in washing machines dedicated for this purpose.	Detergent solution (diluted as per manufacturer's instructions) can be used with the exact choice of detergent determined by the surface and likely degree of contamination.
Cleaning cloths should be colour coded in line with the area of the environment/function for which they are intended. They should be set aside for washing or disposal after each use.	Detergent impregnated wipes may be used for a single piece of equipment or a small area but should not be used routinely as a replacement for the mechanical cleaning process.
Walls and blinds should be cleaned when visibly dusty or soiled.	Particular attention is required to ensure that sinks, shower and related fittings are cleaned on a regular basis and that water drains freely and thoroughly so that there is no pooling of water.
Window curtains should be regularly changed in addition to being cleaned when soiled or exposed to MDROs.	

Risk assessment

The methods, thoroughness and frequency of cleaning and the products used for different surfaces are determined by risk analysis and reflected in healthcare facility policy. Infection prevention and control professionals typically use a risk assessment approach to identify frequently touched surfaces and then coordinate an appropriately thorough cleaning strategy and schedule with the cleaning staff.

A detergent solution is recommended for routine cleaning. When MDROs are suspected or known to be present routine cleaning is intensified and the use of a detergent solution is followed by the use of a disinfectant so that surfaces are cleaned and disinfected. Alternatively, a combined cleaning and disinfection agent may be used.

Cleaning method and product choice

Routine cleaning with detergent and water is the most useful method for removing microorganisms from surfaces. Detergents help to lift dirt and microorganisms so that they can be rinsed away with clean water. Mechanical cleaning (scrubbing the surface) physically reduces the number of microorganisms on the surface. Rinsing with clean water removes the loosened microorganisms and any detergent residue from the surface. Drying the surface makes it harder for microorganisms to survive or grow.

Disinfectants are usually only necessary if a surface that has already been cleaned with detergent and water is suspected or known to have been contaminated by MDROs and or other potentially infectious material including blood and other body fluids. Most microorganisms do not survive for long on clean surfaces when exposed to air and light and routine cleaning with detergent and water should be enough to reduce numbers. Disinfectants are used after routine cleaning or as a combined cleaning/disinfecting agent.

When choosing an appropriate product, the following factors should be considered:

- the impact of cleaning and disinfection products on the wider environment
- cleaning products used on different surfaces should be determined by risk assessment
- initial mechanical cleaning with a suitable detergent followed by disinfection with a chlorine-based product such as sodium hypochlorite where indicated or another appropriate disinfectant
- the intended purpose of the product as per manufacturer's instructions
- that manufacturer's instructions can be complied with in the facility
- the suitability of the product for the type and size of the surface to be cleaned
- the practical application of using the product or technology with available resources including trained staff
- the effectiveness of the product against particular microorganisms including microbiological activity and contact time to kill microorganisms. Contact time refers to the amount of time necessary for the disinfectant to be in contact with surface to inactivate microorganisms.

Cleaning schedules

The recommendations outlined for cleaning should be justified by the risk of transmission of infection within a particular healthcare facility. All organisations should have a documented cleaning schedule that outlines clear responsibilities of staff, roster of duties and the frequency of cleaning required and the products that should be used to clean specific areas. Organisations should also facilitate job or task specific education and training for general and special cleaning of the physical environment. More detailed information about recommended cleaning schedules for different healthcare settings is in section 7.1.

If cleaning is outsourced to a cleaning service provider procedures should be documented including details of how the cleaning service will be undertaken. Procedures must include the following:

- minimum cleaning frequencies and specification of methods: cleaning service providers are required to provide cleaning services at whatever frequencies are deemed necessary in order to meet required standards. Section 7.1 provides a guide for minimum frequencies for cleaning within a healthcare facility providing acute care. It may be adapted to define appropriate cleaning frequency in other settings
- procedures for reporting surfaces that are cracked, chipped or otherwise damaged and slow-draining or non-draining sinks and shower trays to facilities maintenance
- staffing: including rosters for full time, part time and relief staffing members as well as for management and supervisory positions
- equipment: including provision of consumable items (such as cleaning fluids) and facilities to be used to deliver cleaning
- management of the cleaning service: how the cleaning services will be managed and controlled at the service level, including specific details of the on-site management functions.

The risk of transmission of particular infections should be assessed and the cleaning schedule should be adjusted if a known infectious microorganism is present (for example an outbreak of *C. difficile* requires surfaces to be cleaned more frequently and then disinfected with sodium hypochlorite).

Housekeeping rooms and stores

It is important that staff who perform housekeeping duties in larger healthcare facilities (such as hospitals and residential care facilities) have access to dedicated housekeeping rooms or secure stores. Housekeeping rooms and stores should be maintained in accordance with good hygiene practices and should not be used for the storage of personal clothing or grooming supplies. All housekeeping rooms and stores also should:

- have appropriate personal protective equipment available
- have an appropriate water supply and a sink or floor drain
- be appropriately sized and well ventilated with suitable lighting and locks fitted to all doors
- have chemical storage facilities that meet the manufacturers' recommendations. (Note: expiry dates are conditional on appropriate storage of products).

All cleaning equipment must be well maintained clean and in good repair. Cleaning equipment should be cleaned and dried between use. Individual mop pads should be used for each discrete area cleaned within a healthcare facility on a given day and they should laundered daily.

Cleaning carts should:

- have a physical partition between clean and soiled items
- never contain personal clothing or grooming supplies, food or beverages
- be thoroughly cleaned at the end of the day
- be stored dry.

In facilities providing care for people who may be at particular risk from contact with or ingestion of cleaning products cleaning carts should be equipped with a locked compartment for storage of hazardous substances, each cart should be locked at all times when not attended.

Cleaning implements and solutions

Part of the cleaning strategy is to minimise contamination of cleaning solutions and cleaning tools. Proper procedures for effective use of mops, cloths and solutions should be followed:

- prepare cleaning solutions daily or as needed and replace with fresh solution frequently according to facility policy
- wash mops and cloths after use and allow to dry before reuse or use single use mop heads and cloths.

Carpet

The use of carpet in patient care areas should be avoided. (Australasian Health Infrastructure Alliance 2016, AMRIC Implementation Team 2020)

If carpets are used in specific settings such as family rooms adjacent to patient care areas they should be vacuum cleaned daily with well-maintained equipment fitted with high efficiency particulate air (HEPA) filters to minimise dust dispersion. In the event of a spill of any potentially contaminated material, after the spill has been removed as much as possible the carpet should be cleaned for example by a steam cleaning method.

Use of disinfectants

In acute healthcare settings and some other settings where there is an uncertainty about the nature of soiling on the surface (for example blood or body substance contamination versus routine dust or dirt) or the presence of MDROs, *C. difficile* or other infectious microorganisms requiring transmission-based precautions is known or suspected, surfaces should be physically cleaned and disinfected.

This process must involve either:

- 2 step clean - a physical clean using a detergent followed by disinfection with a chlorine-based product such as sodium hypochlorite or another appropriate disinfectant
- 2 in one clean - a physical clean using a combined detergent and a chlorine-based product such as sodium hypochlorite or another appropriate disinfectant.

Physical (mechanical or manual) cleaning is the most important step in cleaning. Application of a disinfectant must not be used as a substitute for thorough physical cleaning. Given this the routine use of a combined detergent and a chlorine-based product such as sodium hypochlorite or another appropriate disinfectant (2 in one clean and disinfection) should include a risk analysis.

To kill microorganisms any disinfectant must:

- Have enough time in contact with the surface to kill the microorganisms (as per the manufacturer's instructions)
- Be used at the right concentration
- Be applied to a clean surface
- Be effective against those particular microorganisms of concern.

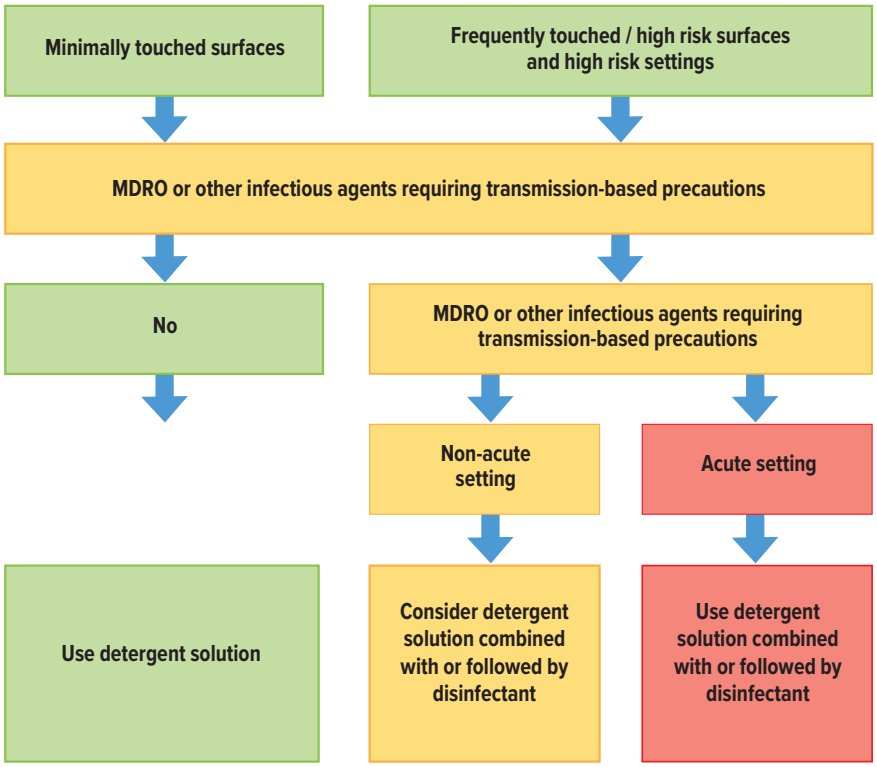

Figure 4 Processes for routine cleaning and product choice

High-level disinfectants or liquid chemical sterilants are not appropriate for general cleaning. Such use is counter to manufacturer's instructions for these hazardous chemicals. Alcohol should not be used to disinfect large environmental surfaces given the risk of additional hazards such as flammability.

Technologies in this area are evolving and new technologies for cleaning and decontamination of the healthcare environment may be offered. The introduction of new cleaning and disinfection technologies should be based on careful evaluation of the evidence to support any claims made and in particular if there is evidence regarding impact on infection outcome for people using healthcare services or staff.

Checking, auditing and environmental sampling

Healthcare facilities use a variety of systems to ensure that cleaning standards are met. These include checklists, colour coding to reduce the chance of cross infection, cleaning manuals, model cleaning contracts and IPC guidance and monitoring strategies.

Auditing of cleaning can be performed through a variety of different methods including process testing and outcome testing. Audits of environmental cleanliness can also facilitate education programmes and motivate staff to strive for improvement in routine cleaning practices.

Table 10 Methods for evaluating environmental cleanliness in healthcare facilities

Type	Method	Definition	Advantages	Disadvantages
Process testing	Visual inspection	An individual trained in the auditing of cleaning inspects an area to assess the level of cleanliness. Primary method used in healthcare facilities.	Can detect obvious soiling of the environment. Most cost-effective method and most rapid for detecting major cleaning issues.	Cannot detect microorganisms that are invisible to the naked eye.
	Fluorescent gel marker (Rock *et al.* 2019)	An invisible gel that can only be detected with UV light is applied to surfaces. The effectiveness of cleaning processes can be determined by shining UV light to determine if the gel has been adequately removed through a cleaning process.	Can allow for an efficient and timely cleaning evaluation on a large scale.	Cannot detect microorganisms that are invisible to the naked eye.
Outcome testing	ATP bio-luminescence	A swab of a surface is taken which is placed into a detection device that will catalyse a reaction with ATP. Testing the surface for ATP measures the amount of organic residue on a surface.	ATP testing provides rapid results and requires no specific laboratory training to be undertaken.	The test can produce false positives and cannot identify the source of the ATP. The residue of some cleaning products may alter the results.

Audit tools

Some organisations have developed tools and templates to assist with an environmental cleaning audit. Some examples include:

- CDC environmental cleaning evaluation worksheet: https://www.cdc.gov/hai/pdfs/toolkits/Environmental-Cleaning-Eval-Worksheet-10-6-2010.xls
- Department of Health and Human Surfaces Tasmania environmental assessment cleaning protocol: https://www.dhhs.tas.gov.au/publichealth/tasmanian_infection_prevention_and_control_unit/evaluating_environmental_cleanliness
- Additional audit tools including tools intended primarily for settings other than acute hospitals may be available from professional societies such as the Infection Prevention Society: https://www.ips.uk.net/national-resources-available-from-ips

Experience indicates that access to hand held electronic devices can support the efficient performance and analysis of environmental audits.

Good practice point: 6
Clean shared clinical equipment that comes into contact with skin, but not with mucosa, blood or body fluids, (that is non-critical equipment in the Spaulding classification) with a detergent solution between use on different people. Disinfection is also appropriate where indicated (for example colonisation with a MDRO).

Exceptions to this should be justified by risk assessment.

Shared clinical equipment

While shared clinical equipment that comes into contact with intact skin only is unlikely to introduce infection it can act as a vehicle by which infectious microorganisms are transferred between people. Examples of possible contaminated surfaces on shared medical equipment include knobs or handles on haemodialysis machines, X-Ray machines, instrument trolleys, stethoscopes, auxiliary temperature monitoring probes, blood pressure cuffs and commodes and dental units (Health Care Infection Control Practices Advisory Committee 2003/2019).

Cleaning frequencies for specific shared clinical equipment are outlined in section 7.1.

Shared equipment should be cleaned with a detergent solution after each use with cleaning agents compatible with the piece of equipment being cleaned as per manufacturer instructions. Detergent cleaning wipes are a practical way of applying the detergent solution. Where indicated disinfection may also be required following routine cleaning. It is best practice to refer to the manufacturer's instructions and Product Safety data sheet prior to using disinfectants. Choosing a disinfectant that is compatible with the surface material is integral in order to avoid damage to the equipment. All exceptions to this should be justified by risk assessment (Loveday HP 2014).

Adequate cleaning supplies should be available at or close to the point of care to enable routine cleaning of shared clinical equipment. The same standard procedures for the cleaning of shared equipment are generally appropriate across all healthcare settings including home healthcare community settings and outpatient settings however the frequency of cleaning may vary with the setting.

To reduce the risk of contamination and the need to clean items between people disposable equipment including thermometers and blood pressure cuffs should generally be used when caring for people requiring transmission-based precautions (for example those with *C. difficile*).

Good practice point: 7
Use surface barriers to protect surfaces such as examination couches that are in contact with a person's skin particularly if those surfaces are likely to be touched frequently with gloved hands during delivery of care or are likely to be contaminated with blood or body fluids or are difficult to clean.

If release of body fluids is expected, the barrier should be impermeable.

If the surface beneath the barrier is dirty or wet on removal of the barrier, the underlying surface should be cleaned and if appropriate disinfected.

Exceptions to this should be justified by risk assessment.

Practical information

Surface barriers (for example clear plastic wrap, bags, sheets, tubing or other materials impervious to moisture) help prevent contamination of surfaces and equipment. Surface barriers on equipment (for example bed boards, computer keyboards, examination couches) needs to be placed carefully to ensure that they protect the surfaces underneath and should be changed and cleaned or disposed of between individuals.

For specialised equipment which is difficult to clean and when the application of detergent directly onto the device is not recommended by the manufacturer a custom surface barrier should be used for example with an intraoral camera. Any custom surface barrier used on such equipment should be disposed of after each person and replaced with a new custom surface barrier.

The use of a surface barrier is an aid to ensuring that surfaces are clean before every patient use. Cleaning is often required in addition to surface barrier use particularly if the surface has not been completely covered, if the surface barrier has been breached or if there has been release of body fluids.

Cleaning of the surfaces of clinical furniture, such as examination couches, may not be required between every person use in low risk settings if the surface was adequately covered during use by the person and there has been no release of body fluids.

Recommendation 5:
Sites should be cleaned and disinfected after spills of blood or other potentially infectious materials.

Quality/level of evidence: weak evidence

+ Strength of recommendation: strong recommendation

Spills of blood or other potentially infectious materials should be promptly cleaned as follows:

- wear gloves and other personal protective equipment appropriate to the task
- confine and contain spill, clean visible matter with disposable absorbent material such as paper towels and discard the used cleaning materials in the appropriate waste container
- clean the spill area with a cloth, wipe or paper towels using detergent solution
- the decision to use disinfectants should be dependent upon the compatibility of the disinfectant with the materials where the spill occurred
- the requirement for disinfection should be based on assessment of risk of transmission
- if disinfection is required a chlorine-based product such as sodium hypochlorite should normally be used
- if a non-chlorine-based disinfectant is used it should be a product suitable for use in a healthcare environment.

Practical information

Management of blood and body substance spills

Prompt removal of spots and spills of blood and body substances followed by cleaning and disinfection of the area contaminated is a sound infection prevention and control practice and meets occupational health and safety requirements.

In circumstances where emergency procedures or urgent transport are underway spills should be attended to as soon as it is safe to do so.

Process of spills management

Strategies for decontamination of spills of blood and other body substances (for example vomit or urine) differ based on the setting in which they occur and the volume of the spill:

- healthcare workers can manage small spills by cleaning with detergent solution. Wipes impregnated with detergent solution may be a practical approach for small spills
- for spills containing large amounts of blood or other body substances workers should contain and confine the spill by:
    - removing visible organic matter with absorbent material (for example disposable paper towels)
    - removing any broken glass or sharp material with forceps
    - soaking up excess liquid using absorbent material (for example disposable paper towels).

Note: that thorough cleaning using water and detergent and appropriate equipment (towels, mop, cloths) is indispensable to decontamination following a spill. The effectiveness of a disinfection process is dependent on the effectiveness of cleaning and cannot compensate for deficiencies in the cleaning process.

If spillage of potentially contaminated material has occurred on soft furnishings, a detergent solution can be used to clean the area thoroughly. Hypochlorite is generally not suitable for use on soft furnishings. The extent of further action required will depend on a risk assessment taking account of the extent and nature of the spillage and the associated risk of transmission of infectious microorganisms.

If the risk cannot be managed otherwise it may be necessary to replace the covers on part or all of the item of furniture. Soft furnishings can also be wet vacuumed. Following cleaning of soft furnishings, they must be allowed to dry before they are reused. Because of the difficulty of cleaning and decontamination, soft furnishings should be avoided in settings where spillage of blood or body fluids is likely to occur.

Alcohol solutions should not be used to clean spillages.

Table 11 Appropriate processes for managing spills

Volume of spill	Process
Spot cleaning	• Select appropriate personal protective equipment (for example gloves and disposable apron) • Wipe up spot immediately with a damp cloth tissue or paper towel or detergent wipe • Discard contaminated materials • Perform hand hygiene
Small spills (up to 10 cm diameter)	• Select appropriate PPE (for example gloves and disposable apron) • Wipe up spill immediately with absorbent material such as paper towels • Place contaminated absorbent material into impervious container or plastic bag for disposal • Clean the area with warm detergent solution using disposable cloth, wipe or sponge • Wipe the area with sodium hypochlorite solution or wipe and allow to dry • Perform hand hygiene
Large spills (greater than 10 cm diameter)	• Select appropriate PPE (for example gloves and disposable apron) • Cover area of the spill with absorbent material such as paper towels and allow to absorb • Remove the absorbent material with absorbed fluid and place in an impervious container or plastic bag for disposal. • If necessary the process of covering the area with absorbent material such as paper towels may be repeated to absorb remaining fluid. • Place all contaminated items into impervious container or plastic bag for disposal • Discard contaminated materials • Mop the area with detergent solution • Wipe the area with sodium hypochlorite and allowed to dry • Perform hand hygiene

Choosing a disinfectant (when required)

The use of sodium hypochlorite is not necessary for routinely managing all spills but it may be used in specific circumstances. There is evidence supporting the use of sodium hypochlorite to inactivate various blood borne and gastrointestinal viruses and to disinfect rooms of people known or suspected to be infected with bacteria such as *C. difficile* or MDROs (Dalziel C 2017). The consideration of use of sodium hypochlorite should be based on risk assessment of the environment, the spill, the risk of transmission of microorganisms and the surface area and potential hazards with using the product.

If a disinfectant is required particularly during the implementation of transmission-based precautions sodium hypochlorite or another appropriate disinfectant must be used.

Choosing a disinfectant that is compatible with the surface material where the spill has occurred is integral in order to avoid damage to the surface.

Supplies for dealing with a spill

Supplies for dealing with a spill of blood or body fluids should be readily available in each area where healthcare is delivered and should include a scoop and scraper, single use gloves, protective apron, surgical mask and eye protection, absorbent material such as paper towels, health care risk waste bags and ties and detergent. All parts should be disposable to ensure that cross contamination does not occur. A spill kit may be convenient for some services as a way to ensure that these supplies are readily available in one location when required.

Good practice point: 8
Perform disinfection using a chlorine-based product such as sodium dichloroisocyanurate (NaDCC), sodium hypochlorite or another appropriate disinfectant in addition to standard cleaning in specific circumstances as required based on institutional guidance or risk assessment. For routine use, a chlorine-based disinfectant should be used with available chlorine at 1000- parts per million.

If a non-chlorine-based disinfectant is used it should be a product suitable for use in a healthcare environment with bactericidal (EN16615), sporicidal (17126) and virucidal (EN14476) activity as required and be CE marked.

Practical information

When using sodium hypochlorite to disinfect hard surfaces the following should be considered:

- environmental surfaces should be clean and free of organic matter
- allow sufficient time to kill the microorganism (at least 10 minutes surface contact time for some organisms)
- A dilution of sodium hypochlorite or sodium dichloroisocyanurate (NaDCC) should be made up fresh just before use in accordance with the manufacturer's instructions to provide the required parts per million of available chlorine such as 1000 parts per million (ppm) for low risk body fluids or 10000ppm for high risk body fluids such as blood
- In general, for chlorine based disinfectant wet contact times of 2 minutes to 10 minutes are be require depending on the microorganism. Wet contact times refers to the period of time during which the surface being disinfected should remain with the disinfectant solution. Guidance on contact times from the manufacturer of the disinfectant in use and from the manufacturer of the item being disinfected should be consulted and followed.

Commercially available chlorine-based products can vary in the % of sodium hypochlorite (liquid products) or calcium hypochlorite (solid or powdered products) they contain. The desired concentration for use is achieved by dilution of the product in water. Most commercially available chlorine-based products will detail instructions for dilution, however, in the unlikely event that you are presented with a product that does not include instructions for dilution you can use these formulae to calculate the amount of product and water required to achieve the desired concentration (World Health Organization 2020).

Before you begin to do the calculation:

- Check the % or ppm of sodium hypochlorite or the % or ppm of calcium hypochlorite in the commercial product
- Decide according to guidance what concentration % or ppm you want to achieve for the specific task, note that 0.1% is the same as 1000ppm and 1% is the same as 10000ppm
- Use the same units throughout the calculation, that means using % for both figures or using ppm for both figures.

Example for calculating a sodium hypochlorite product:

- [What you have (i.e. % concentration in the commercial product) divided by what concentration you want (e.g. you want a 0.1% solution)] minus 1 = total parts of water for each part sodium hypochlorite
- Suppose the product you have comes in a concentration of 5% and you want to dilute to 0.1%: [5% ÷ 0.1%] - 1 = 49
- To achieve the desired concentration of 0.1% sodium hypochlorite in this scenario you will mix 49 parts of water with 1 part of the commercial product.

Example for calculating a calcium hypochlorite product:

- [What you want (e.g. you want a 1% solution) divided by what you have (i.e. % in the commercial product)] multiplied by 1000 = grams of calcium hypochlorite powder for each litre of water
- So if you want a 1% solution and the commercial product you have contains 35%: [1% ÷ 35%] x 1000 = 28.6g
- To achieve the desired concentration of 1% calcium hypochlorite in this scenario you will mix 28.6g of the tablets or powder in 1 Litre of water.

3.1.3.1 Emerging disinfection methods

Emerging modes of disinfection

Some modes of disinfection have emerged and undergone further development for use in healthcare facilities in recent years.

These include:

- Ultraviolet light
- Hydrogen peroxide vapour
- Electrolysed water.

There is also an emerging trend towards using steam and microfibre cloth for environmental cleaning as an alternative to other disinfection methods. The use of steam and microfibre cloths is not recommended in this guideline. Concerns that steam technology may only be practical to use on specific surfaces and may have potential to spread infectious organisms to the nearby environment leading to further contamination are documented in the literature and should be considered (Mitchell *et al*. 2013). If healthcare facilities use microfibre cloths and steam they should do so in the context of a documented risk assessment, consideration of the costs and benefits and should ensure they have appropriate monitoring systems in place. They also need to ensure that staff are well educated and trained in its use, and that infection prevention staff and other healthcare professionals understand the methodology and how to implement it.

Antimicrobial surfaces

Other disinfectant modalities have emerged or undergone further development for use in healthcare facilities. This includes self-disinfecting materials used to coat or impregnate surfaces in clinical areas. These materials include heavy metal alloys (copper and silver) light activated antimicrobial coatings, and surfaces with altered topography designed to inhibit bacterial growth.

Currently there is only sufficient evidence to examine the effectiveness of a copper-based surface compared to standard surfaces on hospital acquired infection. However, the quality of the evidence is very low, as a result copper coated surfaces are currently not recommended for use nor are other antimicrobial surfaces or fittings.

Recommendation 6:
The use of sodium hypochlorite disinfection in addition to cleaning with a detergent solution is recommended for terminal disinfection of healthcare facilities when terminal disinfection is required for example in seeking to end *C. difficile* and norovirus outbreaks.

Note: terminal disinfection must always occur in the context of a process of terminal cleaning and disinfection.

Quality/level of evidence: weak evidence,
+ Strength of recommendation: strong recommendation

Practical information

Terminal cleaning and disinfection is the thorough cleaning/disinfection of all surfaces including floors and re-useable equipment either within the whole healthcare facility or within an individual ward/department/unit/room. Terminal cleaning and disinfection is intended to ensure that, to the greatest possible extent pathogenic microorganisms are removed or inactivated to avoid the risk of transmission to subsequent users of healthcare services and healthcare workers. Terminal cleaning and disinfection may be required in the following circumstances:

- Following an outbreak or increased incidence of a communicable infection
- Following discharge, transfer or death of a person who has had a known communicable infection
- Following use of an area to support application of transmission-based precautions for a person/cohort.

Terminal cleaning and disinfection should be performed on the advice of the Infection Prevention and Control Team or manager in charge of the ward/unit/facility. The terminal cleaning and disinfection should not commence until the relevant area has been fully vacated.

Sodium hypochlorite

Despite the emergence of new disinfection products and technologies, sodium hypochlorite remains a commonly used and accessible chlorine-based disinfectant with broad spectrum antimicrobial properties. The evidence suggests that when the dilution factor is sufficient for sporicidal activity (1000ppm free chlorine) sodium hypochlorite is effective against *C. difficile*. There is also evidence to suggest that sodium hypochlorite disinfection is effective for managing norovirus outbreaks (Brennan *et a*l. 2017).

From a work health and safety perspective, sodium hypochlorite should be used as per manufacturer instructions as it may cause irritation to the skin, eyes and other mucous membranes. It can also corrode metals and discolour or stain fabrics.

Sodium hypochlorite can be corrosive. In some settings other disinfectants may be preferred. Before using any disinfectant for this purpose verify that the product is certified as effective for the intended use and safe for the user and the environment. Disinfectants must be in date and stored, diluted and used according to the manufacturer's instructions.

Recommendation AGAINST 7:
Hydrogen peroxide vapour disinfection is not recommended as a routine adjunct in healthcare facilities as the evidence of added value compared with conventional cleaning and disinfection is not well established.

Quality/level of evidence: weak evidence

+ Strength of recommendation: strong recommendation

Practical information

Current use of emerging disinfectants

Overall, the evidence of the effects of emerging disinfection methods on clinical outcomes remain sparse. If emerging disinfectants are used in healthcare facilities, this should always be used in addition to standard cleaning practices (Brennan *et al*. 2017a and Marra *et al*. 2018).

The WHO has provided advice on the cleaning and disinfection of environmental surfaces available at the following link: https://www.who.int/publications/i/item/cleaning-and-disinfection-of-environmental-surfaces-inthe-context-of-covid-19.

Note: in particular the potential for adverse effects on workers exposed to spraying or fogging with certain chemicals such as formaldehyde, chlorine based agents or quaternary ammonium compounds.

Hydrogen peroxide vapour

Hydrogen peroxide has microbicidal properties against multiple pathogens, including *C. difficile*. Automated (no touch) systems for producing hydrogen peroxide vapour and hydrogen peroxide mist are designed to disinfect by dispersing vapour or mist evenly across a room. As with ultraviolet light, the systems can only be used when rooms are vacated. Rooms and ventilation systems must be sealed to prevent exposure, and hydrogen peroxide must be monitored to ensure safe levels outside the room during disinfection, and within the room before re-entering. The additional costs associated with use of hydrogen peroxide vapour are significant.

There is not yet enough high-quality evidence to determine whether the benefits of using hydrogen peroxide vapour for IPC outweigh the harms and costs.

Hydrogen peroxide vapour may be considered as an adjunct in high-risk settings and during outbreaks when other cleaning and disinfection options have not been effective. If they are used it is appropriate to critically assess if they add value so as to inform future practice. Where use of such systems is being considered the report of the Healthcare Infection Society Working Party on automated room decontamination may be useful (Beswick *et al*. 2022).

Recommendation AGAINST: 8
Ultraviolet light disinfection, ultraviolet light in combination with sodium hypochlorite and other novel approaches to healthcare environment disinfection are not recommended as routine adjuncts in healthcare facilities as the evidence of added value compared with conventional cleaning and disinfection is not well established.

Quality/level of evidence: weak evidence

+ Strength of recommendation: strong recommendation

Current use of emerging disinfectants

Overall, the evidence of the effects of these emerging disinfection methods and clinical outcomes remains sparse. If emerging disinfectants are used in healthcare facilities, this should always be in addition to standard cleaning practices.

Practical information

Ultraviolet light in the UV wavelength range (200 to 270 nanometres) has microbicidal properties against multiple pathogens, including *C. difficile* and other healthcare associated pathogens.

Technologies have been developed for automated (no touch) disinfection of hospital rooms using ultraviolet light. The technologies only disinfect areas directly in the ultraviolet light and can only be used when rooms are vacated, partly because of the potentially harmful effects of ultraviolet exposure (Leas *et al.* 2015).

While there is evidence to demonstrate the ultraviolet light or ultraviolet light combined with sodium hypochlorite disinfection can be effective for disinfection, the magnitude of the benefit for IPC is yet to be established and it is unknown whether these outweigh the harms and justify the costs (Brennan *et al* 2017a and Marra *et al*. 2018).

Ultraviolet light disinfection, ultraviolet light in combination with sodium hypochlorite and other novel approaches to the healthcare environment may be considered as an adjunct in high-risk settings and during outbreaks when other cleaning and disinfection options have not been effective. If they are used it is appropriate to critically assess if they add value so as to inform future practice.

Recommendation AGAINST 9:
The use of surfaces, fittings or furnishing containing materials with antimicrobial properties in healthcare facilities is not recommended as the evidence of added value compared with conventional cleaning and disinfection is not well established.

Quality/level of evidence: weak evidence

+ Strength of recommendation: strong recommendation

Practical information

Current use of antimicrobial surfaces

Overall, the evidence of the effects of antimicrobial surfaces on clinical outcomes remain sparse. If antimicrobial surfaces are used in healthcare facilities, they should always be used in addition to standard cleaning practices (Brenann *et al*. 2017b).

Antimicrobial surfaces

The use of surfaces, fittings and furnishing containing materials with antimicrobial properties have been suggested to reduce the concentration of bacteria on surfaces, in turn reducing environmental exposure to pathogens. Self-disinfecting materials that are considered for use in healthcare facilities include the use of heavy metal alloy coatings on fittings (for example copper or silver coatings for bed rails, tray tables or IV stands). There is currently limited evidence to support the use of environmental fittings with antimicrobial properties to prevent infection.

3.1.4 Reprocessing of reusable medical devices

This section gives principles for reprocessing of reusable medical devices (RMDs) instruments and equipment in any health care setting. Health care facilities should have clear policies and procedures appropriate to their setting. Policies should take account of relevant standards and discipline specific guidelines for best practice on reprocessing requirements. Further information is contained in international standards documents such as those from the international organisation for standardisation (ISO) or European Standard (EN).

Note: that the national position in Ireland regarding reprocessing of Single Use Devices is set out in the Medical Devices Regulations S.I. 261 of 2021 and allows reprocessing of SUD only in accordance with Article 17(2) of the MDR.

What are the risks?

Any infectious microorganism introduced into the body can cause infection. The risk is greater in patients with conditions that make them more susceptible to infection. In all healthcare settings, reusable medical devices should be handled in a manner that minimises the risk of patient, health care worker and environmental contact with potentially infectious material.

Principles of reprocessing reusable medical devices include:

- Before purchase, health care facilities should ensure that manufacturers reprocessing instructions are provided and can be followed by the health care facility
- Reusable medical devices and patient care equipment used in the clinical environment must be reprocessed according to their intended use and manufacturers recommendations

- Single use medical devices should not be reprocessed for reuse. Exceptions to this should only be considered in an emergency situation, be based on a risk assessment and be for the shortest possible period of time.

Assessing the degree of risk

Any medical device (instruments and equipment) that is to be reused requires reprocessing – cleaning, disinfection and/or sterilisation. The minimum level of reprocessing required for reusable instruments and equipment depends on the individual situation and manufacturer's instructions (that is the body site and the way in which the instrument will be used).

The approach to disinfection and sterilisation of patient care items and equipment devised by Spaulding over 45 years ago has been retained and refined and is still successfully used by IPC professionals and others when planning methods for disinfection or sterilisation (Rutala and Weber 2008; Rutala and Weber 2019; Spaulding 1968). The system is based on instruments and items for patient care being categorized into critical, semi critical and non-critical according to the degree of risk for infection involved in use of the items.

Table 12 Categories of items for patient care

Category	Description
Critical	These items confer a high risk for infection if they are contaminated with any microorganism and must be sterile at the time of use. This includes any objects that enter sterile tissue or the vascular system, because any microbial contamination could cause infection.
Semi-critical	These items come into contact with mucous membranes or non-intact skin and should be single use or sterilised after each use. If this is not possible, high level disinfection is the minimum level of reprocessing that is acceptable.
Non-critical	These items come into contact with intact skin but not mucous membranes. Thorough cleaning is sufficient for most non critical items after each individual use, although either intermediate or low-level disinfection may be appropriate in specific circumstances.

Computers, portable mobile devices and personal digital assistants used in patient care are classified as non-critical patient care items. It is important that these items are included in policies for cleaning non-critical items.

Surface barriers such as keyboard covers and washable keyboards that can be easily cleaned may help prevent contamination of surfaces and equipment. These should be correctly used, as per the manufacturer's instructions and changed or cleaned as appropriate.

Cleaning

Cleaning is the removal of foreign material (for example soil and organic material) from objects and is normally carried out using detergent, water and physical action.

Cleaning to remove organic material must always precede high-level disinfection and sterilisation of critical and semi critical instruments and devices as residual proteinaceous materials reduce the effectiveness of the disinfection and sterilisation processes.

If an item cannot be cleaned, it cannot be disinfected or sterilised.

Instruments should be cleaned as soon as practical after use (for example preferably at the point of use) before soiled materials become dried onto the instruments. Dried or baked materials on the instrument make the removal process more difficult, the disinfection or sterilisation process less effective or ineffective and can damage the RMD.

Instruments that can be disassembled must be disassembled before the cleaning and the disinfection or sterilisation process.

Methods of cleaning

Automated

Automated cleaners (ultrasonic cleaners and washer disinfectors) reduce the handling of instruments and are recommended for cleaning instruments that can withstand the process.

- Ultrasonic cleaners work by subjecting instruments to high frequency and high-energy sound waves thereby loosening and dislodging dirt
- Washer disinfectors use detergent solutions at predetermined high temperatures and time periods to clean reusable medical devices. When a washer disinfector is used care should be taken in loading instruments. Hinged instruments should be opened fully to allow adequate contact with the detergent solution. Bowls and other concave items should be oriented vertically or at a steep angle. Overloading of reusable medical devices in washer disinfectors should be avoided.

Manual

Cleaning is done manually for fragile or difficult to clean reusable medical devices and in settings without automatic units. Where manual cleaning methods are used these should comply with international standards:

The two essential components of manual cleaning are:

- Friction - rubbing or scrubbing the soiled area with an appropriately sized soft brush
- Liquid - use of liquids, usually water with or without detergent, to remove soil and debris from internal channels after brushing with an appropriately sized brush and by irrigation when the design does not allow passage of a brush through a channel.

Healthcare workers should wear appropriate PPE for the task for example disposable apron, utility gloves and face protection (protective eyewear and mask or face shield). Care should be taken to prevent aerosols, splashes to mucous membranes or penetration of the skin by sharp instruments.

Cleaning agents

The cleaning solution and style must be appropriate for each instrument and piece of equipment. The manufacturer's instructions will guide the type of cleaning agent required. This is usually neutral pH or mildly alkaline as such solutions generally provide the best material compatibility profile and good soil removal; mildly acidic solutions may damage instruments. Where multiple chemicals are used, they should be compatible with each other.

Enzymes, usually proteases (that is enzymes active on proteins), are sometimes added to neutral pH solutions to assist in removing organic materials such as blood and pus. Cleaning solutions can also contain lipases (that is enzymes active on fats) and amylases (that is enzymes active on starches). Enzymatic cleaners are not disinfectants and proteinaceous enzymes can be inactivated by disinfectants.

As with all chemicals, enzymes must be rinsed from the equipment or adverse reactions could result.

Checking effectiveness of cleaning

The most common means of monitoring the efficacy of the cleaning process for reusable medical devices is by thorough visual inspection following cleaning. However, for complex reusable medical devices, visual inspection may be difficult and not sufficient to monitor cleaning efficacy. Commercially available soil tests or surrogate devices (for example, protein, endotoxin, x-ray contrast medium, or blood) may be used to monitor cleaning process efficacy provided they have undergone validation studies).

International Standard ISO 15883-5:2005 (Washer-Disinfectors, Part 5) outline specific test methods to check the effectiveness of cleaning to verify manual and automated processes. At a minimum, all instruments should be individually inspected (with magnification where possible and appropriate) and be visibly clean.

Disinfection

Disinfection is a process that inactivates non-spore forming infectious microorganisms, using either thermal (moist or dry heat) or chemical means. Items need to be cleaned before being disinfected.

Instruments should be removed from the disinfectant after reprocessing and stored dry. To preserve the surfaces of the instruments, dissimilar metals should be separated before cleaning.

- Thermal disinfection – uses heat and water, at temperatures that destroy infectious microorganisms and is appropriate for items that are heat and moisture resistant and do not require sterilisation. Thermal disinfection is the simplest, most efficient and cost-effective method of disinfection. It can be achieved in an automated thermal washer disinfector by choosing the appropriate cycle.

- Chemical disinfection can be achieved with a compatible disinfectant used alone or together with an automated washer disinfector. Chemical disinfectants include alcohols, chlorine and chlorine compounds, hydrogen peroxide and quaternary ammonium compounds. Commercial formulations based on these chemicals are in most instances designed for a specific purpose therefore, users should read labels carefully to ensure the correct product is selected for the intended use and applied efficiently.

There are 3 levels of disinfection depending on the intended use of the instruments:

- High level disinfection – disinfection that kills all vegetative microbial pathogens when used as recommended by the manufacturer. High level disinfection may not kill all bacterial spores
- Intermediate level disinfection – disinfection that kills all microbial pathogens except bacterial spores when used as recommended by the manufacturer. An agent used for intermediate level disinfection should be bactericidal, tuberculocidal, fungicidal (against asexual spores but not necessarily dried chlamydospore or sexual spores) and virucidal
- Low level disinfection – disinfection that rapidly kills most vegetative bacteria as well as lipid containing viruses when used according to labelling. It cannot be relied upon to destroy bacterial spores, mycobacteria, fungi or all small non-lipid viruses.

Disinfection is not a sterilising process. Wherever possible, sterilise items to be used in semi critical sites or employ single use items.

Sterilisation

Sterilisation destroys all microorganisms on the surface of an instrument or device, to prevent transmission of infection associated with the use of that item. While the use of critical items that have not been properly sterilised represents a potentially high risk of transmitting infectious microorganisms, documented transmission associated with an inadequately sterilised critical item is rare. This is probably due to the wide safety margin associated with the sterilisation processes used in healthcare facilities:

- Reprocessing of heat resistant items is recommended by steam sterilisation due to the safety margin, reliability, validity and lethality
- Reprocessing heat and moisture sensitive items requires use of a low temperature sterilisation technology (for example ethylene oxide, hydrogen peroxide plasma, peracetic acid and aldehyde).

Sterilisation methods are designed to give a sterility assurance level (SAL) of at least 10^{6} provided the sterilisation process is validated by the user. Records of sterilisation sufficient to ensure the required degree of traceability must also be kept verifying that an appropriate reprocessing system is in place.

In this rapidly changing area, reprocessing standards evolved to accommodate changes in equipment design, emerging technologies and sterilisation.

Medical device sterilant and disinfectants

All sterilant and disinfectants must comply with the essential principles for quality, safety and performance through using appropriate testing regimes for performance.

Storage and maintenance

All reusable items of equipment must be stored in a way that maintains their level of reprocessing (for example sterile, high level disinfected). Dry sterile packaged instruments and equipment should be stored in a clean dry environment and be protected from sharp objects that may damage the packaging. The duration for which the level of reprocessing can be considered to be maintained (an expiry date) if the equipment is stored appropriately should be specified. If the equipment is not used during that time the equipment should be reprocessed before use. Further information on handling, transport and storage of reprocessed medical devices is available in international standards documents.

Equipment and instrument surfaces should be regularly examined for breaks in integrity that would impair either cleaning or disinfection and sterilisation (there should be a documented process for this examination). Equipment that no longer functions as intended or cannot be adequately cleaned and disinfected or sterilised should be repaired or discarded. The repair or disposal should be appropriately recorded.

Table 13 General criteria for reprocessing and storage of equipment and instruments in health care settings

Level of risk	Process	Examples	Storage
Critical - entry or penetration into sterile tissue, cavity or bloodstream	Clean thoroughly as soon as possible after using. Sterilise after cleaning by steam under pressure If heat or moisture sensitive sterilise through an automated low temperature chemical sterilant system, other liquid chemicals sterilant or ethylene oxide sterilisation. Ensure critical items are sterilised between each patient use	Invasive surgical and dental equipment for example surgical or oral instruments, arthroscopes, laparoscopes, heat stable scopes. Implants and ultrasound probes used in sterile body cavities	Sterility must be maintained. Packaged items must go through a drying cycle and then be checked to ensure drying has taken place before use or storage. The integrity of the wrap must be maintained. Wraps act as an effective bio barrier during storage. Unpackaged sterile items must be used immediately (without contamination and transfer from steriliser to site of use) or re-sterilised. All endoscopic instruments with channels (except those in sterile packaging) should be stored in a suitable controlled environment storage cabinet

Level of risk	Process	Examples	Storage
Semi critical - contact with intact mucous membranes or non-intact skin	Clean thoroughly as soon as possible after using. Steam sterilisation is preferable. If the equipment will not tolerate steam use a high-level chemical or thermal sterilant or medical device disinfectant	Respiratory therapy and anaesthesia equipment, some endoscopes, vaginal speculae, laryngoscope, blades, cystoscopes, anorectal manometry, diaphragm fitting rings. Probes including transoesophageal, echocardiogram, transrectal ultrasound and transvaginal probes	Store to prevent any environmental contamination. All endoscopic instruments (except those in sterile packaging) should be stored in a suitable forced air-drying cabinet or reprocessed within set time frames prior to use
Non-critical - contact with intact skin	Clean as necessary with detergent solution. If disinfection is necessary, disinfect with a compatible low or intermediate level disinfectant after cleaning	Stethoscopes, sphygmomanometers, blood pressure cuffs, non-invasive ultrasound probes. Intravenous pumps and ventilators. Non-invasive ultrasound probes (not used on contact with non-intact skin or mucous membranes). Commodes, bedpans, blood pressure cuffs and crutches	Store in a clean, dry place to prevent environmental contamination

Source: Rutala and Weber 2008 (Updated 2019)

Reprocessing of flexible endoscopes

Outbreaks associated with flexible endoscopy most commonly occur due to errors in reprocessing. Reprocessing of endoscopes should be according to the manufacturer's instructions. Staff should be aware of the number of channels and valves within the endoscope. The washer disinfector should be appropriate to ensure effective reprocessing of all parts of the endoscope and the process should ensure that no part of the system is excluded from the decontamination cycle.

3.1.4.1 Class of device and associated reprocessing method

Table 14 Class of device and associated reprocessing method

Class	Use	Device (examples)	Reprocessing method (minimum requirement)
Critical	Used in the examination of critical spaces such as joints and sterile cavities	Arthroscopes Laparoscopes	Cleaning followed by sterilisation
Critical/semi-critical	Used to enter sterile space through a body orifice	Bronchoscope Cystoscope	Opinion is divided regarding reprocessing requirements. Cleaning followed by sterilisation is preferred
Semi-critical	Used in the examination of hollow viscera and generally invade only semi-critical spaces although some of their components may enter tissues or other critical spaces.	Laryngoscopes. Nasopharyngeal endoscopes. Transoseophageal probes. Colononoscopes/ Sigmoidoscopes. Gastroscopes/ duodenoscopes	Cleaning, followed by high level disinfection

Based on Best Practice Guidelines for Cleaning, Disinfection and Sterilisation in Health Authorities - December 2011

Reprocessing of loan sets and privately-owned sets

Loan sets and private sets need to be processed prior to use by the healthcare facility as there are no ways to verify claims that the device has been previously reprocessed. Healthcare facilities may not always have the facilities or capacity to reprocess loan sets immediately in accordance with the manufacturers' instructions. The reprocessing unit should be contacted and provided with contents list and reprocessing instructions prior to confirming the ability to reprocess and organising scheduling requirements. This process should be informed by risk assessment.

Loan sets should undergo routine cleaning and sterilisation before being returned to the loaner, as per manufacturer instructions. Loan sets should be transported in fit for purpose containers to minimise the risk of damage, contamination and injury to handlers.

Routine testing of disinfectant

Concentration of a disinfectant or sterilising agent is critical to its effectiveness in infection prevention. The concentration and temperature of the disinfectant and the contact time with the instrument must adhere to the manufacturer's guidance. This information should be reflected in the manufacturer's instructions on the label.

Reusable disinfectants will gradually reduce in their effectiveness overtime, and the appropriate number of uses must be determined by testing that the solution is at or above its minimum effective concentration. This should be checked daily or more frequently according to the number of instruments being reprocessed and the manufacturer's instructions.

Further considerations

Steam sterilisation and the other methods listed above are not sufficient for reprocessing items potentially contaminated with certain types of infectious agent. This includes prions, such as Creutzfeldt Jakob disease (CJD) for which single use items should be used wherever possible and subsequently destroyed by incineration. For further information on infection prevention and control issues related to CJD see https://www.hpsc.ie/a-z/other/cjd/guidance/

For further information on reprocessing reusable medical devices see:

https://www.hse.ie/eng/about/who/nqpsd/qps-improvement/hse-standard-for-decontamination.html

For further information on reprocessing ultrasound probes, refer to: https://www.hse.ie/eng/about/who/nqpsd/qps-improvement/hse-guidance-for-decontamination-of-semicritical-ultrasound-probes-semiinvasive-noninvasive.pdf

Note: that ultrasound gel has been a source of infection associated with diagnostic ultrasound. This risk is not addressed by reprocessing of ultrasound probes. Ultrasound gel is generally not a sterile product and gels in multi-use containers can become contaminated during use. Recommendations for good infection prevention and control practice with ultrasound gels are available at the following link: https://www.gov.uk/government/publications/ultrasound-gel-good-infection-prevention-practice

Individual actions for reducing risk:

- Become familiar with ISO and EN standards and facility protocols on cleaning, disinfecting and sterilising
- Use the appropriate product for the situation and use it as directed
- Participate in education sessions and professional development sessions on reprocessing instruments and equipment particularly when new sterilising or disinfecting equipment is introduced.

3.1.5 Respiratory, hygiene and cough etiquette

Respiratory hygiene and cough etiquette must be applied as a standard infection prevention and control precaution at all times. Covering sneezes and coughs prevents infected persons from dispersing respiratory secretions into the air. Hands must be cleaned after coughing, sneezing, using tissues, after contact with respiratory secretions or objects contaminated by these secretions.

Wearing a surgical mask (if tolerated) assists in reducing dissemination of respiratory virus in symptomatic patients and should be offered to all patients with symptoms of viral respiratory tract infection presenting in a healthcare setting. Use of a mask is in addition to and not instead of the requirement to maintain distance from others.

In the context of a public health emergency or pandemic more general use of surgical masks by patients in the healthcare setting may be advised.

Steps in respiratory hygiene and cough etiquette

Anyone with signs or symptoms of a respiratory infection, regardless of the cause, should follow or be instructed to follow respiratory hygiene and cough etiquette as follows:

- Cover the nose with disposable single use tissues when coughing, sneezing, wiping and blowing nose
- Use tissues to contain respiratory secretions
- Dispose of tissues in the nearest waste receptacle or bin after use
- If no tissues are available, cough or sneeze into the inner elbow rather than the hand
- Clean hands after contact with respiratory secretions and contaminated objects or materials
- Keep contaminated hands away from the membranes of the mouth, eyes and nose
- In health care facilities, patients with symptoms of respiratory infections should sit at least 1m away from others and wear a surgical mask if they can tolerate this. If available and compatible with patient care, health care facilities should place these patients in a separate area while waiting for care
- It is important to note that some people cannot tolerate wearing a mask therefore access to healthcare cannot be declined on the basis that a person is not able to wear a mask.

Health care workers should also assist patients (for example older people, children) who need assistance with containment of respiratory secretions. Those who are immobile will need a receptacle, for example plastic bag, readily at hand for the immediate disposal of used tissues and will need to be offered hand hygiene facilities.

Health care workers with viral respiratory tract infections should not attend for work and should remain at home at least until such time as their symptoms have resolved. In the context of a public health emergency or pandemic or in the context of specific infectious diseases there may be a requirement for longer periods of absence from work.

Annual influenza vaccination of healthcare workers and at-risk patients and SARS-CoV-2 vaccination have an important role to play in protecting those who use healthcare services from exposure to Influenza A and B virus and SARS-CoV-2. Annual influenza vaccination should be promoted in all healthcare settings.

Respiratory hygiene and cough etiquette are particularly important for people on droplet precautions.

3.1.6 Aseptic technique

Aseptic technique protects patients during invasive clinical procedures by employing a variety of infection prevention and control measures that minimise, as far as practicably possible, the presence of pathogenic microorganisms. A number of approaches to promote aseptic technique are available.

Aseptic technique is used to prevent contamination of key parts (for example the part of an intravenous catheter that will be within the vein) and key sites (the place where the catheter will be introduced into the vein) by microorganisms. When aseptic technique is performed asepsis is ensured by:

- Using sterilised equipment
- Hand hygiene
- Identifying and protecting key parts and key sites

- Cleaning and disinfecting key sites
- Use of a non-touch technique
- Use of sterile equipment
- Disinfecting key parts prior to use (scrub the hub.

Terminology

Historically, the practice of protecting patients from contamination and infection during clinical procedures has generated an inaccurate and confusing terminology. The use of accurate terminology is important in order to promote clarity in practice.

Sterile – free from microorganisms (Weller 2014)

Due to the presence of microorganisms in the atmosphere it is not possible to guarantee a sterile technique in a standard health care setting. Sterile techniques can only be reliably achieved in highly controlled environments such as a laminar airflow cabinet or a specially equipped theatre. The commonly used term 'sterile technique 'is therefore not accurate since it is not possible in most clinical settings to perform a 'sterile technique '. The term should be avoided.

Asepsis – freedom from infection or infectious (pathogenic) material (Weller 2014)

An aseptic technique aims to prevent pathogenic microorganisms in sufficient quantity to cause infection, from being introduced to susceptible sites by hands, surfaces and equipment. Aseptic techniques are possible and can be achieved in typical hospital and community settings including primary care.

Clean – free from dirt, marks or stains

Although cleaning followed by drying of equipment and surfaces can be very effective, it does not necessarily meet the quality standard of asepsis. However, the action of cleaning is an essential component in helping render equipment and skin aseptic, especially when there are high levels of contaminants that require removal or reduction. As such, to be confident of achieving asepsis application of a skin or hard surface disinfectant is required either during cleaning or afterwards.

Key site

An area of skin or similar area that is penetrated, for example by a catheter, and is therefore a potential entry point for microorganisms.

Key part

Any sterile part of an item of equipment used when performing an aseptic procedure for example needles and syringe tips.

Aseptic technique in practice

Aseptic technique is a technique used to prevent contamination of key parts and key sites by microorganisms that could cause infection. In aseptic technique, asepsis is ensured by identifying and then protecting key parts and key sites and by standard aseptic technique.

Proprietary frameworks to assist with the implementation of aseptic technique are available and may be present in some health care services and facilities.

Core infection prevention and control components of aseptic technique

Risk assessment

While the principles of aseptic technique remain constant for clinical procedures, the level of practice will change depending upon a standard aseptic technique risk assessment. Considering the technical difficulty of the procedure and the healthcare workers competence, the healthcare worker assesses whether procedures can be performed without touching key parts and key sites directly. IPC precautions are then selected to counter the risks identified. For example, if it is necessary to touch a key part or key site directly, sterile gloves are required. If it not necessary to touch a key part or key site directly nonsterile gloves are appropriate.

Aseptic technique cannot always be applied due to emergency or uncontrolled environmental conditions. Where this occurs, healthcare workers should aim to utilise the principles of aseptic technique. Where there has been a breach, this should be documented and included in handover and the infection risks mitigated as soon as possible.

Key part and key site identification and protection

Key parts must be identified and protected at all times. Aseptic key parts must only come into contact with other aseptic key parts or key sites.

Hand hygiene

Effective hand hygiene is an essential component of aseptic technique. In standard aseptic technique, hand hygiene should be performed as outlined previously. In surgical aseptic technique, a surgical hand scrub is required.

It is known that hand hygiene is not always correctly performed and that even correctly performed hand hygiene cannot always remove all pathogenic microorganisms. Therefore, aseptic technique - identifying key parts and not touching them directly or indirectly - is a vital component of achieving asepsis. That is, to protect a key part from contamination, avoid touching it even when wearing sterile gloves, as sterile gloves can become contaminated.

Glove use

Gloves are single use items. If it is necessary to touch key parts or key sites directly, sterile gloves are used to minimise the risk of contamination. Otherwise, non sterile gloves are sufficient.

Aseptic fields

Even with the best practical cleaning programmes, one cannot assume that healthcare environments are always free of pathogenic microorganisms. Healthcare environments are busy and dynamic environments that may harbour antibiotic resistant organisms. Consequently, aseptic fields are important in providing a controlled aseptic working space to help promote or ensure the integrity of asepsis during clinical procedures. It is important that aseptic fields are fit for purpose. In aseptic technique, aseptic fields are increased in size and sterilised drapes are added as required on the basis of procedure complexity. For example, to administer IV therapy, mobile aseptic fields such as plastic trays should be large enough and with high sides to provide an adequate working space to contain equipment, sharps and spillages whereas insertion of a urinary catheter will generally require a larger prepared aseptic field.

Aseptic technique employs two types of aseptic fields, general and critical, that require different management depending on whether the primary purpose is to promote or ensure asepsis.

General aseptic fields: promoting asepsis

Generally aseptic fields are used in standard aseptic technique when key parts can easily and optimally be protected by critical micro aseptic fields and aseptic technique. The main general aseptic field does not have to be managed as a key part and is essentially promoting rather than ensuring asepsis. Subsequently, aseptic technique is considerably simplified and typically involves nonsterile gloves.

Critical aseptic fields: ensuring asepsis

Critical aseptic fields are used when key parts and key sites, usually due to their size or number, cannot easily be protected at all times with covers and caps, or manipulated at all times using non-touch technique (such as in peripherally inserted central venous catheters, urinary catheter insertion and complex wound care), or when particular open and invasive procedures demand large aseptic working areas for long durations, as in the operating room. In such cases, the critical aseptic fields should be managed as a key part (that is, only equipment that has been sterilised can come into contact with it). Such a critical aseptic field demands the use of sterile gloves and often, full barrier precautions (Loveday 2014). Large critical aseptic fields are used in surgical aseptic technique and as a result the technique is more complicated.

A subtype of a main critical aseptic field is the critical micro-aseptic field. Traditional aseptic or clean techniques have protected key parts by syringe caps, sheathed needles, covers or packaging. This approach is given new emphasis in aseptic technique, because the inside of such caps and covers have been sterilised and thus provide an optimum all-encompassing aseptic field for key parts.

Environmental control

Prior to aseptic procedures, healthcare workers must ensure that there are no avoidable nearby environmental risk factors, such as bed making or patients using commodes.

Sequencing

Aseptic technique practice is sequenced to ensure an efficient, logical and safe order of procedure events.

Surgical or standard aseptic technique?

Differentiation between standard and surgical aseptic technique is intended to provide clarity and structure to aid understanding but not to polarise practice. Aseptic technique guidelines help standardise practice, technique and equipment levels.

- Standard aseptic technique - clinical procedures managed with standard aseptic technique will characteristically be technically simple, short in duration (approximately less than 20 minutes) and involve relatively few and small key sites and key parts. Standard aseptic technique requires a main general aseptic field and typically nonsterile gloves. The use of critical micro-aseptic fields and aseptic technique is essential to protect key parts and key sites
- Surgical aseptic technique - surgical aseptic technique is demanded when procedures are technically complex, involve extended periods of time, large open key sites or large or numerous key parts. To counter these risks, a main critical aseptic field and sterile gloves are required and often full barrier precautions (Loveday 2014). Surgical aseptic technique should still utilise critical micro-aseptic fields and aseptic technique where practical to do so.

Table 15 Use of aseptic technique for specific procedures

Procedure	Standard/surgical aseptic technique	Rationale/typical procedure
IV therapy	Standard aseptic technique	Key parts can typically be protected by optimal critical micro-aseptic fields and non-touch technique. Key sites are small. Procedures are technically simple and have less than 20 minute's duration.
Simple wound dressings	Standard aseptic technique	Key parts and sites can be protected by optimal critical micro-aseptic fields and non-touch technique. Procedures are technically simple and less than 20 minutes duration.
Complex or large wound dressings	Surgical aseptic technique	The complexity, duration or number of key parts may demand a critical aseptic field.
Urinary catheterisation	Standard / surgical aseptic technique	An experienced healthcare worker can perform catheterisation with the use of a main generally aseptic field, micro-aseptic fields and non-touch technique. However, less experienced healthcare workers may require a critical aseptic field.
Cannulation	Standard / surgical aseptic technique	Although technically quite simple, the close proximity of healthcare worker hands to the puncture site and key parts may demand sterile gloves - dependent upon the health care workers competency.
PICC/CVC insertion	Surgical aseptic technique	The size of the CVC or PICC line, invasiveness, numerous key parts and equipment and duration requires a critical aseptic field and full barrier precautions.

Procedure	Standard/surgical aseptic technique	Rationale/typical procedure
Surgery	Surgical aseptic technique	Surgical access involves deep or large exposed wounds, numerous key parts and equipment and long procedures. Standard operation room precautions are required.

Aseptic technique

Recommendation 10:
Sterile gloves are used for surgical aseptic procedures and contact with sterile sites.

Quality/level of evidence: weak evidence

+ Strength of recommendation: strong

Practical information

Sterile gloves are indicated for any surgical procedure, vaginal delivery, invasive radiological procedures, performing vascular access and procedures (central lines) preparing total parental nutrition and chemotherapeutic agents.

3.1.7 Waste management

When handling waste:

- There is a requirement for separation of waste at source into healthcare risk waste and non-risk waste. Healthcare risk waste is (HCRW) is any waste that poses a risk due to its potential infectious nature and includes items contaminated with blood or body fluids, contaminated waste from patients with transmissible infectious diseases and other healthcare infectious waste. https://greenhealthcare.ie/
- Apply standard precautions to protect against exposure to blood and body substances during handling of waste; perform hand hygiene following the procedure
- Segregation should occur at the point of generation
- Waste should be contained in the appropriate receptacle, identified by colour and label, and disposed of according to the facility waste management plan
- Healthcare workers should be trained in the correct procedures for waste handling
- Waste bags should not be overfilled
- Sinks and shower drains should not be used for disposal healthcare risk waste such as body fluids.

Regardless of where waste is generated (for example from isolation rooms versus routine patient care areas) the principles of determining whether it is to be treated as healthcare risk waste or non-risk waste remain the same. The practical management of HCRW may be very challenging when small quantities of HCRW are generated in the household or similar setting. In all cases prompt effective containment of HCRW so as to minimise potential exposure to the waste until safely disposed of is central to managing the risk.

For additional information on waste management, see the HSE Waste Management Handbook:

https://www.hse.ie/eng/about/who/healthbusinessservices/national-health-sustainability-office/files/hse-waste-management-handbook.pdf

3.1.8 Handling of linen

Healthcare facilities must have documented policies on the collection, transportation and storage of linen. Healthcare facilities that process or launder linen must have documented operating policies.

All used linen should be handled with care to avoid dispersal of microorganisms into the environment and to avoid contact with staff clothing. The following principles apply for linen used for all patients (that is whether or not transmission-based precautions are required):

- Appropriate personal protective equipment is worn during handling of soiled linen to prevent exposure of skin and mucous membrane to blood and body substances
- Used linen must not be rinsed or sorted in patient care areas
- Use linen must be washed in washing machines that are appropriate to the purpose and setting. In higher risk settings such as acute hospitals domestic washing machines are generally not used and are not appropriate but these are generally suitable for services based in community houses
- Used linen should be segregated into used linen and fouled/infected linen using colour-coded bags at the location of use
- Hand hygiene is performed following the handling of used linen
- Clean linen must be stored in a clean and dry place that prevents contamination by aerosols, dust, moisture and vermin and is separate from used linen.

Patient items

Domestic type washing machines must only be used for patients' personal items (other than linen).

Washing must involve the use of an appropriate detergent and hot water. If hot water is not available, only individual patient loads can be washed at one time. Clothes dryers should be used for drying.

The documents at the following links may be helpful for those seeking information:

https://www.hps.scot.nhs.uk/web-resources-container/national-guidance-for-safe-management-of-linen-in-nhsscotland-health-and-care-environments-for-laundry-servicesdistribution/

and

https://www.infectionpreventioncontrol.co.uk/content/uploads/2020/08/CH-21-Safe-management-of-linen-July-2020-Version-2.00.pdf

3.2 Transmission-based precautions

Summary

Section 3.2 outlines transmission-based precautions to guide staff in the presence of suspected or known infectious microorganisms that represent an increased risk of transmission.

A summary of recommended precautions for specific infectious microorganisms can be found below:

- Transmission-based precautions are applied in addition to standard precautions
- The aim of instituting transmission-based precautions early is to reduce further transmission opportunities that may arise due to the specific route of transmission of a particular pathogen
- It is frequently appropriate to implement transmission-based precautions on the basis of clinical suspicion while awaiting laboratory test results
- Instituting and discontinuation of transmission-based precautions should be based on a risk assessment based on clinical and laboratory data where available. Discontinuation of transmission-based precautions should not be based solely on a laboratory test result.

Patient care tip

When transmission-based precautions are applied during the care of an individual, this should be noted in their record/care plan and consideration given to how to minimise risk of associated harm. The use of gloves or masks and other equipment as well as the use of signs on the door can cause worry and upset. People may feel that they are being stigmatised. Transmission-based precautions can also lead to less contact with clinical staff and family. This can make people feel lonely and isolated. This can be particularly difficult for people who already have problems with anxiety, learning disability or dementia. All healthcare workers should understand that there is a risk of harm associated with transmission-based precautions and that they should do whatever can be done to reduce the risk. Clearly explaining to people why these precautions are necessary may help to reduce or avoid harm. The impact on the person may be greater if the transmission-based precautions are applied for a long period of time. The need for continued transmission-based precautions should be reviewed regularly. Transmission-based precautions are generally not appropriate in settings other than the acute hospital but may be required in specific contexts such as an outbreak of infectious disease or pandemic.

3.2.1 Application of transmission-based precautions

What are the risks?

- Indirect or direct contact transmission when health care workers hands or clothing become contaminated, patient care devices shared between people become contaminated, people with infection or colonisation have contact with other people, or environmental surfaces are not adequately cleaned and where appropriate disinfected
- Droplet transmission when health care workers hands become contaminated with respiratory droplets which are transferred to susceptible mucosal surfaces such as the eyes, nose or mouth, when infectious respiratory droplets are expelled by coughing, sneezing or talking and come into contact with another person's mucosa (eyes, nose or mouth) either directly or via contaminated hands
- Airborne transmission when people inhale small particles that contain infectious microorganisms

When are transmission-based precautions applied?

Transmission-based precautions are applied to patients suspected or confirmed to be infected or colonised with microorganisms transmitted by the contact, droplet or airborne routes.

The combination of measures used in transmission-based precautions depends on the routes of transmission of the infectious microorganism involved, as outlined below. In the acute care setting, and where appropriate in other settings, this will involve a combination of the following measures:

- Continued implementation of standard precautions
- Appropriate use of personal protective equipment PPE (including gloves, aprons or gowns, surgical masks or FFP2 respirator masks and protective eyewear)
- Patient dedicated equipment
- Allocation of single rooms or cohorting of patients
- Appropriate air handling
- Enhanced cleaning and disinfection of the healthcare environment
- Restricted movement of people within and between facilities
- Limit number of healthcare workers caring for the person to those that are essential.

For infectious microorganisms that have multiple routes of transmission, more than one transmission-based precautions category is applied. Whether used singly or in combination, transmission-based precautions are always applied in addition to standard precautions. Transmission-based precautions remain in effect for limited periods of time, for example until signs and symptoms of the infection are resolved, or according to recommendations from IPC professionals specific to the infectious microorganism.

The mode of transmission of infectious microorganisms is the same in long-term care facilities, primary care practice and other settings as it is in the acute hospital setting. However, the risk of transmission and the likely impact of transmission may differ due to the population groups and the nature of care provided. The potential harm from transmission-based precautions may be greater in some settings particularly in settings that represents a person's home.

Considering the following will help to establish the risk of spread of microorganisms and the likely impact of spread of microorganisms in settings other than the acute hospital:

- Population of people served- this will influence the nature of care required and the type of potential infectious microorganisms (for example, some populations have a higher incidence of having tuberculosis)
- The profile of care - this includes the level of training of staff, what kind of procedures are performed and whether equipment is reprocessed or is single use
- Local infrastructure - this influences water quality, food availability and access to other health services.

In developing policies and procedures for a health care facility or service it is useful to refer to discipline specific guidelines to inform practice on specialised areas.

An overview of risk management principles and processes is given below.

Individual actions for reducing risk:

- Consult with IPC professionals to ensure that appropriate transmission-based precautions are applied and that they remain in place until the risk of transmission of the infectious microorganism has passed
- Remember that transmission-based precautions are applied as well as standard precautions
- Tell people why particular measures are needed to control the spread of infection
- Become familiar with local policy and appropriate PPE. Know when and how it should be put on and taken off when attending to people on transmission-based precautions
- Make sure you know which type of mask is needed in different situations and how to check that they are properly fitted
- Always contain or cover the infected or colonised areas of a person to whom contact precautions apply before moving them from one patient care area to another
- Explain the purpose and process of respiratory hygiene and cough etiquette to people on droplet precautions
- Ask people on droplet or airborne precautions to wear a surgical mask if they're being moved from one patient care area to another and if they can tolerate the mask
- If people are moved to a single patient room (contact or droplet precautions) or mechanically ventilated room (airborne precautions) explain why this is necessary to prevent transmission of infection
- Make sure you are fully immunised against vaccine preventable diseases.

Environmental cleaning

In an acute hospital and similar settings where the presence of infectious microorganisms requiring transmission-based precautions is suspected or known, surfaces should be physically cleaned with a detergent solution. Sodium hypochlorite or another appropriate disinfectant should be used. This can be achieved using a 2-step process (physical clean followed by disinfection) or a 2 in one clean and disinfect as outlined above.

In settings other than acute hospitals the risk of contamination, mode of transmission and risk to others should be used to determine whether disinfectants are required.

Crockery and utensils used by people on transmission-based precautions do not require containment and should be treated in the same manner as those used for other people that is to say they should be washed in a dishwasher. Disposable crockery and utensils are not necessary and may harm the environment.

This section does not provide specific guidance on cleaning. Section 7.1 and the following section below provides guidance on frequency of cleaning of specific items in low, medium and high-risk settings. Further information on the considerations required when developing cleaning schedules is provided above.

3.2.2 Contact precautions

What are the risks?

There is clear evidence that certain infectious microorganisms are transmitted by direct or indirect contact during the delivery of care.

Direct transmission occurs when infectious microorganisms are transferred from one person to another person without a contaminated intermediate object or person. For example, blood or other body substances from an infectious person may come into contact with a mucous membrane or breaks in the skin of another person (Beltrami *et al*. 2003; Rosen 1997).

Indirect transmission involves the transfer of an infectious microorganism through a contaminated intermediate object (sometimes called a fomite) or person. Contaminated hands of health care workers are important contributors to indirect contact transmission (Bhalla *et al*. 2004; Boyce and Pittet 2002; Duckro *et al.* 2005). Other opportunities for indirect contact transmission include:

- when clothing becomes contaminated while caring for a person colonised or infected with an infectious microorganism which can then be transmitted to subsequent people cared for (Perry 2001; Zachary 2001)
- When contaminated patient care devices are shared between people without adequate cleaning and disinfection between use by different people (Brooks *et al*. 1992; Desenclos 2001; Siegel *et al.* 2007)
- When environmental surfaces become contaminated.

Direct or indirect contact transmission of microorganisms during patient care is generally accepted as responsible for the majority of spread of healthcare associated microorganisms that contribute to infections in people using healthcare services.

Contact precautions

Recommendation 11:

Contact precautions, in addition to standard precautions, are implemented routinely in the acute hospital setting in the presence of known or suspected infectious microorganisms that are spread by direct or indirect contact with the people cared for or their environment. The principles of contact precautions are relevant in all settings but the application must be appropriate to the context in which care is delivered and the needs of the person cared for.

Quality/level of evidence: weak evidence

+ Strength of recommendation: strong

Practical information

When should contact precautions be implemented?

Contact precautions are used when there is a risk of direct or indirect contact transmission of infectious microorganisms that are not effectively contained by standard precautions alone (for example specific organisms such as *C. difficile* or meticillin resistant *Staphylococcus aureus* (MRSA) or, highly contagious skin infections or infestations). In addition to the acute hospital setting contact precautions should be applied in other settings with similar levels of risk of transmission. Information about which precautions to apply for specific microorganism/conditions is given in section 7.4.

Patient placement

Single patient rooms

A single patient room is recommended for patients who require contact precautions. Note: that single patient rooms are also an effective precaution to reduce droplet and airborne transmission of infection and can also protect immunocompromised patients. Rooms with their own toilet/shower and anterooms are preferred. Anterooms increase the effectiveness of single patient rooms with respect to airborne infection by reducing the potential escape of airborne infectious particles into the corridor.

The rationale for single patient rooms for patients who require contact precautions include:

- it helps to reduce contact between the person in the room and other people
- access to a dedicated bathroom which is not shared with other people can reduce the spread of *C. difficile* and other infectious microorganisms
- the door and signage can help to remind healthcare workers to adhere to contact precautions
- it can facilitate greater frequency of cleaning and decontamination as there is limited impact on neighbouring patients
- the greater prominence of clinical hand wash facilities or hand hygiene dispensers is likely to improve hand hygiene compliance.

Other points relevant to patient placement include the following:

- keep patient notes outside the room
- keep patient bedside charts outside the room
- perform hand hygiene upon entering and leaving room
- keep doors closed where safe to do so, this may not be possible when caring for people who need to be observed all or most of the time. If a door must remain open considered how to mitigate associated risks and note that doors with observation panels may reduce the requirement for open doors
- make sure rooms have clear but discrete signage
- it is generally not appropriate to schedule patients who require contact precautions to the end of the list for procedures such as interventional radiology or surgical procedures for IPC purposes.

When a single patient room is required but is not available, consultation with infection prevention and control professionals is recommended to assess the various risks associated with other patient placement options, for example cohorting. Consider also HSE guidance on prioritisation for isolation when there are limited single rooms: https://www.hse.ie/eng/about/who/healthwellbeing/our-priority-programmes/hcai/resources/general/priority-guide-for-isolation.pdf

If cohorting takes place it is recommended that, to the greatest extent practical, a dedicated team of staff care for cohorted patients and movement of staff and patients is minimised to and from the cohort area. Patient beds/chairs should be separated by a minimum of 1 metre (edge to edge) to reduce opportunities for the inadvertent sharing of items between patients. A distance of greater than 1m is required in some settings based on local risk assessment. Closed or partly closed privacy curtains may also reduce interaction. If cohorting is in the context of a suspected or confirmed airborne infection adequate ventilation should be assured to the greatest extent practical. Note: that when increasing natural ventilation it is necessary to consider if the people present are at particular risk from exposure to airborne fungal spores.

If it is necessary to place a person who requires contact precautions in a room with a person who is not infected or colonised with the same microorganism:

- avoid placing these people with people who are at increased risk of an adverse outcome from infection, for example people who are immunocompromised, have open wounds or have anticipated prolonged length of stay
- reinforce performance of hand hygiene as per the five moments of hand hygiene and change PPE between contact with the people in the cohort area.

Movement of patients

Limiting movement of the person on contact precautions reduces the risk of environmental contamination. If movement is required between care areas within or between facilities it is important to ensure that infected or colonised areas of the person's body are contained and covered. Contaminated PPE should be removed and disposed of and hand hygiene performed before the person is moved. In most situations PPE such as apron and gloves is not required while transferring a patient colonised with MDRO from one department to another. Clean PPE should be put on before assisting the person at the destination. In many circumstances it may be appropriate for people on contact precautions to leave the clinical area to go to non-clinical areas, for example to go outside for a walk, with advice to minimise contact with other people and to avoid use of toilet facilities if possible until they return to their room.

Care of a deceased person who was subject to transmission-based precautions at the time of death

As a precaution, transmission-based precautions that applied during life should generally continue to apply to the care of the deceased when preparing the body for removal from the healthcare setting. See Appendix 7 for notes on measures required in the context of certain key infections at the time of death. Appendix 7 is based on information available in the National Infection Prevention and Control Manual of NHS Scotland at the following link: https://www.nipcm.scot.nhs.uk/appendices/appendix-12-mandatory-application-of-transmission-based-precautions-to-key-infections-in-the-deceased/

Recommendation 12:
Hand hygiene be undertaken and personal protective equipment (PPE) be used as appropriate when healthcare workers have contact with people or with body fluids of people who require contact precautions. This principle is relevant in all settings but the application must be appropriate to the context in which care is delivered.

Quality/level of evidence: weak evidence,

+ Strength of recommendation: strong recommendation

Practical information

How should contact precautions be applied?

Contact precautions are applied in addition to standard precautions.

The key aspects of applying contacts precautions relate to:

- hand hygiene
- use of appropriate personal protective equipment
- special handling of equipment

- patient placement
- minimising patient movements between patient care areas.

Hand hygiene and PPE

Effective hand hygiene is particularly important in preventing contact transmission. The WHO 5 moments for hand hygiene as outlined above should be followed at all times. When the presence of *C. difficile* or non-enveloped viruses is known or suspected, use of alcohol-based hand rubs alone may not be sufficient to reduce transmission of these microorganisms.

Putting on both gloves and apron upon entering the patient care area to deliver care that is likely to involve contact with the patient helps to contain infectious microorganisms, especially those that have been implicated in transmission through environmental contamination (for example *C. difficile*, norovirus and other intestinal tract pathogens, Respiratory Syncytial Virus) (Donskey 2004; Duckro *et al.* 2005; Hall and Douglas 1981; Wu *et al.* 2005). If multiple tasks are performed whilst in the patient zone, contaminated gloves should be removed after a task, hand hygiene should be performed and clean gloves applied before starting the next task with that patient to reduce the risk of transmission of microorganisms. Considerations in selecting an apron or gown appropriate to the situation are outlined elsewhere in this document.

A surgical mask and protective eyewear or face shield must be worn if there is the potential for generation of splashes or sprays of blood and body substances into the face and eyes.

Hand hygiene compliance is likely to be improved through greater prominence of clinical hand wash facilities and alcohol-based hand rub dispensers. More information is provided elsewhere in this document.

Recommendation 13:

Where possible patient-dedicated equipment or single-use patient-care equipment be used for people on contact precautions.

If common use of equipment for multiple people on contact precautions is unavoidable, clean and disinfect the equipment (sterilise if appropriate) and allow it to dry before use on another person.

Quality/level of evidence: weak evidence

+ Strength of recommendation: strong recommendation

Practical information

Single use or patient dedicated equipment

Precautions with respect to patient care equipment are very important in the care of patients on contact precautions. If patient care devices (for example blood pressure cuffs, mobility aids) are shared between people without appropriate cleaning, disinfection or reprocessing between uses, they may transmit infectious microorganisms. Where common use of equipment for multiple people is unavoidable, perform a risk assessment, and carry out cleaning according to the manufacturer's instructions between use for care of different people.

Any medical device (instruments and equipment) that is to be reused requires reprocessing – cleaning, disinfection and/or sterilisation. The minimum level of reprocessing required for reusable instruments and equipment depends on the individual situation (that is the body site, presence of multidrug resistant organisms and the nature in which the instrument will be used). For further information on the reprocessing of reusable medical devices, see the relevant section of this document.

3.2.3 Droplet precautions

A number of infectious microorganisms are transmitted through respiratory droplets (that is large particle droplets more than 5 microns in size) that are generated by a patient who is coughing, sneezing or talking. Transmission by large particle droplets requires close contact as the droplets do not remain suspended in the air and generally only travel short distances. They can, however, contaminate horizontal surfaces close to the source person, and the hands of healthcare workers can become contaminated through contact with those surfaces. For this reason, consideration should be given to the need for additional PPE (see below).

Droplet precautions are based on evidence that show that:

- hand hygiene is effective in preventing transmission of viruses and reducing the incidence of respiratory infections both within and outside healthcare settings (Aiello 2002; Boyce and Pittet 2002; Pittet and Boyce 2001)
- physical interventions are highly effective against the spread of a broad range of respiratory viruses (Gralton and McLaws 2010; Jefferson *et al.* 2009)
- surgical masks worn by an uninfected person protect the wearer from droplet contamination of the nasal or oral mucosa with infectious droplets (Siegel *et al.* 2007)
- physical proximity of less than one metre has been associated with an increased risk for transmission of some infections by the droplet route
- placing surgical masks on people with an infection transmitted by respiratory droplets can also prevent infected people from dispersing respiratory secretions into the air (Siegel *et al.* 2007).

How should droplet precautions be applied?

The key aspects of applying droplet precautions relate to:

- standard precautions including respiratory hygiene and cough etiquette
- use of appropriate PPE
- special handling of equipment
- patient placement
- minimising patient movement
- appropriate signage.

Droplet precautions

Recommendation 14:
Healthcare workers implement droplet precautions when caring for people known or suspected to be infected with microorganisms transmitted by respiratory droplets. This includes wearing a surgical mask in the patient-care environment when a minimum distance from a person on droplet precautions cannot be maintained.
Note: For the purpose of recommendation 14 a minimum distance of 1 metre is generally applied when caring for people suspected or known to have droplet transmitted infections (for example meningococcal meningitis).

Quality/level of evidence: weak evidence

+ Strength of recommendation: strong recommendation

Practical information

When should droplet precautions be implemented?

Droplet precautions are intended to prevent transmission of infectious microorganisms spread through close respiratory or mucous membrane contact with respiratory secretions. As these microorganisms do not generally travel throughout the air over long distances, special air handling and ventilation are generally not required. Infectious microorganisms for which droplet precautions are indicated include influenza, norovirus, *Bordetella pertussis*, *Neisseriae meningitidis*. Surgical masks that are fluid impervious protect the wearer from droplet contamination of the nasal or oral mucosa but do not adequately protect the wearer from infections transmitted by the airborne route. Evidence indicates that respirator masks are not superior for reducing the risk of infections transmitted by the droplet route and they are less comfortable to wear. The surgical mask is removed after leaving the room occupied by the infectious person (or moving away from the patient zone). Hand hygiene should be performed after taking off the mask. For further information on characteristics and levels of surgical masks see below.

In some circumstances wearing a surgical mask may represent a barrier to effective patient care. A clear face visor does not provide a comparable level of protection but a visor that extends from above the eyes to below the chin and from ear to ear is likely to offer some protection for the wearer and may be used if for any reason use of a mask is not practical in the context.

Hand hygiene and droplet precautions

Some infectious microorganisms transmitted by the droplet route may also be transmitted by contact. Hand hygiene is therefore an important aspect of droplet precautions and the WHO 5 moments for hand hygiene outlined above should be followed.

Good practice point: 9
People who require transmission-based precautions (contact, droplet or airborne) should be accommodated in a single-patient room. Where this is not possible, people colonised or infected with the same organism should be cohorted in a discrete area with a minimum distance maintained between the people receiving care in the cohort area.

Consistent with the persons care needs, minimise the number of healthcare workers and the time healthcare workers are exposed to an infectious patient.

Practical information

Placement of people on droplet precautions

Placing people on droplet precautions in a single patient room reduces the risk of person to-person transmission. When single patient rooms are in short supply, the following principles apply in decision making on patient placement:

- prioritise patients who have highly infectious diseases for which other control measures are not available
- prioritise those with excessive cough and sputum production for single patient room placement
- consider the person's ability to perform hand hygiene and follow appropriate cough etiquette
- place together in the same room (cohort) patients who are infected with the same microorganism and are suitable roommates.

If it becomes necessary to place people who require droplet precautions in a room with a person who does not have the same infection:

- avoid placing people on droplet precautions in the same room with people who have conditions that may increase the risk of adverse outcomes from infection or that may facilitate the transmission (for example those who are immunocompromised, have anticipated prolonged lengths of stay, have pre-existing lung disease, cardiac conditions or muscular dystrophy)
- ensure that people are physically separated (more than one metre apart) from each other and draw the privacy curtain between beds.

If a patient requires care under droplet precautions but an aerosol generating procedure (AGP) associated with an increased risk of infection is undertaken, then droplet precautions should be increased to airborne precautions for at least the duration of the procedure. The procedure should be undertaken in a treatment room, away from other people (if the person is cohorted with others).

In all cases the importance of respiratory hygiene and cough etiquette should be explained to people on droplet precautions.

In primary care and other office-based practice, examples of appropriate implementation of droplet precautions include segregation in waiting rooms for people with violent or frequent coughing and the availability of tissues, alcohol-based hand rub and a waste bin so that people can practice respiratory hygiene and cough etiquette. In some circumstances, if there is no indication that the person is seriously ill and there is no separate waiting area in the practice/clinic it may be acceptable to ask a person who travelled by car to the practice/clinic to wait in the car until they can be seen.

For further information on isolation and cohorting of patients, see below

Movement of people on droplet precautions

When movement of a person on droplet precautions within or between facilities is necessary, there is the potential for other people including healthcare workers to come into contact with infectious microorganisms when the person coughs or sneezes. This can be addressed by asking the person to wear a surgical mask while they are being transferred (if they can tolerate it) and to follow respiratory hygiene and cough etiquette. Children should wear a correctly fitting mask when they are outside the isolation room if this is practical and does not compromise patient care.

Broader application of droplet precautions

In the context of a public health emergency related to an acute respiratory disease (for example COVID-19) it may be appropriate for a period of time to consider a broader application of droplet precautions including application to people without overt clinical features of a droplet transmitted infectious disease. This is more likely to be considered if clinical features do not reliably allow identification of people who likely to be infectious.

3.2.4 Airborne precautions

Recommendation 15:
Airborne precautions, in addition to standard precautions, are implemented in the presence of known or suspected infectious microorganisms that are transmitted from person-to-person by the airborne route and when Aerosol Generating Procedures (AGPS) associated with an increased risk of infection are performed on people with known or suspected infectious microorganisms normally transmitted by the droplet route.

Quality/level of evidence: weak evidence

+ Strength of recommendation: strong recommendation

Practical Information

When should airborne precautions be implemented?

Airborne precautions reduce the risk of transmission of microorganisms that remain infectious over time and distance when suspended in the air. These microorganisms may be inhaled by susceptible individuals who have not had face to face contact with (or been in the same room as) the infectious individual.

Infectious microorganisms for which airborne precautions are indicated include measles virus (rubeola), chickenpox (varicella) and *M. tuberculosis*. As outlined above other respiratory viruses, specifically SARS-CoV-2, may sometimes be transmitted by the airborne route.

Information about which precautions to apply for specific conditions is given in section 7.3.

Recommendation 16:
It is good practice to wear correctly fitted and fit checked respiratory protection (FFP2 respirator) when entering the patient-care area when an airborne-transmissible infectious microorganism is known or suspected to be present and when entering the patient care area where Aerosol Generating Procedures (AGPs) associated with an increased risk of infection are performed on people with known or suspected infectious microorganisms normally transmitted by the droplet route.

Quality/level of evidence: weak evidence

+ Strength of recommendation: strong recommendation

Practical information

How should airborne precautions be applied?

The key aspects of applying airborne precautions relate to:

- standard precautions, including respiratory hygiene and cough etiquette (see above)
- appropriate ventilation

- use of appropriate PPE, particularly correctly fitted FFP2 respirators
- minimising exposure of people who use healthcare services and healthcare workers to the infectious microorganisms.

Note: there may be specific instances in particular in relation to multidrug resistant TB where FFP3 may be preferred although there is no persuasive evidence that they offer greater protection.

Personal protective equipment

When there is a high probability of airborne transmission due to the infectious microorganism or procedures performed on infectious people (for example bronchoscopy on a patient with suspected or confirmed infection) sound scientific principles support the use of fit-tested and fit-checked FFP2 respirators to prevent airborne transmission. FFP2 respirators are designed to help reduce exposure of the wearers airway to airborne contaminants such as particles, gases or vapours.

The requirements for FFP2 respirators are stated in requirements of European Standards (EN). FFP3 respirators are required to meet higher filtration efficiency and may be preferred by some facilities. The requirements for fit testing and fit checking are comparable for both FFP2 and FFP3 respirators.

FFP2 respirators – fit testing and fit checking

In order for an FFP2 respirator to offer the maximum desired action the wearer should be properly fitted and trained in its safe use.

Healthcare workers are encouraged to observe each other's mask fitting and immediately advise of any fitting issues to maximize healthcare worker safety and safety of those who use healthcare services.

Fit testing

The purpose of fit testing is to identify which style of respirator is suitable for an individual, and to ensure that it is worn correctly. It also provides an opportunity to ensure healthcare workers are properly trained in the correct use of the mask. When fit testing is undertaken, it should be done based on relevant requirements in conjunction with the risk assessment with relevance to the healthcare setting.

The Health and Safety Authority indicate that where a risk assessment indicates that HCW's need to use a close-fitting respirator mask for their protection that every effort should be made to comply with the requirement for fit testing of the worker, as far as is reasonably practicable. When fit testing of all staff is not immediately possible, then fit testing should be prioritised for those at greatest risk. Priority groups for fit testing include the following:

- HCW's most likely to be involved in performing AGPs, in particular endotracheal intubation
- HCW's most likely to have the most frequent or prolonged exposure to airborne infection.

The following represent opportunities when fit testing may be considered:

- at the commencement of employment for employees who will be working in clinical areas where there is a significant risk of exposure to infectious microorganisms transmitted via the airborne route - assessment of the significance of risk will involve consideration of the location, for example risk is higher in an intensive care unit, and activities to be undertaken, for example a physiotherapist performing a procedure to induce sputum production in potentially infectious patients is considered at risk of exposure to infectious aerosols

- when there is a significant change in the wearers facial characteristics that could alter the facial seal of the respirator, for example significant change in body weight or facial surgery
- at regular intervals.

Health care facilities should ensure that they have a respiratory protection programme that regularly evaluates the risk to which health care workers are exposed and determines which employees are required to undertake fit testing.

Employers must ensure that their employees are medically fit to wear a respirator.

There are 2 types of facial fit test - qualitative and quantitative. Qualitative fit tests are fast and simple but can be influenced by the wearer. Quantitative fit tests require the use of specialised equipment used by a trained operator.

Fit checking

Health care workers must perform fit checks every time they put on an FFP2 respirator to ensure it is properly applied. No clinical activity should be undertaken until a satisfactory fit has been achieved. Fit checks ensure the respirator is sealed over the bridge of the nose and mouth and that there are no gaps between the respirator and face. Health care workers must be trained in performance of a fit check.

The procedure for fit checking includes:

- placement of the respirator on the face
- placement of the headband or ties over the head and at the base of the neck
- compressing the respirator to ensure a seal across the face, cheeks and the bridge of the nose
- checking the positive pressure seal of the respirator by gently exhaling. If air escapes, the respirator needs to be adjusted checking the negative pressure seal of the respirator by gently inhaling. If the respirator is not drawn in towards the face, or air leaks around the face seal, readjust the respirator and repeat process or check for defects in the respirator.

The manufacturer's instructions for fit checking of individual brands and types of FFP2 respirator should be referred to at all times.

Healthcare workers who have facial hair, including a one to two-day beard growth, must be aware that an adequate seal cannot be guaranteed between the FFP2 respirator and the wearer's face.

Wearing an FFP2 respirator

Considerations when using an FFP2 respirator include:

- if a good facial seal cannot be achieved, for example the intended wearer has a beard or long moustache, an alternative respirator such as a powered air purifying respirator should be used
- respirator masks should not be touched while being worn
- respirator masks should be changed when they become moist
- respirator masks should never be reapplied after they have been removed
- respirator masks should not be left dangling around the neck
- hand hygiene should be performed upon touching or disposing of a used respirator mask.

Removal of an FFP2 respirator

Correct removal of an FFP2 respirator mask is important as there is a risk of contamination to the user if not removed correctly. Considerations when removing an FFP2 respirator include:

- removal of respirator masks should be by the straps from the back of the head forwards
- respirator masks should be removed outside the patient care area and disposed of in a closed receptacle.

Figure 5 Fitting a P2 respirator, Removing and disposing of respirator

Note: FFP2 respirator mask are available in several different designs and only one is illustrated above.

Good practice point: 10

Place people on airborne precautions in a room with bathroom facilities and with appropriate controlled ventilation or in a room from which air does not circulate to other areas.

Exceptions to this should be justified by risk assessment.

Consistent with the persons care needs it is good practice to minimise the number of healthcare workers and the time healthcare workers are exposed within shared airspace with a person on airborne precautions.

Practical information

Patient placement

People with suspected or confirmed airborne infection should be placed in a room with appropriately controlled ventilation or a room from which air does not circulate to other areas. The same applies to people with droplet-transmitted respiratory virus infection when AGPs are performed on them. Health care workers should be aware that it is important to place people on airborne precautions in an area that can be contained. People should also be asked to wear a surgical mask (if they can tolerate it) when they are not in a single room until advised to remove it by attending staff. The door to the room must remain closed for any person who requires airborne precautions. Consistent with the person's care needs it is good practice to minimise the number of healthcare workers and the time healthcare workers are exposed within shared airspace with the person. Where possible only staff and visitors who have confirmed immunity (evidenced by serological immunity or vaccination history) to the specific infectious microorganism (for example measles virus) should enter the room. While appropriate PPE should be worn by all staff and visitors, those with unknown immunity or non-immune health care workers should be extra vigilant. While there is a paucity of evidence to confirm their effectiveness, rooms with controlled ventilation may reduce the transmission of airborne infection within health care settings.

Standardised transmission-based precautions signage should identify the isolation room and include the necessary precautions to be adopted.

Prior to placing a person in a room with appropriately controlled ventilation, the pressure should be checked. When negative pressure rooms are in use, the pressure differential should be checked regularly, preferably daily, even if a continuous differential pressure sensing device is in use.

The patient should be advised that visitors should be limited, assessed by staff and advised of the risk to them. Of note, there may be little additional risk to a visitor from brief exposure while visiting in the healthcare setting if they have already been intensively exposed to infection risk in a household setting immediately prior to the patient's admission. In that circumstance however, the visitor may pose a risk to others if they are also infectious. Visitors' names should be recorded. The recording of names of visitors may support follow up of potentially exposed people by Public Health if required.

Movement of patients

If transfer of the person outside the room with appropriately controlled ventilation is necessary, asking the person to wear a correctly fitted surgical mask while they are being transferred and to follow respiratory hygiene and cough etiquette, as well as covering any skin lesions associated with the condition (for example chickenpox) will reduce the risk of cross transmission. Children should wear a correctly fitting mask when they are outside an isolation room in so far as possible and consistent with the child's care needs.

3.3 Personal Protective Equipment (PPE)

What are the risks?

Any infectious microorganism transmitted by the contact or droplet route can potentially be transmitted by contamination of health care workers hands, skin or clothing. Cross contamination can then occur between the health care worker and people cared for, between health care workers or between the health care worker and the environment. Infectious microorganisms transmitted through droplets or aerosols can also come into contact with the mucous membranes of the healthcare worker.

PPE refers to a variety of barriers, used alone or in combination, to protect mucous membranes, airways, skin and clothing from contact with infectious microorganisms. PPE used as part of standard precautions includes aprons, gowns, gloves, surgical masks, protective eyewear and face shields. Selection of PPE is based on the type of interaction with the person cared for, known or possible infectious microorganisms and the likely mode of transmission of those microorganisms.

There have been few controlled clinical studies evaluating the relationship between the use of PPE and risk of healthcare associated infections. However, the use of barriers reduces opportunities for transmission of infectious microorganism. PPE also protects people from exposure to infectious microorganisms in the surrounding environment that may be be transferred to the person by healthcare workers.

Decision making about PPE

Selection of PPE must be based on assessment of the risk of transmission of infectious microorganisms to the person cared for or healthcare worker and the risk of contamination of the clothing or skin of healthcare workers or other staff by patients' blood, body substances, secretions or excretions.

Local policies and current health and safety legislation should also be considered.

Factors to be considered are:

- probability of exposure to blood and body substances
- type of body substance involved
- probable type and probable route of transmission of infectious microorganisms.

Appropriate sequences and procedures for putting on and removing PPE are described below.

All PPE must meet appropriate standards. PPE should also be used in accordance with manufacturers recommendations. PPE is always used as well as and not as a substitute for hand hygiene.

Where to wear PPE

PPE is designed and issued for a particular purpose in a specific setting and should not be worn outside of that area. Protective clothing for staff in areas where there is a high risk of contamination (for example operating suite/room) must be removed before leaving the area. Even when there is a lower risk of contamination, protective clothing that has been in contact with patients should not be worn outside the patient care area. Similarly, to reduce the risk of transmission of microorganisms between people, PPE should be removed and if necessary replaced before attending to another person.

Sequence for putting on and removing PPE

To reduce the risk of transmission of infectious microorganisms, PPE must be used appropriately. The sequence for putting on and removing PPE is illustrated in posters and videos on the HSPC website.

https://www.hpsc.ie/a-z/respiratory/coronavirus/novelcoronavirus/guidance/infectionpreventionandcontrolguidance/ppe/

https://www.hpsc.ie/a-z/respiratory/coronavirus/novelcoronavirus/guidance/infectionpreventionandcontrolguidance/ppe/

In certain settings, patients may also be required to wear PPE. However, there may be issues around adherence when dealing with specific groups of people such as paediatric patients or people with dementia or claustrophobia. In these cases, other IPC measures should be applied. Use of PPE by a patient should not be made a condition of access to care.

Personal protective equipment

Recommendation 17
PPE including gloves, respiratory protection, face protection, aprons or gowns should be used as required by the task being performed and in line with standard or transmission-based precautions.

Quality/level of evidence: weak evidence

+ Strength of recommendation: strong recommendation

PPE should generally:

- be used only when required by the task being undertaken (avoid "ritual" use of PPE)
- be appropriate to the task being undertaken
- be worn for a single procedure or episode of patient care where contamination with body substances is likely
- be removed in the area where the episode of patient care takes place (with the exception of masks which should be removed promptly after leaving the area within which the protection of a mask is required).

Note: In the context of a pandemic or other exceptional event, continued use of certain items of PPE when seeing a number of patients with the same infectious disease in direct succession in one clinical area may be acceptable based on a risk assessment. This may apply to mask, face protection and gowns if the task performed by the healthcare worker does not bring the item of PPE into physical contact with the person cared for and the item of PPE remains visibly clean and intact. The same pair of gloves must not be used when caring for multiple people.

Practical information

Aprons and gowns

International guidelines recommend that protective clothing (apron or gown) be worn by healthcare workers when:

- close contact with the person, materials or equipment may lead to contamination of skin, uniforms or other clothing with infectious microorganisms

- there is a risk of contamination with blood, body substances, secretions or excretions (except sweat)
- the type of apron or gown required depends on the degree of risk, including the anticipated degree of contact with infectious material and the potential for blood and body substance to penetrate through to clothes or skin. Gowns and aprons used as PPE when delivering healthcare should be fluid impervious
- aprons and gowns should be changed between caring for different people
- aprons /gowns are used upon entering the room of a person requiring contact precautions when contact with the person or the persons environment is anticipated. Aprons or gowns should be appropriate to the task being undertaken. Aprons or gowns are not required upon entering the room of a patient on contact precautions if the purpose is to leave or remove a meal tray or for a brief visual or verbal check on the patient's condition.

Table 16 PPE Recommended Use

Type	Recommended use	Characteristics
Plastic apron	Suitable for general use when there is the possibility of sprays or spills or exposure to blood or body substances during low-risk procedures. Worn during contact precautions when limited patient contact is likely.	Fluid impervious Single-use, for one procedure or episode of patient care. Disposable
Full body gown/ coverall suit	Worn when there is a risk of contact of the healthcare worker's skin with broken skin, when extensive skin to skin contact (for example lifting a patient with scabies) is likely, or a risk of contact with blood and body substances which are not contained (for example patient is vomiting). Worn when there is the possibility of extensive splashing of blood and body substances or there is a risk of exposure to large amounts of body substances (for example in some operative procedures). Worn when exposed to APGs associated with an increased risk of infection.	Fluid impervious. Single-use and disposable or reusable after reprocessing. Long sleeved so clothing and exposed upper body areas are protected. Always worn in combination with gloves and other PPE where indicated
Sterile gown	Worn for procedures that require an aseptic field	Pre-packaged

Removing aprons and gowns

Removal of aprons and gowns before leaving the patient care area (for example in the room or anteroom prevents possible contamination of the environment outside the persons room. Aprons and gowns should be removed in a manner that prevents contamination of clothing or skin. The outer contaminated side of the apron or gown is turned inward and rolled into a bundle and then discarded into a designated container for healthcare risk waste if visibly contaminated. If the apron or gown is dry and if there is no visible contamination it may be discarded as non-risk waste.

Recommendation 18:
Wear personal protective equipment to protect the face and eyes during procedures that generate splashes or sprays of blood and body substances into the face and eyes, when entering the patient-care area, when an airborne-transmissible infectious microorganism is known or suspected to be present and when entering the patient care area where (AGPs) aerosol generating procedures associated with an increased risk of infection are performed on people with known or suspected infectious microorganisms normally transmitted by the droplet route.

Quality/level of evidence: weak evidence

+ Strength of recommendation: strong recommendation

Note: that routine venipuncture is unlikely to create splashes and sprays and does not generally require use of PPE to protect the face and eyes.

Practical information

Face and eye protection

The mucous membranes of the mouth, nose and eyes are portals of entry for infectious microorganisms, as are skin surfaces if skin integrity is compromised.

Face and eye protection reduce the risk of exposure of health care workers to splashes or sprays of blood and body substances and is an important part of standard precautions. Procedures that generate splashes or sprays of blood and body substances require a mask worn with protective eyewear or face shield. In specific circumstances if a mask cannot be worn use of a face shield alone is expected to reduce risk of contamination of mucous membranes of mouth, nose and eyes to some degree but is not considered equivalent to a mask.

Table 17 PPE Face and Eye Protection

Type of care	Examples	Face and eye protection required
Routine care	General examination (for example medical, physiotherapy, nursing) Routine observations	Not required unless caring for a person on droplet precautions (surgical mask) or airborne precautions (FFP2 respirator mask)
Procedures that generate splashes or sprays	Dental procedures Nasopharyngeal aspiration Emptying wound or catheter bag	Protective eyewear/full-length face shield Fluid-resistant surgical mask

Type of care	Examples	Face and eye protection required
Procedures involving the respiratory tract (including the mouth)	Intubation Nasopharyngeal suction	Protective eyewear Surgical mask

Surgical masks

Surgical masks are loose fitting, single use items that cover the nose and mouth. They are used as part of standard precautions to keep splashes or sprays from reaching the mouth and nose of the person wearing them. They also provide some protection from respiratory secretions and are worn when caring for patients on droplet precautions. People who are coughing or known to be infectious can be asked to wear a mask to limit potential dissemination of infectious respiratory secretions from the patient to others.

Considerations when using a surgical mask include:

- masks should be changed when they become soiled or wet
- masks should never be reapplied after they have been removed
- masks should not be left dangling around the neck
- touching the front of the mask while wearing it should be avoided
- hand hygiene should be performed upon touching or discarding a used mask
- masks should normally be changed between episodes of care for different people however continued use of a mask while moving between people may be justified by risk assessment in the context of an outbreak on pandemic provided the mask is clean, dry and undamaged.

If children are asked to wear a mask in specific circumstances the mask should be suitable for use by the child and must not interfere with respiratory function.

Surgical masks can be categorized into 2 main types these are type II and type IIR. The latter is fluid resistant and is required where the wearer is likely to be exposed to splashing of blood or body substances.

Eye protection

Goggles with the anti fog coating provide reliable and practical eye protection from splashes, sprays and respiratory droplets from multiple angles. Newer styles of goggles fit adequately over prescription glasses with minimal gaps (to be efficacious, goggles must fit snugly particularly from the corners of the eye across the brow).

Other types of protective eyewear include safety glasses with side shield protection which are widely used in dentistry and other specialties that use operating microscopes. While effective as eye protection goggles and safety glasses do not provide splash or spray protection to other parts of the face.

Personal eyeglasses and contact lenses do not represent adequate eye protection.

Face Shields

Single use or reusable face shields may be used in addition to surgical masks as an alternative to protective eyewear. Compared with other forms of protective eyewear, a face shield can provide protection to other parts of the face as well as the eyes. Face shields extending from chin to crown provide better face and eye protection from splashes on sprays; face shields that wrap around the sides may reduce splashes around the edge of the shield.

Removing face and eye protection

Removal of a face shield, protective eyewear on surgical mask can be performed safely after gloves have been removed and hand hygiene performed. Their ties, earpieces and headbands used to secure the equipment to the head are considered clean and therefore safe to touch with bare hands. The front of a mask, protective eyewear or face shield is considered contaminated.

Cleaning reusable face and eye protection

Reusable face shields and protective eyewear should be cleaned according to the manufacturer's instructions, generally with detergent solution, and be completely dry before being stored. If they are to be disinfected they should be disinfected using either an appropriate disinfectant or heat.

Individual actions for reducing the risk:

- before putting on personal protective equipment explain to the person that it is a routine part of IPC
- assess the risk of spraying or splashing in the specific situation and choose PPE accordingly
- follow appropriate sequence and procedure for putting on and removing PPE as outlined in HSE training materials
- lead by example and champion the appropriate use of PPE in your setting.

Recommendation 19:
Single-use, gloves are worn for:

- each invasive procedure
- direct contact with sterile sites and non-intact skin or mucous membranes
- any activity that has been assessed as carrying a risk of exposure to blood and body substances.

Routine use of gloves for all clinical contact with people cared for is not appropriate. Use of gloves is not an alternative to hand hygiene.
Quality/level of evidence: weak evidence
+ Strength of recommendation: strong recommendation

Note: Hand hygiene should be performed prior to donning gloves and after gloves are removed. Gloves must be changed between people cared for and during care of an individual person if the hands move from a contaminated body site for example perineal area to a clean body site for example face. Single-use gloves should not be decontaminated with alcohol hand rub. If single-use gloves are thought to be contaminated, torn or damaged they must be removed, hand hygiene performed and a fresh pair of gloves applied if required.

The Glove Pyramid concept promoted by the World Health Organisation is a useful concept for promoting appropriate glove use and discouraging inappropriate use. See the WHO Glove Use Information Leaflet at https://www.who.int/publications/m/item/glove-use-information-leaflet-(revised-august-2009)

It is not good practice to wear gloves as a routine. This tends to result in the wearer becoming casual about use of gloves and thus placing themselves and others at risk. Indications of casual glove use include touching the face, adjusting clothing, folding arms and handling personal items while wearing gloves and wearing of gloves in non-clinical areas or then transiting between clinical areas. Inappropriate use and disposal of gloves as well as other items of PPE represents a significant environmental concern (Zhang *et al.* 2021)

Practical information

Gloves

Gloves combined with hand hygiene, can protect both people cared for and health care workers from exposure to infectious microorganisms that may be carried on hands. As part of standard precautions, they are used to prevent contamination of health care workers hands when:

- you anticipate direct contact with blood or body substances, mucous membranes , non-intact skin and other potentially infectious material
- handling or touching visibly or potentially contaminated patient care equipment and environmental surfaces.

The capacity of gloves to protect health care workers from transmission of blood borne infectious microorganisms following a needle stick or other puncture that penetrates the glove barrier has not been determined.

When and how gloves should be worn?

As with all personal protective equipment the need for gloves is based on careful assessment of the task to be carried out, the related risk of transmission of microorganisms to the person cared for; and the risk of contamination of the health care workers clothing and skin by the blood and body substances of the person cared for. Risk assessment includes consideration of:

- who is at risk, whether it is the patient or the health care worker or both?
- whether sterile or nonsterile gloves are required, based on contact with susceptible sites or clinical devices and the aspect of care or treatment to be undertaken
- the potential for exposure to blood or body substances
- whether there will be contact with non-intact skin or mucous membranes during general care and invasive procedures
- whether contaminated instruments or patient care equipment will be handled
- whether hands will be in contact with a contaminated surface.

When gloves are worn in combination with other PPE they are put on last.

What type of gloves should be worn?

Nonsterile single use medical gloves are available in a variety of materials. Hypersensitivity to latex is a major concern therefore in Ireland use of natural rubber latex (NRL) gloves is avoided or minimised. Nitrile gloves are the standard glove used by the HSE.

https://www.hse.ie/eng/staff/resources/hrppg/policy-on-prevention-and-management-of-latex-allergy.html

The selection of glove type for nonsurgical use is based on a number of factors:

- the task to be performed (that is the glove type should be suitable for the intended use and aim to avoid interference with dexterity, friction, excessive sweating or finger and hand muscle fatigue
- anticipated contact with chemicals and chemotherapeutic agents.

Table 18 Use of Gloves

Glove	Indications for use	Examples
Non-sterile gloves	Potential for exposure to blood, body substances, secretions or excretions including contact with contaminated equipment or environment. Contact with non-intact skin or mucous membranes	Venepuncture. Vaginal examination. Dental examination and dental procedures that do not require a sterile field. Emptying a urinary catheter bag. Naso-gastric aspiration. Management of minor cuts and abrasions.
Sterile gloves	Potential for exposure to blood, body substances, secretions or excretions. Contact with susceptible sites or clinical devices where sterile conditions should be maintained	Surgical aseptic technique procedures for example Urinary catheter insertion. Complex dressings. Central venous line insertion site dressing. Lumbar puncture. Clinical care of surgical wounds or drainage sites. Dental procedures requiring a sterile field.
Reusable utility gloves	Indicated for non-patient-care activities. Utility gloves may be decontaminated for re-use provided the integrity of the glove is not compromised usually this is by washing the gloves before removal and storing dry (check manufacturer's directions)	Worn for cleaning the environment or cleaning and disinfecting patient care equipment. Instrument cleaning in sterilising services unit
Gloves suitable for clinical use		
Synthetic gloves (for example nitrile) Procedures involving high risk of exposure to blood-borne virus and where high barrier protection is needed		
NRL (latex) gloves Generally avoided because of concerns re latex hypersensitivity. If used select powder-free latex gloves to minimise the risk of latex sensitivity or allergies		

When should gloves be changed?

Gloves, other than utility gloves, should be treated as single use items and discarded after use, and not washed or decontaminated with alcohol hand rub. This is because infectious microorganisms cannot be reliably removed from glove surfaces and continued glove integrity cannot be ensured.

Changing of gloves is necessary:

- between episodes of care for different people to prevent transmission of infectious microorganisms between people (Loveday et al. 2014; Siegel *et al.* 2007)
- during the care of a single person to prevent cross contamination of body sites for example if the hands move from a contaminated body site for example perineal area to a clean body site for example the face (Boyce and Pittet 2002)
- if the interaction with the person cared for involves touching portable computer keyboards, other portable devices or any other mobile equipment that is transported from room to room (Siegel *et al.* 2007).

Prolonged and indiscriminate use of gloves should be avoided for a number of important reasons. Failure to change gloves between procedures has been found to increase the risk of cross transmission and has been associated with transmission of meticillin resistant *Staphylococcus aureus* (MRSA) and Gram-negative bacilli (Doebbling *et al.* 1988; Olsen *et al.* 1993). Prolonged glove use may also cause adverse reactions and skin sensitivity (Loveday *et al.* 2014; Siegel *et al.* 2007).

Further, the use of gloves must be in addition to standard hand hygiene practices. Hand hygiene should always be performed before putting on gloves and after removing them.

Latex allergy

Latex allergy is an immune mediated reaction to certain proteins in latex rubber. The amount of latex exposure needed to produce sensitization or an allergic reaction is unknown. The HSE has discontinued routine use of NRL gloves to minimise risk for patients and staff with latex hyper-sensitivity.

https://assets.hse.ie/media/documents/Policy_on_the_Prevention_and_Management_of_Latex_Allergy.pdf

Removing and disposing of gloves

When removing gloves, care should be taken not to contaminate the hands. After gloves have been removed, hand hygiene should be performed in case infectious microorganisms have penetrated through unrecognized tears and have contaminated the hands during glove removal.

Gloves should be disposed of as soon as they are removed with disposal complying with local policies and standards.

3.3.1 Other items of clothing

Ties and lanyards

The wearing of lanyards and neckties should generally be avoided as evidence indicates these pieces of clothes may facilitate transmission of infection (Kotsanas *et al.* 2008; Murphy *et al.* 2017).

Footwear

Footwear suitable for the duties being undertaken must be worn and preferably be designed to minimise the risk of injury from dropped sharps as well as minimise risk of exposure to blood and body substances. Footwear that leaves the skin of the foot exposed is generally not appropriate for clinical environments because of the risk of dropped sharps.

Disposable shoe covers are generally not appropriate for IPC purposes. Use of disposable shoe covers may contaminate hands when putting on or taking off.

Uniforms and Scrub Suits

Uniforms and scrub suites are not PPE. In areas of clinical practice where there is a high risk of repeated exposure to blood and other body substances, it is recommended that uniforms/scrub suits be worn as well as the appropriate personal protective equipment.

Whilst no clinical studies have demonstrated cross transmission of health care associated pathogens by standard apparel, a number of small prospective trials have demonstrated that the uniforms of health care professionals can become contaminated with a variety of pathogens (Bearman *et al.* 2014).

Healthcare workers involved in direct patient care should wear a clean uniform/scrub suit for each shift. Uniforms should generally be washed at 60°C. The healthcare facility should have a process in place to ensure appropriate cleaning of a uniform/scrub suit that has been obviously contaminated with blood or body substances.

3.4 Management of multi drug resistant organisms (MDRO) and outbreak situations

Summary

Section 3.4 outlines approaches to the management of multi drug resistant organisms (MDROs) and outbreak situations

For the purpose of these guidelines, MDROs are taken to include meticillin resistant *Staphylococcus aureus* (MRSA) vancomycin resistant enterococci (VRE) and multi drug resistant Gram-negative bacteria (MDRGN) amongst others.

- The decision to perform surveillance testing of people for colonisation with MDROs when the person is admitted to a health care facility or during their stay in the facility is dependent upon the specific MDRO, any identified patient risk factors and the current epidemiology of the MDRO at that facility/unit and relevant guidance
- Surveillance testing for MDROs may be particularly important for MDROs of concern before they become so widespread in a healthcare system or the wider community that there is little probability of containment within the healthcare setting
- Surveillance testing for MDROs that are already widely disseminated in the community is generally a lower priority, however it is appropriate to consider differences in population groups. For example an MDRO widely disseminated in adults may remain uncommon in children
- Categorisation of a person colonised with an MDRO as no longer requiring transmission-based precautions (often referred to as clearance of the MDRO) should be made with care as failure to detect an organism on one or more laboratory tests does not exclude the possibility that the organism is still present at a low level. This is particularly a concern for MDRO's that colonise the

colon

- Decisions to discontinue transmission-based precautions for a person colonised with a specific MDRO should take into account relevant national guidance and/advice of an IPC expert
- Communication with patients/service users regarding removing of the requirement for transmission-based precautions is challenging. It is generally not possible to give an assurance that an MDRO is no longer present. Written information is very valuable to support clear communication
- Applying standard precautions including hand hygiene is a critical measure to prevent and control the spread of MDROs
- Antimicrobial stewardship is a critical measure to prevent and control the spread of MDROs
- Transmission-based precautions are appropriate in the acute care setting for MDRO's that are uncommon in a healthcare facility/healthcare system to maximise the probability of containment
- Transmission-based precautions may be considered for patients colonised or infected with any MDRO in the acute care setting although this is a lower priority for those MDRO's which are now widely disseminated. As above, it is appropriate to consider variations in population group and setting, for example children's hospital services may differ from adult services
- Maintaining a surveillance system to record the presence of relevant MDROs can assist in the timely reporting and notification of cases or outbreaks
- All outbreaks of healthcare associated infection including outbreaks of MDROs must be notified promptly to the Department of Public Health as required by law
- All outbreaks must be managed promptly by an Outbreak Control Team or equivalent group that has the authority and competence appropriate to the scale of the outbreak.

Patient care tip

When a patient is infected or colonised with a MDRO or has been exposed to a risk of colonisation during an outbreak they must be told about this. Communication with the person is normally the responsibility of the clinical team with responsibility for overall care. Although there is a risk of harm such as anxiety, mood disturbances, feelings that they are being stigmatised and of reduced contact with clinical staff, family or friends, people have a right to information regarding their health. Clearly, explaining to patients what is happening and why it is happening may help to reduce harm. A patient's MDRO status must not diminish their access to appropriate care in a facility that meets their needs.

3.4.1 MDROs

Note on terminology

Testing of people for colonisation with MDROs has traditionally be referred to as "screening" however this has potential to result in confusing this process with structured screening programmes. In this document this practice is referred to as surveillance testing.

What are the risks?

MDRO's which are predominantly bacteria, are resistant to multiple classes of antimicrobial agents. Antimicrobial resistance increases the morbidity and mortality associated with infection and contributes to increased costs of care due to prolonged hospital stay and other factors, including the need for more expensive drugs. A major cause of antimicrobial resistance is the exposure of a high-density and medically vulnerable population in an acute care setting to frequent contact with health care workers (resulting in

attendant risk of cross infection) and extensive antimicrobial use in this setting.

For the purpose of these guidelines, MDROs are taken to include (but are not limited to):

- Meticillin resistant *Staphylococcus aureus*. MRSA remain responsible for a significant proportion of hospital acquired bloodstream infections. Mortality from MRSA related BSIs ranged from 10 % to 50% according to the setting (Herwaldt 1999). More recent publications confirm continuing excess mortality associated with MRSA bacteraemia compared with MSSA bacteraemia (Lambert *et al.* 2011 and Wolkewitz 2011). Brady and colleagues report attributable mortality of 19.5% for meticillin-resistant *S. aureus* blood stream infection compared with 13.3% for meticillin-susceptible *S. aureus* (Brady *et al.* 2017)
- Vancomycin resistant enterococci with resistance encoded on mobile resistance determinants. VRE colonisation is very common in certain categories of patients in Ireland. In the first half of 2019 VRE accounted for 38% of all *Enterococcus faecium* blood stream infection in Ireland (EARS-Net data on antimicrobial resistance in Ireland Quarter 1-2 2019). The ratio of invasive VRE infection to colonisation appears to be proportionately lower than for MRSA (Christiansen *et al.* 2004).
- There is a range of Gram-negative bacteria with multiple classes of drug resistance or resistant mechanisms to critically important antimicrobials. MDRGNs are associated with treatment failure and increased morbidity. Amongst Gram-negative bacteria, acquired resistance to three or more classes of antimicrobials is generally accepted as defining an MDRO. Highly transmissible resistance is a particular feature of antimicrobial resistance among the Gram-negative bacteria, examples of particular categories include:
    - Extended spectrum beta-lactamase producing Enterobacterales (ESBLs), which are now very common in hospitals and community in Ireland
    - Carbapenemase producing Enterobacterales (CPE), which at present, in Ireland are mainly detected in patients with significant contact with acute hospitals
    - Other MDRGN include other MDR Enterobacterales and certain *Acinetobacter spp*. and *Pseudomonas spp*
- *Candida auris*, a yeast like fungus resistant to azole antifungals is an emerging concern globally.

The most critical elements in controlling the spread of MDROs in healthcare settings are likely to be adherence to standard precautions in all settings and with all patients and antimicrobial stewardship.

In addition, a 2-level approach is necessary for the prevention and control of MDROs. This involves implementation of:

- core strategies for MDRO prevention in every healthcare setting include standard precautions and antimicrobial stewardship (horizontal strategies)
- organism based or resistance mechanism-based approaches (vertical strategies) are also required if the incidence or prevalence of MDROs are not decreasing despite implementation of the core horizontal strategies.

In the event of an MDRO outbreak, investigation and control or containment should be conducted as outlined below. The best practices considered in these guidelines are based on the assumption that healthcare settings already have basic core strategies in place.

Organism specific approach

When the incidence or prevalence of MDROs is not controlled despite implementation of the core strategies further measures to control transmission need to be considered. A risk management approach focuses on:

- the type of MDRO (consider prioritisation of available isolation facilities according to MDRO and other demands on available isolation capacity)
- the healthcare area (for example, intensive care or haematology or oncology units have higher risks of transmission and or more significant consequences of transmission for outcome)
- patient factors (for example, whether the consequences of infection are severe)
- available resources (for example, whether surveillance testing of a certain patient population or the hospital environment for the target MDRO is necessary and feasible)
- whether additional interventions to interrupt transmission are available and appropriate in the context (for example decolonisation for MRSA may be considred in advance of certain surgical procedures).

Further measures may include:

- targeted surveillance testing for the MDRO- timely active surveillance testing to identify people who are colonised combined with the use of contact precautions for the care of people who are colonised has been followed by a significant reduction in the rates of both colonisation and infection of people with MRSA (Calfee and Farr 2002). Surveillance testing involves collecting specimens from the person and subsequent laboratory analysis of these samples. In a risk assessment approach to surveillance testing, considerations include the endemicity of the MDRO, the prevalence of MDRO infection and the likelihood of MDRO carriage. When an MDRO is relatively uncommon detection may identify a manageable number of high-risk cohorts to whom contact precautions can be rigorously applied. If an MDRO becomes very highly prevalent the value of surveillance testing may be reduced if it becomes impractical to effectively apply contact precautions to all those people identified as positive. Detection of colonisation is not of itself a control strategy but can play an important part in a context where there is capacity to act on the results to limit further spread
- The patient care team, the IPC team and the patient should be informed promptly of the results of surveillance testing. If surveillance testing returns a positive result, contact precautions should normally be applied in the acute hospital setting. This requires appropriate use of isolation and cohorting facilities
- Note: that failure to detect an MDRO on a sample does not exclude the possibility that the person is colonised with the MDRO. Sample quality and technical issues related to limits of detection may result in failure to detect MDRO colonisation
- Targeted surveillance testing of the health care environment is appropriate in some contexts particularly in the acute care setting. There is growing evidence that persistent reservoirs of MDRO in the health care environment may contribute to the spread of MDROs especially MDRGN
- Decolonisation - interventions for MRSA may be:
    - Topical - whole body washes and topically applied antimicrobial agents
    - Systemic - orally administered antimicrobial agents
    - Combinations of systemic and topical therapy

The US Centre for Disease Control MDRO management guidelines provides useful information on decolonisation
https://www.cdc.gov/infectioncontrol/guidelines/mdro/index.html#anchor_1554733842

- Surveillance and timely feedback - increased surveillance may be appropriate to monitor the effect of interventions designed to control particular MDROs. Surveillance information should be fed back to health care workers and facility management promptly.

Surveillance testing

In acute care settings, routine surveillance testing for all MDROs for all admitted patients is often not practical or appropriate. The decision to perform surveillance testing for specific MDROs on specific cohorts of people should be based on the level of risk and the local epidemiology of the specific MDRO. Control measures specific to local factors should be determined and endorsed by the health care facility management structure and the surveillance testing protocols for MDROs should be influenced by the:

- relevant national guidance
- local prevalence of the MDRO
- the reason for admission of the person
- the potential risk of transmission of the MDRO to others
- the risk status of the unit to which the person is admitted
- the likelihood that the person is carrying an MDRO
- the existence of a plan and capacity to manage risk associated with MDRO identified.

To reduce the risk of transmission of MDROs, it is recommended that the following approaches to surveillance testing be implemented. This guidance for surveillance testing is based on patient risk factors for these organisms. Other approaches may be defied by local experience taking account of surveillance testing initiatives or epidemiology. Expert direction and resources may be required for effective MDRO screening.

Table 19 Suggested approach to surveillance testing for MDRO in the acute hospital setting

Organism	Who to perform surveillance testing on	Sample collection
CPE	As per national CPE Guidelines	For surveillance testing use rectal swabs, stool samples and consider sampling other sites Test appropriate isolates of relevant species from diagnostic samples (including all invasive isolates)
ESBL	Selected patients based on institutional risk assessment for example Neonatal ICU, general ICU, haematology, oncology, organ transplantation	Rectal swabs, stool samples and consider sampling other sites Test appropriate isolates of relevant species from diagnostic samples (including all invasive isolates)

Organism	Who to perform surveillance testing on	Sample collection
MRSA	Selected patients based on institutional risk assessment for example Neonatal ICU, general ICU, haematology, oncology, organ transplantation	Nasal/body swabs and consider sampling other sites Test appropriate isolates of *S. aureus* from diagnostic samples (including all invasive isolates)
VRE	Selected patients based on institutional risk assessment for example Neonatal ICU, general ICU, haematology, oncology, organ transplantation	Rectal swabs, stool samples and consider sampling other sites Test appropriate isolates of relevant species from diagnostic samples (including all invasive isolates)
Other MDRGN	Selected patients based on institutional risk assessment for example Neonatal ICU, general ICU, haematology, oncology, organ transplantation	Rectal/stool samples or other appropriate sites Test appropriate isolates of relevant species from diagnostic samples (including all invasive isolates)
Candida auris	Surveillance testing may be appropriate in the context of an outbreak and for patients who have recently accessed healthcare services outside of the EU.	Test appropriate isolates of relevant species from diagnostic samples (including all invasive isolates)

Note: (1) Surveillance testing of health care workers for MDROs is generally not appropriate but may be required in the context of microbiological or epidemiological evidence that gives reasonable grounds for concern that a colonised or infected healthcare worker is a likely source of transmission. (2) For sampling of colonic colonisation stool samples are likely to be a better sample when available but collection of rectal swabs may be more convenient.

Home care and other community-based settings

The current evidence does not support routine surveillance testing for MDROs in home care and community-based settings such as residential care facilities. In these settings, the use of standard precautions and antimicrobial stewardship as part of routine practice should assist in minimising the cross-transmission risks of infection, regardless of MDRO status.

Residents or service users with specific risk factors for transmission of microorganisms, such as a discharging wound, should have a risk assessment performed to determine whether any measures beyond standard precautions should be implemented. Any additional precautions implemented should have due regard to the overall care needs of the resident/service user.

Removing the requirement for transmission-based precautions from people colonised with MDRO

A key reason for establishing criteria for removing the requirement for transmission-based precautions from people colonised with MDRO is that some people find the burden of being permanently identified as MDRO colonised very difficult to bear.

However, in this context it is important to communicate with healthcare workers and patients/service users that "clearance" means that there is sufficient basis for removing the requirement for transmission-based precautions in the acute hospital setting however, experience indicates that some people who meet these criteria may subsequently test positive for the same MDRO particularly if they received antimicrobial treatment.

It is not suggested that healthcare providers need to have a programme to seek to eradicate all MDRO colonisation nor that they should actively seek to establish clearance by repeated testing of individuals unless this is important to the person and/or it facilitates one or more aspects of providing care for the person.

Removing the requirement for transmission-based precautions for MRSA

All of the following criteria should be satisfied prior to removing the requirement for transmission-based precautions related to MRSA:

- No wounds/all wounds healed and no indwelling medical devices that pass through the skin or a body orifice present
- No exposure to any antimicrobial or antiseptic body wash for at least 2 weeks prior to testing
- No exposure to antimicrobial therapy targeting MRSA in the past 3 months
- Consecutive samples from above surveillance sites reported not detected on 3 separate occasions taken at least 48 hours apart
- More than 3 months has elapsed from the last positive specimen.

It is important to note that colonisation with MRSA may continue for a prolonged period of time and that MRSA can resurface if a person is hospitalised or prescribed antimicrobials. People who were colonised for MRSA but are subsequently considered "cleared" require retesting if readmitted to an acute care facility particularly a high-risk unit.

VRE

There is no agreed protocol for VRE clearance and caution should be applied. However, hospitals IPC teams may consider removing the MDRO alert and managing people with standard precautions if all of the following criteria are met:

- No wounds/all wounds healed and no indwelling medical devices that pass through the skin or a body orifice present
- No antimicrobial therapy targeting VRE in the past 3 months
- 3 consecutive rectal swabs or faecal samples obtained on separate occasions at least 3 weeks apart reported as VRE not detected
- More than 3 months have elapsed since time from last positive specimen.

MDRGNs (excluding CPE)

There is not yet an agreed protocol for the clearance of MDRGN carriage due to a lack of scientific evidence. However, hospitals IPC teams may consider removing the MDRO alert and managing people with standard precautions if all of the following criteria are met:

- No wounds/all wounds healed and no indwelling medical devices that pass through the skin or body orifice present

- No antimicrobial therapy targeting the MDGRN in the past 3 months
- 3 consecutive rectal swabs or faeces obtained on separate occasions at least 3 weeks apart reported as not detected
- More than 3 months have elapsed since time from last positive specimen.

CPE

Follow existing CPE Guidance for Ireland, see HPSC website at following link: https://www.hpsc.ie/a-z/microbiologyantimicrobialresistance/strategyforthecontrolofantimicrobialresistanceinirelandsari/carbapenemresistantenterobacteriaceaecre/guidanceandpublications/

Emerging MDROs

Candida auris is an emerging concern. It has been detected in Ireland on a number of occasions in association with patients returning after accessing healthcare services outside the EU. Laboratories should identify all isolates of *Candida species* from normally sterile body sites to species level and should consider identifying a proportion of other *Candida species* particularly from critical care and haematology or oncology patients. Surveillance testing of patients who have recently used healthcare services outside of the EU for *C. auris* on admission to acute hospitals should be considered, particularly if admitted to critical care areas.

Linezolid resistance in Gram-positive cocci including *Enterococcus spp*. and *Staphylococcus epidermidis* is also a concern. Linezolid-resistant *Enterococcus faecium* has been associated with hospital outbreaks and plasmid mediated linezolid resistance accounts of more than 20% of linezolid-resistant *enterococci* in Ireland (Egan *et al.* 2020a Egan *et al.* 2020b).

Antimicrobial stewardship

Antimicrobial use is the primary driver for selection of MDRO (see section 3.10). Safe and appropriate use of antimicrobials is a critical element of Ireland's national plan for antimicrobial resistance and of patient quality and safety initiatives (Department of Health 2017). Over the last 50 years, the prevalence of MDROs has risen rapidly initially mainly in hospitals but now increasingly in the community also. There is good evidence that overall levels of antimicrobial resistance correlate with the total quantity of antimicrobials used. In individuals, the risk of colonisation and infection with MDROs correlates strongly with previous antimicrobial therapy. Useful tools and resources to assist in implementation of antimicrobial stewardship are located on the following link: https://bit.ly/3rPt7tq

Multidrug-resistant microorganisms

Recommendation 20:
In the acute hospital in-patient setting, contact precautions should generally be applied in caring for people colonised or infected with specific multidrug resistant organisms (MDROs). Contact precautions in this context are generally not appropriate in healthcare settings other than acute hospital in-patient settings.

Quality/level of evidence: weak evidence

+ Strength of recommendation: strong recommendation

The specific MDRO for which contact precautions are applied in a specific hospital should be clearly documented and decisions should be informed by national or hospital specific risk assessment that takes account of the current epidemiology of the MDRO, the risk of dissemination and the likely clinical consequences of infection with the MDRO.

In general, healthcare in the community, including primary care services, for people colonised with MDRO can be delivered with strict adherence to standard precautions. Additional measures may be required in particular instances based on risk assessment.

Practical information

Core strategies for multi drug resistant organisms MDROs prevention and control

Successful control of MDROs is based on a combination of interventions with a shift over the last decade towards the engagement and participation of patients in infection prevention and control strategies. The control of MDROs involves antimicrobial stewardship, continued rigorous adherence to standard precautions (including hand hygiene and appropriate use of PPE) and implementation of specific contact precautions until people have been discharged from the acute hospital facility or until such time as application of contact precautions can be discontinued based on laboratory results and IPC team assessment.

In non-acute healthcare settings standard precautions (particularly hand hygiene by both people cared for and health care workers) in addition to antimicrobial stewardship are generally sufficient to manage the risk of MDRO transmission. However, additional measures including placement in a single room and use of PPE, may be considered for certain elements of care of the person if the they are heavily colonised or if there is known continuing transmission. Local guidelines and circumstances should determine practice in settings where the population cared for is particularly medically vulnerable (Matlow and Morris 2009).

There is emerging evidence, which suggests that there are a range of possible harms to people associated with the use of contact precautions for those infected or colonised with an MDRO. This needs to be considered. These are discussed below. Organisational measures - such as staff education on prevention and management of MDRO transmission, antimicrobial stewardship programmes, and appropriate response to active surveillance cultures - are discussed below.

Hand hygiene

MDROs can be carried from one person to another by the hands of a healthcare worker. Contamination can occur during patient care or from contact with environmental surfaces in close proximity to the patient, particularly when patients have diarrhoea and the reservoir of the MDRO is the gastrointestinal tract. Effective hand hygiene is therefore the most important measure to prevent and control the spread of MDROs. Alcohol based hand rub has been shown to be effective against MRSA and VRE (Picheansathian 2004).

Personal protective equipment

Both direct patient contact (for example routine patient care) and indirect contact (for example involving environmental contamination) can lead to contamination of the healthcare worker’s hands and clothing.

Appropriate use of hand hygiene and relevant PPE are considered as effective a strategy as patient isolation in containing MDROs particularly when isolation may not be feasible (Bearman *et al*. 2007 and Trick *et al*. 2004).

However, a systematic review (Lopez-Alcalde *et al*. 2015) failed to identify studies assessing the effects of wearing gloves, gowns or masks for contact with MRSA hospitalised patients, or with their immediate environment, on the transmission of MRSA to patients, hospital staff, patients' caregivers or visitors.

Patient placement (isolation)

Placing people that are colonised or infected with MDROs in single rooms, cohort rooms or cohort areas as a component of a multifaceted IPC policy can reduce acquisition rates and infection with MDROs in acute care settings. Cohorting patients with the same strain of MDRO has been used extensively for managing outbreaks of specific MDROs including CPE, ESBL, MRSA, VRE and *Pseudomonas aeruginosa*.

However, it is not always appropriate to cohort patients with the same MDRO species if they have a different resistance mechanism or different resistance patterns (for example if patients are colonised with strains of MRSA that differ with respect to susceptibility to multiple antimicrobial agents). CPE positive patients should not be grouped together unless they are known to carry the same type of CPE.

Decisions regarding priority of isolation when demand for single rooms exceeds availability should take account of national guidance on prioritisation and be guided by the IPC team and the person's needs, their acuity and the types and strains of MDRO present. Priority should always be given to patients requiring airborne precautions. There may also be other competing priorities for single rooms not related to infectious diseases for example patient security and end of life care. When isolation is not feasible patients should have access to individual toilet facilities or commode. These issues also need to be considered when allocating single rooms.

In long-term residential care facilities isolation is generally not appropriate to the needs of residents. In this setting standard precautions, including hand hygiene and appropriate use of PPE, for individual residents and environmental contact is preferred (Trick *et al*. 2004).

Due to the varying nature of health care facilities, it is not feasible to provide a generic policy on the movement of people with MDROs. This needs to occur at an institutional level and be relevant to the persons care plan. These policies should not limit access to treatment and should consider the social and psychological implications of managing a person with an MDRO. People colonised with MDRO should not be placed "last on the list" if they require investigations or procedures including surgery unless there is a justification based on individual risk assessment.

Environmental cleaning

In acute hospital areas where the risk of patient vulnerability and risk of cross infection due to the presence of an MDRO is high, contact precautions should generally be followed provided the MDRO is not so widespread in the healthcare setting and the community that application of contact precautions is impractical. This will require cleaning and disinfection of all patient surrounds and frequently touched objects as previously outlined.

Environmental monitoring

In acute hospital areas where there is evidence of acquisition of MDRO (in particular MDRGN) associated with particular areas environmental sampling to detect possible environmental reservoirs of MDRO should be performed in addition to visual inspection to identify persistent environmental reservoirs of infection. This may also be appropriate in settings other than acute hospitals in the context of an outbreak of infection.

Patient equipment

Standard precautions concerning patient care equipment are very important to the care of people with MDROs. Patient care devices (for example electronic thermometers) may transmit infectious microorganisms if devices are shared between patients. To reduce the risk of transmission, disposable or patient dedicated equipment is preferred as previously outlined.

Monitoring

Monitoring of the acquisition of target MDRO infection and colonisation should continue after interventions to control spread are implemented. If rates of acquisition of MDRO do not decrease, more interventions may be needed to reduce MDRO transmission.

Contacts of people with MDRO colonisation or infection

Identification of contacts of people colonised or infected with MDRO other than CPE is not routinely required but may be appropriate in the context of a specific outbreak or specific clinical context based on institutional risk assessment. In relation to CPE, existing national guidance should be followed.

Emerging evidence on contact precautions

Although good evidence of effectiveness is lacking, based on established practice and rationale contact precautions should generally be considered for people colonised or infected with an MDRO in the acute hospital setting where there is anticipated patient and/or environmental contact as above. If there is no contact with the person or the person's environment (for example briefly speaking with the person) then there is generally no need for the healthcare worker to use PPE.

There is emerging evidence that use of contact precautions for people colonised or infected with an MDRO may be associated with a range of harms including reports of decreased satisfaction with care, increase in adverse events such as falls and ulcers, reduced healthcare worker engagement with patients, higher rates of anxiety and depression and increased days spent in hospital (Mehrota *et al*. 2013; Morgan et al. 2013; Russel *et al*. 2016). However, not all studies regarding the specific impact of contact precautions on these harms are conclusive, in part due to low quality evidence and poor study design.

In addition to the universal application of standard precautions and Antimicrobial Stewardship, some healthcare facilities may consider use of other approaches to prevent transmission of MDROs. These include bathing people with chlorohexidine and enhanced environmental cleaning and disinfection (Morgan *et al*. 2013). It's important that healthcare facilities who chose to use such horizontal measures implement processes and policies surrounding the use for people infected or colonised with an MDRO and monitor the impact of these measures on the transmission of MDROs through process and outcome reporting.

It is important that both patients and healthcare workers are provided with education about the purpose and use of contact precautions in the context of MDROs. Educating healthcare workers on the importance of maintaining similar levels of patient engagement for patients in isolation can assist in reducing some of the potential harms associated with contact precautions.

Patient care tip

When people are placed on transmission-based precautions due to infection or colonisation with an MDRO, they must continue to receive an equal standard of care. Care is required to counteract potential psychological adverse effects of isolation such as anxiety and depression and the feeling of being stigmatised.

Good practice point: 11

Healthcare facilities should operate a surveillance system to monitor healthcare associated infections and specific multidrug resistant organisms.

The specific healthcare associated infections and specific MDROs for which surveillance should be performed should be informed by relevant national guidance and healthcare facility risk assessment that takes account of current epidemiology, the risk of dissemination and the likely clinical consequences of colonisation or infection.

Practical Information

Note: Council recommendation 2009/C 151/01 of 9 June 2009 on patient safety, including the prevention and control of healthcare associated infections recommends that member states adopt and implement a strategy at the appropriate level for the prevention and control of healthcare associated infections.
See https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32009H0703(01)#:~:text=COUNCIL%20RECOMMENDATION%20of%209%20June%202009%20on%20patient,particular%20the%20second%20subparagraph%20of%20Article%20152%284%29%20thereof%2C

Surveillance of Healthcare Associated Infection

Healthcare associated infection is a clinical diagnosis. Effective surveillance for healthcare associated infection must have a strong clinical basis. High quality and adequately resourced diagnostic laboratory services are essentially to support effective surveillance but laboratory based surveillance alone is not sufficient. Key examples of healthcare associated infections that may be the subject of surveillance may include catheter associated urinary tract infection (CAUTI), acute diarrhoeal disease, healthcare associated *C. difficile* infection, surgical site infection (SSI), blood stream infection (BSI), central venous catheter associated infection and ventilator associated pneumonia (VAP). Although the focus of surveillance for healthcare associated infection was initially largely on the acute hospital setting its importance is increasingly recognised in care settings in the community including the home care setting (Hoxa, Duysburgh and Mortgat 2021).

Healthcare services will often not have the capacity to conduct surveillance of all of these conditions or may not be able to conduct surveillance of all conditions at one time. Healthcare facilities that provide residential care (acute hospitals, hospice, rehabilitation facilities and long-term residential care for older people) should include a plan for clinical healthcare associated infection surveillance based on national priorities (Health Service Executive (HSE) and Health Protection Surveillance Centre (HPSC) and the priorities for their institution in an annual infection prevention and control plan. In many community settings submission of samples for testing for asymptomatic colonization with MDRO is not appropriate. The requirement may be to maintain an up to date record of people with previously identified MDRO colonization and infection and to ensure that when MDROs are identified in diagnostic samples that the information is appropriately recorded. Clinical surveillance should be based on clear case definitions aligned where possible to HSE, HPSC or European Centre for Disease Control (ECDC) surveillance definitions or definitions from other authoritative sources. Surveillance data should be reported to relevant clinical teams and to hospital management and should be publicly available after appropriate review.

Surveillance of (MDROs)

Surveillance of MDROs is based on laboratory detection of the organisms and therefore high quality and adequately resourced clinical microbiology laboratory services are the foundation of surveillance of MDROs. MDROs may be detected in diagnostic samples (such as samples of blood, body fluid or tissue submitted to detect a pathogen in a person where a clinical diagnosis of infection is suspected) and in surveillance samples (such as rectal or nasal samples submitted to detect MRDO colonisation). Surveillance for MDROs should be aligned to National and European MDRO surveillance priorities. Surveillance of MDROs is imperative in order to understand the impact, magnitude and distribution of antimicrobial resistance (AMR) thus supporting Ireland's second One Health National Action Plan for Antimicrobial Resistance (iNAP2) available at https://www.gov.ie/en/publication/d72f1-joint-action-on-antimicrobial-resistance/#:~:text=Ireland's%20second%20One%20Health%20National,(DAFM)%20in%20November%202021.

Coordinated national MDRO surveillance supports the development of policies and programmes and can inform a coordinated response to critical antimicrobial resistances (CARs). National Surveillance Data on MDROs comes mainly from microbiology laboratories that contribute data to the European Antimicrobial Resistance Surveillance Network managed by the Health Protection Surveillance Centre and from National Reference Laboratory services. Each acute hospital should have an active MDRO surveillance strategy, based on national guidelines and current epidemiology of MDRO colonisation. Laboratories should contribute data and isolates as required to support national surveillance systems. In addition to established MDRO concerns facilities should be aware of emerging threats such as acquired linezolid resistance.

All healthcare facilities must comply with the legal obligation to ensure timely reporting of those MDROs which are classified as notifiable diseases to the Department of Public Health.

Good practice point: 12

Healthcare service providers should have processes in place to identify people with communicable infectious disease before attendance at /presentation to the service or as soon as possible after presentation. This is to ensure that such people are cared for with appropriate IPC precautions from the outset. These processes are particularly important during an epidemic/pandemic.

Practical information

Early recognition of people with communicable infectious disease

In the context of emerging infectious diseases, healthcare systems can easily serve to amplify the spread of infection. People with symptoms of the emerging illness tend to seek healthcare and thereby may introduce infectious microorganism into a healthcare setting. There is a high risk of spread of infection in the healthcare setting because people receiving care are in close contact with healthcare workers and with vulnerable patients/service users. It is important that healthcare service providers put in place processes at the point of access to services to identify any person presenting with undiagnosed fever, skin rash or respiratory symptoms or other key risk factors for infection or colonisation with organisms of concern. A risk assessment is required in such cases and relevant transmission-based precautions should be applied as a precaution if there is a basis for concern regarding a rare or novel communicable infectious disease.

Healthcare service providers should have up-to-date plans for enhanced early detection of patients with specific infectious diseases (ideally detection in advance of their attendance) that can be activated in the context of a public health emergency related to an infectious disease. These processes may use voice, text, public announcement and other approaches to encourage people with relevant symptoms to telephone in advance of attendance.

3.4.2 Outbreak investigation and management

What constitutes an outbreak?

An outbreak may be defined as:

- Occurrence of more cases of disease than expected in a given area among a specific group of people over a particular period of time
- Two or more linked cases of the same illness / colonisation.

Outbreaks commonly identified in healthcare facilities include:

- MDROs
- Respiratory pathogens (for example influenza, respiratory syncytial virus (RSV), SARS-CoV-2)
- Diarrhoeal pathogens (for example norovirus and *C. difficile*).

This section gives principles and overall guidance for managing an outbreak. For specific guidance on particular infectious microorganisms consider national or international microorganism specific guidance and consult with Infection Prevention and Control and Public Health Practitioners.

Outbreak investigation and management

A suspected outbreak may be identified by a healthcare worker in the facility including identification by laboratory personnel. Outbreaks may also be identified by a Department of Public Health. Registered designated centres must also notify HIQA. When an outbreak is detected, the healthcare facility's infection prevention and control management system and the Department of Public Health must be notified and an outbreak control team (OCT) should be formed. The membership of the OCT should be relevant to the scale and impact of the outbreak and the healthcare facility involved. IPC expertise is required. The Department of Public Health will determine in each case if a representative of the Department is required to join the OCT.

The responsibility for investigation and the extent of the investigations will vary according to the outbreak type and circumstances. It is important to investigate an outbreak immediately, as the availability and quality of microbiological evidence and epidemiological data diminishes rapidly with time between onset of illness and investigation.

An outbreak management plan should be developed based on relevant national policy and consultation between the infection prevention and control team, healthcare workers, patients, facility management and Department of Public Health, as appropriate. Such a plan is an institutional responsibility and multifactorial. Although implementation is typically led by a person with designated responsibility for IPC such as an IPC nurse, clinical microbiologist or infectious diseases physician, overall responsibility rests with the senior executive of the facility (General Manager or Chief Executive Officer). An OCT is normally chaired by the senior executive or their representative and the senior executive should review and approve the outbreak report.

The outbreak response may differ according to the nature of disease, the virulence of the organism and the susceptibility to infection of the people concerned. However, the principles that underlie an outbreak investigation are similar: establish a case definition, identification of the aetiological microorganism, the route of transmission, exposure factors and the population at risk and control measures required.

All healthcare facilities should have systems in place to ensure timely reporting of notifiable diseases to the relevant Department of Public Health. This may enable tracing of contacts of infected people in order to initiate appropriate care, if this is required. Healthcare facilities may need to identify staff on duty and other people present who may have been exposed to the infectious person and be at risk.

One of the important aspects of the outbreak management process is the written and oral communication of findings to people using the service, to the appropriate authorities, the appropriate health professionals and the public. This communication is based on the type and severity of the outbreak. When informing patients of harm related to an outbreak it is important to provide full and clear information. The HSE Open Disclosure Process outlines the importance of open, honest, timely and transparent communication in such cases. https://www.hse.ie/eng/about/who/nqpsd/qps-incident-management/open-disclosure/ During an outbreak, it is important to provide education to the key stakeholders and clinicians about the organism and its mode of transmission.

Within a healthcare facility, effective communication could consist of:

- Appropriate signage to limit access to a room or clinical unit
- Electronic alerts on the medical record to manage cases and contacts
- Emails and multimedia to target all stakeholders within the health care facility
- Provision of education and written materials to patients and visitors to inform them of the situation and the infection prevention and control measures with which they should comply
- Provision of information to key external stakeholders.

The table below outlines the process of outbreak investigation and corresponding management. In practice many steps are taken more or less simultaneously, as the results of investigations and implementation of strategies to contain and control will vary with the availability and timeliness of information and seriousness of the outbreak. Outside of the acute hospital there may be more limited ability to investigate an outbreak of healthcare associated infection and these investigations will generally be led by the relevant Department of Public Health once they have been notified. All outbreaks, however minor, should be investigated promptly and thoroughly and the outcomes of the investigations documented.

Not all steps are relevant in every case for example small outbreaks with limited impact and that resolve rapidly merit a proportionate approach to management. Outbreaks discovered retrospectively may likewise merit a very limited response. In all cases people who have been impacted should be informed and relevant learning applied to prevent future outbreaks. Table 20 should be considered in association with relevant Public Health guidance related to specific infections.

Table 20 Outbreak investigation and management

Steps	Suggested approach	Responsibilities (dependant on facility and type of outbreak)
Step 1. Recognise outbreak and prepare to investigate		
Determine existence of the outbreak	Establish a provisional case definition. Establish background rate of infection/colonisation. Consider if observed number of cases is in excess of the usual/ expected number, and if cases are clinically typical. Examine surveillance data.	Healthcare workers. IPC Team (see foot note re membership). Laboratory personnel. Consult with Public Health.
Determine if immediate control measures are needed	Reinforce standard precautions. Apply appropriate transmission-based precautions.	Manager/CEO, healthcare workers and IPC team—as soon as outbreak is suspected.
Notify and communicate with:	Relevant health service managers, Healthcare workers and ancillary staff in immediate area. Infection prevention and control professional. Laboratory. Public health Department, Health Information and Quality Authority	Manager/CEO, healthcare workers—as soon as outbreak is suspected. Laboratory personnel (for example routine testing can signal) as soon as outbreak is suspected. IPC Team, Public Health Department.

Steps	Suggested approach	Responsibilities (dependant on facility and type of outbreak)
Formation of an outbreak control team (OCT) – this will vary according to location/ resources, made up of one or more people with designated responsibility	Membership may include but is not limited to: Managers of implicated areas (Note: a chair of the OCT must be designated and will normally be the senior executive or their representative) Administrators (medical and nursing), Relevant Clinical Directors/Chief Clinical Directors, IPC professional or designated person with infection prevention and control training/experience (Note: a Lead investigator should be designated and will normally be a IPC professional or a Public Health Doctor), Clinical Microbiologist, Public Health Doctor, Infectious diseases physician, Epidemiologist/statistician Representatives of laboratory, cleaning services and estates food services, Communications, Occupational Health, Others as defined by circumstances.	Manager/CEO – as soon as notified.
Step 2. Verify the diagnosis and confirm that an outbreak exists		
Confirm that there are more than the expected number of cases meeting the provisional case definition of the disease of interest in the period under review	Confirm clinical diagnoses (symptoms and features of illness). Review laboratory data and request additional laboratory tests if necessary, for example molecular typing of organisms to confirm relationships.	Laboratory and other clinical personnel.
Consider likely outbreak definition and whether criteria are met	Are there more cases than expected compared to previous weeks/months? Consider epidemiology of cases—are there two or more linked cases of the same illness?	OCT representatives (IPC professionals, other senior clinicians).

Steps	Suggested approach	Responsibilities (dependant on facility and type of outbreak)
Step 3. Establish case definition and find cases		
E**stablish a set of standards criteria to decide whether or not a person has the infection of concern**	Case definition should be based on: clinical information about the disease, characteristics of the people who are affected, information about the location, specification of the time period for the outbreak. Case definition can be refined later after collection of primary data. Cases should be classified using the case definition as: 'Confirmed' (usually laboratory verification) 'Probable' (usually has typical clinical features) 'Possible' (Usually has fewer typical clinical features).	OCT representatives (IPC professionals, other senior clinicians).
Find cases	Gather critical information by: Interview and follow-up of disease notification and health alerts.	Healthcare workers. OCT representatives. Healthcare facility management.
Identify and count cases	Collect the following types of information: identifying information demographic information clinical information risk factor information (including environmental tests).	OCT representative.
Tabulate information collected on cases investigated and update as new cases appear	Time—date of onset of illness. Person—age, sex. Place—where did the exposure occur? Other relevant information.	OCT representative.

Steps	Suggested approach	Responsibilities (dependant on facility and type of outbreak)
Step 5. Determine who is at risk		
Identify groups at risk	Number of people who have developed the disease/ condition of interest (numerator). At risk population: number of people likely to be exposed for example total number of patients on ward, staff and visitor contact (denominator). Time and place of onset. Personal characteristics.	OCT representative.
Initiate precautionary measures	Use of standard precautions and appropriate transmission-based precautions. Increase frequency and efficiency of environmental cleaning. Prophylactic treatment/ vaccination. Antimicrobial restrictions. Exclusion of cases from high risk activities. Isolation and/or cohorting of people. Restricting movement of people including staff and visitors. Testing of people with isolation of those affected and cohorting of contacts. Provision of health information and advice.	Management Healthcare workers. IPC professional. OCT.
Step 6. Implement ongoing control/prevention measures (this can be done at any time during the outbreak as deemed necessary)		
Review measures initiated for immediate control (Step 1 and Step 5)	Are infection prevention and control measures adequate to reduce risk of transmission?	Management Healthcare workers. IPC professional. OCT

Steps	Suggested approach	Responsibilities (dependant on facility and type of outbreak)
Implement appropriate ongoing control measures and strategies to prevent further illness	Restrict spread from the cases. Interrupt chain of infection. Interrupt transmission or reduce exposure. Reduce susceptibility to infection. Assessment of policy, regulations, standards and audit practice Microbiological testing of environment if appropriate.	Management Healthcare workers. IPC professional. OCT.
Communicate and coordinate with all stakeholders	Electronic flagging of medical records of contacts. Reinforcement of IPC precautions to staff, people using the service and visitors.	Management Healthcare workers. IPC professional. OCT.
Make plans to evaluate their effectiveness	Document type and time of implementation of infection prevention and control measures. Monitor factors contributing or affected by outbreak and any associated changes.	Management Healthcare workers. IPC professional. OCT
Step 7. Communicate findings		
Prepare a brief written report that evaluates methods used for the control of the outbreak (Note: a HSE template exists for documenting closure of an outbreak, this also serves as a concise report)	Include discussion of factors leading to outbreak, comprehensive timelines, summary of investigation and documented actions. Short- and long-term recommendations for prevention of similar outbreak. Disseminate to appropriate stakeholders including publication.	Management, OCT.
Step 8. Develop hypothesis—the 'how' and 'why' (this step is not likely to be required or achievable for many outbreaks but may be more relevant for outbreaks associated with newer pathogens or where the origin and or extent of the outbreak is difficult to explain)		
Develop hypotheses from the factual information gathered to date on potential source, vector, pathogen and route of transmission	Data collected by interview. Common links. Plausible exposure. Environmental test results where appropriate. Review literature (as appropriate).	OCT (IPC professional and Public Health)

Steps	Suggested approach	Responsibilities (dependant on facility and type of outbreak)
Step 9. Test hypothesis with established facts (this step is not likely to be required or achievable for many outbreaks but may be more relevant for outbreaks associated with newer pathogens or where the origin and or extent of the outbreak is difficult to explain)		
P**erform epidemiologic study**	Cohort. Case-control	OCT (IPC Professional and Public Health)
Analyse the data	Compare the risk factors among ill (cases) vs. not ill (controls). Attack rates and Relative risk	OCT (IPC Professional and Public Health)
Carry out further studies if necessary- to support the hypothesis or if analytic studies do not confirm the hypothesis	Further study to refine case definition. May involve testing of environment samples, food samples or environmental screening in some situations (for example *Legionella spp.*, *Pseudomonas spp.*).	OCT

Note: The IPC team is a multidisciplinary team including IPC Nursing, Medical staff, Medical Scientists, other laboratory scientists, Surveillance Scientists, Antimicrobial Pharmacists and Administrative Grades. Close working relationships between procurement services and estates services are essential for effective implementation of IPC.

Table 21 Individual actions for reducing the risk and impact of outbreaks

Individual actions for reducing the risk and impact of outbreaks:

Become familiar with the policies that apply to the implementation of transmission-based precautions in the event of an outbreak.

If an outbreak is suspected or identified, implement core strategies for prevention and control and seek advice from an IPC or person with designated responsibility for this task regarding intensified strategies appropriate to the specific organism.

Good practice point: 13

All residential healthcare facilities (hospitals, residential care facilities, hospices and rehabilitation facilities) should have plans in place for detection and management of outbreaks of infectious disease or colonisation with specific MDROs. Outbreaks should be investigated promptly and thoroughly and a brief outbreak report should be prepared at the conclusion of the outbreak and the outcomes of the investigations documented. It is good practice to notify the Medical Officer of Health promptly in writing (for example by email) of the closure of the outbreak and to provide a copy of the outbreak report when completed

Practical information

All healthcare facilities should have an outbreak management plan based on relevant national guidance, local policy and consultation between the infection prevention and control professionals, healthcare workers, patients, facility management and Department of Public health as appropriate.

IPC strategies to control/contain an outbreak

These guidelines provide core principles of IPC; however, it is the responsibility of healthcare facilities to develop and adapt these principles to their setting and to develop local policies as required.

Good governance and administrative or managerial support as well as adequate IPC capacity (human resources and information and communication technology) are crucial to support outbreak management. Healthcare facilities, in particular acute hospitals should make every effort to ensure that they have an information and communication platform that supports IPC practice as this is a critical asset in the detection and response to outbreaks. An information and communication platform specifically designed to support IPC is generally appropriate. However, the same functionality may be incorporated in some cases into general patient information management systems.

The health care worker's role in outbreak management will include:

- Reinforcement of standard precautions, including adherence to the WHO five moments for hand hygiene, environmental cleaning, training protocols and appropriate use of personal protective equipment
- Implementation of relevant transmission-based precautions including isolation and cohorting
- Designating contacts where this is required and ensuring appropriate communication with and care of people who are designated as contacts.

Key precautions required for each infectious microorganism are listed below.

Identifying cases

Agreeing a case definition is an essential part of managing an outbreak. The definition should include clinical, epidemiological and laboratory criteria as necessary to define a case. Criteria for identification of possible, probable and confirmed cases should be considered as appropriate to the outbreak. Identifying cases is the responsibility of the healthcare facility as an essential preliminary to isolation and cohorting. Cases must be notified to the Medical Officer of Health (Department of Public Health). Communication with and management of cases who are still in the care of the facility is the responsibility of the healthcare facility. Communication with and management of cases among staff who are still working in the facility is the responsibility of the healthcare facility. The respective roles of the Infection Prevention and Control Team, Occupational Health Services and facility management in fulfilling the responsibility of the healthcare facility should be clearly defined. Communication with and management of cases who have left the facility and of cases among staff who are no longer employed in the facility is the responsibility of the Department of Public Health after all the relevant details have been communicated to Public Health.

Identifying contacts

In the case of certain infectious microorganisms there is a need to designate and manage contacts as well as cases. In that case a definition of a contact for the purposes of managing the outbreak must be agreed. Identifying contacts that occurred within the healthcare facility is the responsibility of the healthcare facility.

Communication with and management of patients who are still in the care of the facility is the responsibility of the healthcare facility. Communication with and management of staff who are still working in the facility is the responsibility of the healthcare facility. The respective roles of the Infection Prevention and Control Team, Occupational Health Services, facility based Contract Tracing Teams (where applicable) and management in fulfilling the responsibility of the healthcare facility should be clearly defined. Communication with and management of contacts who have left the facility and of staff who are no longer employed in the facility is the responsibility of the Department of Public Health after all the relevant details have been communicated to Public Health.

Hand hygiene

During an outbreak, adherence to the WHO five moments for hand hygiene can assist in preventing further cases and reducing environmental contamination.

Environmental monitoring and cleaning

Environmental testing for environmental reservoirs of infection should be considered. Frequency and efficiency of environmental cleaning should be increased above the standard for the area to ensure any microbial contaminants are removed. A targeted cleaning regime may be introduced and continued for the duration of the outbreak dependent on the mode of transmission of the infectious microorganism.

Consideration should be given to whether the surrounding environment will need to be disinfected in addition to being cleaned. Further information is available in previous sections of this guideline.

Case and contact isolation

The isolation of colonised or infected people and of contacts when required is important when managing an outbreak. Standard and transmission-based precautions signage should identify the isolation room and include the necessary precautions to be adopted. If isolation is not possible, cohorting of people should occur as advised by an IPC professional.

Single room

Single person rooms are always indicated for people placed on airborne precautions and are preferred for people who require contact or droplet precautions. In the event of an outbreak, single person rooms are generally preferred for all modes of transmission.

People should be isolated in a room with toilet and shower facilities. If this is not possible a standard room may be used with dedicated commode. For people on airborne precautions a room with appropriately controlled ventilation is required where possible. If this is not available a standard room may be used, ideally away from areas of general circulation. The door should be kept closed for people on transmission-based precautions and in particular for those on airborne precautions.

During an outbreak, single patient rooms should be prioritised for people who have conditions that facilitate transmission of infectious material to other patients (for example draining wounds, faecal incontinence, uncontained secretions) and for those who are at increased risk of acquisition and of harm resulting from infection (for example immunosuppression, open wounds, indwelling catheters, anticipated prolonged length of stay, total dependence on health care workers for activities of daily living). The prioritisation of single rooms may also need to take into account other factors that might warrant the need for single rooms, including people requiring end of life care or special security (Chaudhury *et al*. 2005).

Case and contact cohorting

Cohorting people who are colonised or infected with the same strain of microorganism and of contacts when required, confines their care to one area and prevents contact with other people. Cohorts are created based on clinical diagnosis, microbiologic confirmation when available, epidemiology and mode of transmission of the infectious microorganism. Placing severely immunosuppressed people in care areas with other people should be avoided if at all possible during an outbreak.

Cohorting allows more efficient use of staff. Cohorting has been used for managing outbreaks of MDROs, influenza and COVID-19.

Placement of large numbers of people

In the event of an outbreak or exposure involving large numbers of people who require transmission-based precautions, an IPC practitioner should be consulted on patient placement decisions.

Appropriate measures may include:

- Cohort of people in areas of the facility that are away from other people
- If the pathogen is airborne, use of temporary portable solutions (for example exhaust fans) to create a controlled ventilation environment in the converted area of the facility may be required. Mechanical ventilation systems should be deployed with appropriate engineering support.

Restricting movement within the facility

Restricting movement of people during an outbreak reduces the risk of further transmission.

If transfer within the facility or transport to another facility is necessary, advice should be sought from an IPC professional. If an infected or colonised person must be moved, the transport service and receiving area or facility should be notified of the nature of the person's infection or colonisation.

It is important to:

- ensure that infection prevention and control measures do not deny or cause unreasonable delay in access to health care
- ensure that infected or colonised areas of the person's body are covered if relevant. If the target infection is transmitted by the droplet or airborne route, ask the person to wear mask while being moved, if tolerated and the person's clinical condition permits.

Contaminated PPE should be removed and disposed of and hand hygiene performed before the person is moved. Clean PPE should be put on before the care is delivered to the person at the destination.

Exclusion policies

Exclusion policies may also be implemented to restrict the spread of disease throughout a health care facility. This could include:

- excluding people from participating in specific non-urgent activities
- restricting or curtailing visiting hours for people in outbreak areas
- excluding staff from work until well if it appears likely that they represent a risk for the transmission of infection (for example food handlers or clinical staff)

- managing vaccine hesitancy, contraindication to vaccination and vaccine nonresponse by ensuring appropriate work placements, work adjustments, work restrictions and exclusions.

In an outbreak of gastroenteritis, healthcare workers must not return to work until diarrhoea and vomiting have ceased and for the duration of any recommended exclusion period after resolution of symptoms. It is extremely important that healthcare workers comply with all infection prevention and control precautions including hand hygiene upon return to work, given that some studies have shown prolonged shedding of gastrointestinal pathogens for up to 21 days. Information about exclusion periods for healthcare workers with acute infections is outlined below.

Applying transmission-based precautions during an outbreak

Successful outbreak management is based on a combination of standard precautions and transmission-based precautions. Specific interventions will be guided by the IPC Team, based on the mode of transmission of the infectious microorganism.

Declaring that an outbreak is over

An outbreak is declared over when the OCT is satisfied that a sufficient period of time has elapsed since the last detected case to conclude that transmission has ceased. Twice the duration of the incubation period for the infecting organism is used in some cases but this is not applicable in all cases. It may be practical to resume essentially normal service prior to formal declaration of the end of the outbreak subject to risk assessment and a judgment made at the OCT that there is no longer evidence of ongoing transmission.

Patient care tip

People who use healthcare services, their families and visitors may experience concern or fear or feel that they are not being given enough information in an outbreak situation.

Clearly explaining the process of outbreak management and the importance of IPC measures may assist them in understanding the situation and improve adherence to IPC practice.

Consider referring concerned people or relevant others to IPC practitioners for more in depth discussions and information.

Good practice point: 14
Consider the use of early bay closures to control known or suspected outbreaks of norovirus and other agents causing gastrointestinal infection rather than immediate closure of entire wards/units.

Practical information

In the past, ward or unit closure was considered as the central control measure for managing outbreaks of norovirus in health care facilities. However, a recent literature review undertaken for the development of the 2019 Australian IPC guidelines found that efficient control may be achieved by the closure of bays rather than closing an entire ward or unit (University of South Australia 2017). If taken, this approach needs to be implemented early (within three days of the first case becoming ill) before extensive transmission has occurred within a clinical area. There is a clear rationale for applying a similar approach to other agents causing gastrointestinal infection.

Statutory Requirement: 2
All outbreaks of infectious disease and individual cases of notifiable infections must be notified promptly to the Medical Officer of Health (in the relevant Department of Public Health).

3.5 Applying standard and transmission-based precautions during procedures

Summary

Section 3.5 outlines processes for risk identification and the application of standard and transmission-based precautions for certain procedures. It is not intended to provide guidance on performing procedures but outlines the principals involved in the delivery of care that reduces the risk of transmission of microorganisms and occurrence of infection during the insertion and maintenance of invasive medical devices and for surgery.

Medical and dental procedures increase the risk of transmission of infectious microorganisms between people using healthcare services and healthcare workers.

- Procedures includes any situation in which there is a potential for contact between the skin of the healthcare worker and the person's tissues, body cavities or organs, either directly or by surgical instruments or invasive medical devices
- The more invasive the procedure, the greater the risk of infection. Before a procedure is undertaken, consideration should be given to whether there is a safer less invasive alternative that meets the needs of the person
- The level of infection risk depends on a range of factors including the site and complexity of the procedure and patient characteristics, for example, age or underlying illness
- Healthcare workers should be trained and competent in safe procedural techniques and participate in regular education sessions about minimising the infection risk of procedures. If there is any uncertainty regarding IPC requirements related to a procedure, healthcare workers should contact a person with appropriate expertise in IPC.

Patient care tip

People who use healthcare services and their carers should be offered clear and consistent information and advice through all stages of their care. This should include the risks of procedure related infections, what is being done to reduce these risks and how they are managed.

3.5.1 Taking a risk management approach to procedures

All procedures involve some risk of infection. Minimising the infection risk associated with the procedure should be an integral part of considering the overall risks and benefits of that procedure to the person. The aim should be to perform any procedure that serves the overall best interests of the person in a timely manner with the lowest level of infection risk that will meet the treatment goals for that person. When performing the procedure, associated infection risks should be identified and minimised.

In developing local policies for a healthcare facility, it is useful to refer to guidelines developed to inform practice in performing specialised procedures.

Classifying procedures

Procedures can be classified according to the level of perceived risk, by applying the principles of Spaulding's criteria for assessing the risk of medical instruments and equipment according to their intended use (see below).

Table 22 Classifying Procedures

Level of risk	Criteria	Example
High risk (critical site)	Any surgical entry into tissue, body cavities or organs, or repair of traumatic injury.	Abdominal surgery Dental surgery
Medium risk (semi-critical site)	Contact with mucous membranes or non-intact skin.	Respiratory procedure Internal/ instrument examination (for example ultrasound, endoscopy) Minor skin surgery Minor dental procedure
Low risk (non-critical site)	Contact with intact skin.	Non-invasive examinations or procedures (for example abdominal ultrasound) Blood pressure measurement, Electrocardiogram (ECG), Injection through intact skin Extra-oral dental examination

Appropriate use of devices

Appropriate use of devices is integral to reducing the risk of infection associated with procedures. Single use or single patient items should be used wherever practicable. Items designed for single patient use must not be used for multiple people. Healthcare workers should be aware of situations where cross contamination may occur during routine procedures.

Aseptic technique

Aseptic technique protects people during invasive clinical procedures by employing IPC measures that minimise, as far as practicably possible, the presence of microorganisms. While the principles of aseptic technique remain constant for all clinical procedures, the level of practice will change depending upon a standard aseptic technique risk assessment. See previous sections for further information.

The care bundle approach

The institute for health care improvement (http://www.ihi.org/) in the USA developed a structured care bundle approach to help healthcare workers consistently deliver the safest possible care for patients undergoing treatments with inherent risks. A bundle is a set of evidence-based practices, generally 3 to 5, that when performed together and consistently, improve patient outcomes (Resar *et al*. 2005).

Many bundle elements are well established practices, combined in a structured protocol that is agreed upon and is the responsibility of the whole clinical team. Bundle characteristics include the following:

- the elements are all necessary and sufficient and make up a cohesive unit of steps that must all be completed to succeed
- the elements are all based on randomised controlled trial evidence
- the elements involve all or nothing measurement making implementation clear-cut
- bundle elements occur at a specific time and in a specific place, for example during morning rounds every day

Examples of care bundles are given in section below. These can be used to monitor assess and improve performance as well as to increase consistency of care.

Existing care bundles can be used as a tool and be developed by each facility to meet its needs. For more information, refer to the IHI website at www.ihi.org

3.5.2 Invasive medical devices

3.5.2.1 Introduction

Summary

Invasive medical devices include but are not limited to:

- catheters inserted for drainage for example urinary catheters
- catheters for intravascular access for example peripheral intravenous catheter, peripherally inserted central venous catheter (PICC) and central venous catheter (CVC)
- devices for mechanical ventilation for example endotracheal intubation
- devices for feeding for example enteral feeding tube.

The following sections provide best practice guidance on strategies for the selection, insertion, maintenance and removal of invasive medical devices.

Invasive medical devices

Good practice point: 15
Healthcare facilities should develop, implement and review processes to address the insertion, use, maintenance, and removal of invasive medical devices. These processes should be centered on the principles of only using devices if they are deemed essential, removing them as soon as they are no longer needed and using care bundles while they are in place.

Healthcare facilities should undertake a risk assessment to assist with determining appropriate procedures and timing for the removal of invasive medical devices and for the surveillance and management of invasive medical devices and device related infection.

Practical information

Invasive medical devices are a common source of healthcare associated infections and provide a route for infectious microorganisms to enter the body. Pneumonia, urinary tract infections and bloodstream infection account for around 70% of intensive care unit HCAIs and most of these are associated with invasive devices (Cruickshank and Ferguson 2008). In many settings including acute hospital, residential care and home care, urinary catheters are associated with a significant risk of infection. The need for appropriate processes and policies in all health care facilities that addresses the proper insertion, use, management and removal of invasive medical devices is therefore paramount (Loveday *et al*. 2014).

Aseptic insertion and careful maintenance of devices is critical in all healthcare settings to reducing infection risk. Information on use of aseptic technique for specific procedures, including invasive medical devices, can be found above and in appendix 7.

Key concepts in minimising the risk of infection related to the use of invasive medical devices:

- Only use an invasive medical device when clinically indicated and consider the infection risk during decision making
- Ensure staff are adequately trained and competent in the skills required for safe insertion, maintenance and removal of a device
- Choose the most appropriate device and system for the person
- Check the device at every shift and remove as soon as no longer necessary
- Protect the device and exit site from exposure to potentially infections microorganisms when showering and bathing
- Regularly monitor the person, the insertion site and the device for any signs and symptoms of infection
- Minimise the period of time a device remains in a person
- Provide patient education on the infection risk associated with the insertion of devices, how to recognise infection and the importance of proper maintenance
- Clearly document the insertion, maintenance and removal of the device as well as daily review of continuing need for the device
- Implement appropriate surveillance systems to monitor infection rates associated with use of medical devices.

3.5.2.2 Indwelling urinary devices

An indwelling urinary catheter is a flexible, tubular device passed into the bladder either through the urethra or through the abdominal wall above the symphysis pubis and is used to empty the contents of the bladder. Indwelling urinary catheters are used for a number of reasons including (Meddings *et al*. 2015):

- Management of urinary retention or obstruction

- Management of clot associated with gross haematuria
- Monitoring associated with sepsis, trauma, renal function, electrolyte or fluid balance
- Injury or surgery affecting urinary function or involving immobility, including injury, surgery or disease affecting the spinal cord
- Urinary incontinence management associated with wound care, end of life care or chemotherapy if other options available adversely impact comfort
- Urogenital or bladder management, for example management of fistula or haematuria
- Labour and birth management.

What are the risks?

Bacteria associated with infection in the setting of urinary catheterisation gain access to the urinary tract either through:

- Extraluminal contamination - from the health care worker's hands or from the person's own colonic or perineal flora. This can occur if there is a break in aseptic technique during insertion of the catheter or servicing of the drainage system
- Intraluminal contamination - this can occur through reflux of bacteria from a contaminated urine drainage bag.

Around 20% of health care associated infections are urinary tract infections with approximately 1.7% of all hospital patients acquiring a urinary tract infection during their stay (Mitchell *et al.* 2016). A large proportion of healthcare associated urinary tract infections are associated with urinary catheterisation with up to 97% of urinary tract infections in intensive care units associated with an indwelling catheter. As approximately 25% of adult patients in hospital receive short term indwelling urinary catheters it is of paramount importance that best practice IPC processes are followed in relation to urinary catheters (Webster *et al*. 2001).

Healthcare associated urinary tract infections are associated with a range of harms including an increased length of stay in hospitals (Mitchell *et al*. 2016). The risk of infection is related with the method and duration of catheterisation the quality of catheter care and host susceptibility. The longer a urinary catheter is in place the greater the risk of infection.

Minimising the risk from indwelling urinary devices

- Assessing the need for catheterisation - limiting catheter use and minimising duration are primary strategies in reducing the risk of catheter associated urinary tract infections (CAUTI). Facilities should clearly outline the indications for catheter insertion and the need for insertion of an indwelling urinary device should be reviewed before the procedure is performed
- Education of healthcare workers – healthcare workers performing catheterisation should be trained and competent in the technique and familiar with policies and procedures for insertion, maintenance and changing of indwelling urinary devices
- Educating patients – it is important to provide people with information in relation to the need for catheterisation and details about the insertion, maintenance and removal of the catheter
- Implementing appropriate surveillance – surveillance relating to indwelling catheters is valuable and can include monitoring for compliance with indications for insertion and documentation of processes.

Table 23 Minimising the risk from indwelling urinary devices

Stage	Process
Insertion	Insert only if clinically indicated. Ensure documented facility policy on urethral catheter insertion is being followed and that staff members performing the procedure are trained in the specific technique. Select appropriate catheter and catheter size. Use sterile equipment (including a sterile drape) and aseptic technique when inserting urinary catheters and connecting to the sterile system. Clean the urethral meatus with sterile normal saline before insertion of the catheter. However, the evidence underpinning this suggestion is currently inconclusive. Use an appropriate sterile, single-use lubricant when inserting the catheter. Male patients may require the application of anaesthetic gel prior to the insertion of the catheter. After insertion, follow the manufacturers' instructions with respect to the recommended volume of sterile water for insertion into the catheter balloon. Record the volume of water inserted. Properly secure the catheter to the drainage device and secure the catheter and the drainage device to the patient. Document insertion of the device in the patient medical record (detailing device, date, time, product and clinical indication).
Maintenance	The need for catheterisation should be assessed at least once daily. Use an aseptic closed system and avoid breaches to this system (for example unnecessary emptying of the urinary drainage bag). Before manipulation, perform hand hygiene and put on non-sterile gloves. Position drainage bag to prevent back-flow of urine or contact of bag with the floor. Regularly check for kinks in tubing and ensure that there is continuous drainage. Ensure there is a secure connection between the catheter and the drainage device.**Do not** add antiseptic or antimicrobial solutions into drainage bags, as studies have shown no reduction in the incidence of bacteriuria when adding hydrogen peroxide or chlorhexidine into drainage bags. Do not perform dipstick analysis of urine from patients with indwelling urinary catheters to assess for evidence of infection (see https://www.hse.ie/eng/services/list/2/gp/antibiotic-prescribing/conditions-and-treatments/urinary/position%20statements%20dipstick%20urinalysis%20for%20utis%20in%20adults) **Do not** submit urine samples from patients with indwelling urinary catheters for laboratory analysis for evidence of infection unless there is a clear clinical indication. Empty the drainage bag frequently enough to maintain urine flow and prevent reflux. Use a separate urine collection container for each person, avoiding contact between the drainage bag and container. Following use, the container should be discarded if single use, or cleaned and disinfected if reusable. Change drainage bags only when necessary (that is according to either manufacturers' recommendations or the person's clinical needs) Clamping is unnecessary. Daily meatal and periurethral hygiene can be maintained through routine bathing or showering. No reduction in bacteriuria has been demonstrated when aseptic/antimicrobial agents are used for meatal care compared with routine bathing or showering. Document all procedures involving the catheter or drainage system. Evidence indicates that bladder irrigation, instillation and washout may have local toxic effects and contribute to the development of resistant microorganisms. However, continuous or intermittent bladder irrigation may be indicated during urological surgery or to manage catheter obstruction.

Stage	Process
Removal	Remove as soon as the catheter is no longer required. Withdraw the sterile water from the balloon in advance of removal. Systems should be used to prompt early removal of the urinary catheter, as evidence suggests that reminders and stop orders can reduce CAUTI. Document all information regarding the catheter removal.

Urinary catheter maintenance bundle

An example of a bundle procedure for maintenance of urinary catheters is to:

- Perform a daily review of the need for a urinary catheter
- Check the catheter has been continuously connected to the drainage system
- Ensure patients and service users are aware of their role in preventing urinary tract infection or if the person is unable to be made aware perform routine daily meatal hygiene as above
- Empty urinary drainage bags frequently enough to maintain urine flow and prevent reflux. Use a separate urine collection container for each person avoiding contact between the drainage bag and container
- Perform hand hygiene and put on gloves and apron before each catheter care procedure; on procedure completion, remove gloves and apron and perform hand hygiene again. These practices can be measured and used to monitor performance by the clinical team.

Patient care tip

People who require catheterisation should be provided with information regarding the reason for the catheter and the plan for review and removal.

Given the risk of urinary tract infection associated with urinary catheterisation, it is important that the person or relevant other person understand about infection prevention, are aware of the signs and symptoms of urinary tract infection and know how to access expert help if difficulties arise.

3.5.2.3 Intravascular access devices

Indwelling intravascular access devices (catheters) provide a route for:

- Administering fluids, blood products, nutrients and intravenous medications
- Monitoring hemodynamic function
- Maintaining emergency vascular access
- Obtaining blood specimens.

The main types of intravascular access devices are:

- Peripheral intravenous catheters (PVCs) - which are inserted into peripheral veins, for example small veins in the arms, are the most commonly used intravascular access device in hospitalised patients. They are short term devices
- Peripheral inserted central venous catheters - which are also inserted through a peripheral vein site and can be used for a prolonged period of time, for example for chemotherapy regimes, extended antimicrobial therapy or total parenteral nutrition. They are often called PICC lines

- Central venous catheters - which are inserted into larger veins within the chest and abdomen and generally remain in place for long periods of time. They are sometimes called a central venous (CVC) line
- Note: that midline venous catheters- (an 8 - 12 cm catheter inserted in the upper arm with the tip located just below the axilla are increasingly used and may have advantages over PICC lines) https://www.rch.org.au/uploadedFiles/Main/Content/anaes/a_procedural_guide_to_midline_insertion.pdf
- Other vascular access devices - examples include arterial lines and totally implantable central venous access ports.

What are the risks?

Intravascular access devices provide potential routes for infectious microorganisms to cause local infection or to enter the bloodstream. As a result, despite their important role in diagnostic and therapeutic care, intravascular access devices are a potential source of healthcare associated infections the most severe form being bloodstream infections (BSI) associated with the insertion and maintenance of these devices. Intra vascular access device related BSIs are associated with significant mortality, worsening of the severity of the person's underlying ill health, prolonging the period of hospitalisation and increasing the cost of care.

There is a risk of infection when the device is inserted and while it remains in situ. The risks inherent in insertion of intravascular access devices include bypassing the skin, which is an important barrier against microorganisms gaining entry to sterile sites such as the bloodstream and leaving a foreign body in the person for several days or longer which is associated with a high likelihood that it will become colonised by microorganisms.

Risk factors for intravascular access device related BSI are (Mermel 2017):

- prolonged hospitalisation before the intravascular access device is inserted
- prolonged placement of the intravascular access device
- heavy microbial colonisation of the insertion site that contaminates the catheter during insertion with subsequent migration along the cutaneous catheter track and risk of contamination from health care workers hands or equipment during insertion
- heavy microbial colonisation of the cannula or catheter hub usually secondary to contamination from health care workers hands during care interventions such as preparing and administering injections
- contamination of fluids, medicines or ultrasound gel

The microorganisms that colonise catheter hubs and the skin adjacent to the insertion site are the source of most intravascular access device related BSIs. Coagulase negative staphylococci particularly *Staphylococcus epidermidis* are the most frequently implicated microorganisms. Other microorganisms commonly involved include *Staphylococcus aureus*, *Candida species* and enterococci.

Minimising the risk from intravascular access devices

Table 24 Minimising the risk from intravascular access devices

	Peripheral Intravenous Catheter (PIVC)	Peripheral Inserted Central Catheter (PICC)	Central Venous Catheter (CVC)
Need for catheterisation	All types of intravascular access devices should be used only when clinically indicated and deemed necessary, and when all other alternatives have been considered (such as oral medication). Select the most appropriate device and site for the patient after assessing the need for the device and duration of therapy.		
		The risk factors associated with inserting central lines should be considered prior to insertion, and all risks should be minimised.	
Skin preparation	Healthcare workers should allow sufficient contact time for site preparation, ensuring the following: • remove hair, if necessary, using clippers (not shavers) (Tanner *et al.* 2021 and WHO 2016) • clean a site large enough for insertion before applying antiseptic and allowing to dry completely • decontaminate the site using a single-use application of alcohol-based chlorhexidine gluconate solution (2% chlorhexidine gluconate in 70% isopropyl alcohol) (Centers for Disease Control and prevention 2011 and National Institute for Health and Care Excellence) • if insertion through or close to mucous membranes is necessary, use aqueous solution supplemented with 2% chlorhexidine • for people with a history of chlorhexidine hypersensitivity, use 10% alcohol-based povidone-iodine solution or 10% aqueous povidone-iodine if insertion is close to or through mucous membranes		
Device selection	Choose the shortest and smallest gauge suitable for the prescribed therapy as this can reduce the risk of phlebitis. This must be well secured to prevent dislodgement.	Use a central catheter with the least number of lumens, connectors and ports possible. Consider the length of time that the catheter is likely to be in situ. If total parenteral nutrition is being administered, a single lumen should be reserved for that use. There is evidence to suggest that antimicrobial coated or impregnated catheters can reduce the risk of bloodstream infection. However, the magnitude of the benefits differ according to the healthcare setting, and significant benefits have primarily been reported in intensive care units (Lai *et al.* 2014; Loveday 2014; Talbot *et al.* 2017)	

	Peripheral Intravenous Catheter (PIVC)	Peripheral Inserted Central Catheter (PICC)	Central Venous Catheter (CVC)
Site selection	**In selecting the best insertion site, consider:** - using the person's non-dominant forearm, where possible - using the basilic or brachial veins on the posterior (dorsal) forearm, where possible. - note that the metacarpal veins on the dorsum of the hand are easiest to visualise but more liable to clot and are prone to vessel damage. **Avoid, where possible:** - using areas of flexion (for example the wrist and antecubital fossa), as this may predispose to phlebitis. - using areas below previous cannulation, bruised or phlebitic areas. - using an infected limb, or a limb with a PICC or implanted venous access device. - using the arm on the side of the body where lymph node clearance/ fistulas may be located - using lower limbs due to the risk of deep vein thrombosis - using the anterior (ventral) forearm veins, especially the cephalic vein, in people with chronic renal failure.	In selecting the best insertion site, consider using the non-dominant arm where possible.	Where appropriate in overall clinical context use a subclavian site, rather than a jugular or a femoral site, in adult patients for CVC placement
Insertion	All healthcare workers who insert intravascular access devices should be appropriately trained or under the supervision of a trained clinician. Required competencies are determined according to healthcare facility policy. Perform hand hygiene immediately prior to the insertion of all catheters, either by washing with antimicrobial hand wash solution and water or using an alcohol-based hand rub. Multiple insertion attempts increase risk of infection, to avoid this each healthcare facility should have a documented escalation pathway, and a process for identifying people with difficult vascular access early so that they are referred to the appropriately skilled inserter.		

	Peripheral Intravenous Catheter (PIVC)	**Peripheral Inserted Central Catheter (PICC)**	**Central Venous Catheter (CVC)**
	Use aseptic technique for the insertion of PIVCs	Use maximum sterile barrier precautions for insertion of central venous catheters; there is evidence that they can reduce immediate post-insertion skin colonisation.	
		If PICC insertion must be done at the bedside (that is in the person's' room), establish a suitable aseptic field and maintain this throughout the procedure	Using a two-dimensional ultrasound can offer benefits in safety and quality when compared with an anatomical landmark technique (Brass *et al.* 2015). If using ultrasound guidance, healthcare workers should be appropriately trained in this technique and the principles of asepsis applied throughout the procedure including the use of sterile ultrasound gel. Consideration may be given to the use of CVC insertion bundles.
Dressing and securement	Use either sterile gauze or sterile, transparent, semi-permeable dressing to cover the catheter site. There is insufficient evidence to suggest the use of one dressing type over the other. Patient preference and clinician preference are currently acceptable factors to consider when choosing a dressing type. If a person is diaphoretic or if the site is bleeding or oozing, use gauze dressing until this is resolved. Inspect dressing (device and site) at each shift. If there is any moisture or leaking, or the dressing becomes damp, loose, soiled or lifting then it should be replaced. Replacement of dressings: • Gauze dressings should be replaced at least every 24 hours • CVAD/PICC transparent dressings should be replaced every 7 days • PVCs are a short-term device and change may not be required until the device is removed.		

	Peripheral Intravenous Catheter (PIVC)	Peripheral Inserted Central Catheter (PICC)	Central Venous Catheter (CVC)
Maintenance	Use hand antisepsis and aseptic technique for catheter site care and for accessing the system. The safe maintenance of an intravascular access device includes: good practice in caring for the person's catheter hub and connection port to avoid contamination by staff hands, the use of an appropriate site dressing regime, and using flush solutions to maintain the patency of the line. Examine the dressing, device and site at each shift and promptly remove a catheter that is no longer required. Replace catheter site dressing if it becomes damp, loosened or soiled—do not reinforce a suboptimal dressing with tape. Using chlorhexidine-impregnated dressings at the catheter insertion site has been shown to reduce intravascular access device related bloodstream infection and device colonisation rates. The safety of these dressings has not been established in low birth- weight neonates who may be at risk of skin or systemic toxicity (Loveday *et al*. 2016 and Talbot *et al*. 2017). Patients and service users should be educated to alert healthcare staff if they experience any discomfort at the insertion site including pain, burning, swelling or bleeding. When using a needleless connector, the hub should be scrubbed (70% alcohol wipe is the application of choice) before each access to minimise the risk of microbial contamination (Mermel 2017; Moureau and Flynn 2015).		
Device replacement	All catheters should be checked at each shift and removed when no longer required or if infection is suspected. All catheters inserted in an emergency situation (for example by emergency ambulance services or during cardiac arrest) should be removed and replaced when the person is stable and within 24 hours of insertion unless there is a clearly document clinical reason not to do so.		
	Do not routinely replace PVCs in neonates and children. There are two options for the replacement of PVCs in adults. See below for more detailed information.		Do not routinely replace CVCs.
Replacement of administration sets	All administration sets should be replaced when disconnected from the hub or if the catheter is changed. Leave administration sets that do not contain lipids, blood or blood products in place for intervals of up to 96 hours. Change administration sets used for intermittent infusion of blood, blood products or lipid emulsions when the infusion is complete or at least every 24 hours. Change administration sets used to infuse propofol every 12 hours or as per manufacturer's guidelines. Change administration sets used to infuse heparin every 24 hours.		

Patient engagement

Health care workers should inform patients and service users of the reason why they require an intravascular access device and the plan of care including planned removal. Where appropriate, they should also be involved in the choice and placement of the intravascular access device and educated about keeping the dressing dry.

Replacement of PVCs

Policies on the replacement of PIVCs should be based on a formal risk assessment that takes into account:

- the availability of staff appropriately trained in the insertion, monitoring, assessment and maintenance of PVCs on each shift
- the quality of PVC surveillance in the health care facility including regular inspection of the site and device and of PVC related *Staphylococcus aureus* bloodstream infection
- the need for robust documentation and reporting processes on device insertion, maintenance and removal that is supported by the results of audits.

In considering the above factors, health care facilities may routinely follow one of the following 2 options:

Option 1 - replace a PIVC every 72 hours

This practice is based on observational studies that show an increased risk of bloodstream infection with PIVCs left in place for more than 72 hours (Mermel *et al.* 2017)

Option 2 - replace a PIVC based on clinical indication

A strategy of replacing a PIVC when a clinical indication for replacement is identified (rather than routinely at 72 hours) may be considered only when there is:

- surveillance of PIVC related BSI performed at the facility
- comprehensive documentation of insertion, maintenance and removal of PVCs (audit results demonstrate a sustained compliance with daily PVC assessment documentation)
- compliance with competency requirements for insertion and management.

This option is informed by a systematic review first published in 2011 for the Australian IPC Guidelines and updated most recently in 2019 which concluded that rates of BSI and thrombophlebitis were not significantly different when PVCs were changed based on clinical indication rather than routinely replaced (Webster *et al.* 2019). The rate of PVC related BSI however, is approximately 1/1000-3000 patients, so studies with larger patient numbers are required to determine the true impact of this approach on blood stream infection.

Replacing a PVC based on clinical indication can be cost saving and may reduce the discomfort for people associated with regular replacement.

3.5.2.4 Devices used for mechanical ventilation

Certain patients require mechanical ventilatory support by endotracheal tube or tracheostomy.

When performing endotracheal intubation and ventilation in the presence of known or suspected infectious microorganisms that are transmitted by the airborne route or droplet route airborne precautions are required. Airborne precautions are required in this specific context for patients with known or suspected droplet transmitted respiratory infection because this procedure is an AGP associated with an increased risk of infection.

What are the risks?

Ventilator associated pneumonia (VAP) is a type of healthcare associated pneumonia that can occur in up to 25% of all people who require mechanical ventilation. VAP is a common cause of morbidity and mortality with crude death rate of 5% to 65% as well as increased healthcare costs. VAP can develop at any time during ventilation but occurs more often in the first few days after intubation because the intubation process itself contributes to the development of VAP.

VAP primarily occurs because microorganisms colonise the endotracheal tube or tracheostomy tube and are carried into the lungs, often in people who may have underlying lung or immune problems. Bacteria may enter the lungs during procedures such as bronchoscopy.

Many practices have been demonstrated to reduce the incidence of VAP and its associated burden of illness. The first consideration should always be whether intubation is necessary.

Table 25 Care Bundles (Ventilation)

Strategy	Summary
Physical strategies	• When intubation is necessary, use the orotracheal route as this is associated with a reduction in VAP and a decreased incidence of sinusitis compared to nasotracheal intubation. • Use new circuits for each patient and change these if they become visibly soiled or are malfunctioning, as per manufacturer instructions. • There is no difference in the incidence of VAP between people whose airways are humidified using a heat and moisture exchanger, and those whose airways are humidified using a heated humidifier. The decision should be made for each patient, with the aim to ensure adequate moisture output to minimise the risk of airway obstruction. • Change heat and moisture exchangers for each person every 5–7 days and as clinically indicated. Less frequent changes of heat and moisture exchangers may be associated with a slightly decreased incidence of VAP. • Use a closed endotracheal suctioning system, as safety considerations favour the use of closed systems. The number of disconnections should be minimised to reduce the risk of staff exposure to potentially infected secretions. • Change the endotracheal system for each patient as clinically indicated. Scheduled daily changes of closed systems have no effect on VAP. • Provide endotracheal tubes with subglottic secretion drainage ports for people likely to require intubation for more than 48 or 72 hours. • Assess patients for sedation, weaning and extubation each day. • Regular attention to oral care as appropriate. • Use a microbiological filter to prevent contamination of the ventilator.
Positional strategies	• Elevate the head of the bed to 30°-45°. Where this is not possible, raise the head of the bed as much as possible. • Semi-recumbent positioning may be associated with a decreased incidence of VAP, but may not be safe for all patients.
Pharmacological strategies	• Consider the use of the oral antiseptic chlorhexidine. • For people with severe head injury, consider the use of the oral antiseptic povidone-iodine (in the form of an oropharyngeal rinse). • There are insufficient data to make a recommendation in critically ill patients other than those with severe head injuries.

3.5.2.5 VAP care bundles

There are numerous care bundles in use for the management and prevention of VAP. Before implementing a care bundle, it is important to identify current practice in the particular area. Gaps in service provision need to be identified, analysed and systematically addressed through the implementation of the bundle. Examples of available bundles include:

Scottish Infection Care Society Audit Group VAP Prevention Bundle
http://www.sicsag.scot.nhs.uk/hai/VAP-Prevention-Bundle-web.pdf

IHI Ventilator Bundle:
https://www.ihi.org/resources/Pages/Tools/VentilatorBundleChecklist.aspx

3.5.2.6 Enteral feeding tubes

Enteral feeding is usually prescribed for people requiring artificial nutrition support for 7 to 10 days and is also used for those needing long-term support. Home enteral tube feeding may be considered for people needing artificial nutrition support for more than 30 days.

What are the risks?

Contamination of feeds is a key concern in both the hospital and community settings, with contamination largely occurring during the preparation or administration of feeds and being linked to serious clinical infection. Most evidence concerning enteral feeding relates to gastrostomy or percutaneous endoscopic gastrostomies. However, the principles outlined here are also applicable to nasogastric and jejunostomy feeding.

Table 26 Enteral tube feeding

Activity	Process
Preparation	• Perform hand hygiene before starting feed preparation. Even closed systems can become contaminated if hand hygiene is not adequate. • Wherever possible, use pre-packaged, ready-to-use feeds. Closed systems (that is pre-sterilised, prefilled, ready-to-use feeds that do not expose feed to the air during assembly) have lower contamination than open systems. The design of the system is also important in order to minimise handling. • If decanting, reconstitution or dilution is required, use a clean working area and equipment dedicated for enteral feed use. • Mix feeds with cooled boiled water or freshly opened sterilised water (for patients who are immunosuppressed) using an aseptic non-touch technique.

Activity	Process
Administration	• Perform hand hygiene immediately before administration. • Use minimal handling and aseptic non-touch technique to connect the administration system to the enteral feeding tube. • Use aseptic technique for administration of medications. • Discard administration sets and feed containers after each feeding session.
Care of insertion site and enteral feeding tube	• Perform hand hygiene immediately before commencing. • Wash the stoma daily with water and dry thoroughly. • Flush the enteral feeding tube with fresh tap water before and after feeding or administering medications to help minimise the potential risk of microbial colonisation of the internal and external surfaces. Use cooled boiled water or sterilised water for patients who are immunosuppressed.

Patient care tip

Patients and carers should be educated in techniques of hand hygiene, enteral feeding and the management of the administration system before being discharged from hospital.

Quality improvement interventions

The implementation of quality improvement interventions can support the appropriate use and management of intravascular access devices and ensure their timely removal.

Aspects of quality improvement can include:

- implementing protocols for device insertion and maintenance
- using reminders and prompts to review the use and removal of intravascular access devices
- auditing compliance with intravascular access device protocols and providing feedback to staff
- providing continual professional education to staff regularly engaged in intravascular access device insertion and maintenance.

Device related infection, quality improvement and care bundles

There are numerous care bundles in use on the management of indwelling devices. Before implementing a care bundle, it is important to identify current practice in the particular area. Gaps in service provision need to be identified, analysed and systematically addressed through the implementation of the bundle. Examples of available bundles include:

Health Protection Surveillance Centre https://www.hpsc.ie/az/microbiologyantimicrobialresistance/carebundles/

To achieve the desired quality improvement the following should be considered

- Co-design of processes and procedures with patient care teams
- Application of Human Factors, Ergonomics and Behavioural Science principles to design of systems to support care bundle implementation

3.5.3 Surgical procedures

The discussion in this section applies to all surgical procedures regardless of setting. While there is less evidence for surgical procedures in GP practice and similar settings than for hospitals the same principles apply. For additional details, the UK National Institute for Health and Care Excellence (NICE) provide detailed guidance on prevention of surgical site infection available at https://www.nice.org.uk/guidance/ng125

What are the risks?

The microorganisms that cause surgical site infections may be endogenous, that is derived from the person's skin or mucosa. Exogenous infection occurs when microorganisms from instruments or the operating environment contaminate the site during the operation, when microorganisms from the environment contaminate a traumatic wound or when microorganisms gain access to the wound after surgery before the skin has sealed.

The risk of surgery related infection is increased by factors that:

- increase the risk of endogenous contamination for example procedures that involve parts of the body with a high concentration of normal flora such as the bowel
- increase the risk of exogenous contamination for example prolonged operations that increase the length of time that issues are exposed
- diminish the efficacy of the general immune response for example diabetes, malnutrition or immunosuppressive therapy with radiotherapy, chemotherapy or steroids or local immune response for example foreign bodies, damaged tissue or formation of a hematoma.

Minimising the risk of surgical procedures

Practices to prevent surgical site infections are aimed at minimising the number of microorganisms introduced into the operative site - for example by:

- Removing microorganisms that normally colonise the skin
- Preventing the multiplication of microorganisms at the operative site - for example by using prophylactic antimicrobial agents
- Enhancing the person's defences against infection - for example by minimising tissue damage and maintaining normothermia
- Preventing access of microorganisms into the incision postoperatively by use of a wound dressing.

This section gives general guidance on preventing surgical site infection. More detailed information can be found in the national institute for health and clinical excellence surgical site infection guidelines and the WHO global guidelines for the prevention of surgical site infection (National Institute for Health and Care Excellence 2008; Leaper and Edmiston 2016)

Patient care tip

Patients and carers require clear consistent information and advice throughout all stages of their care including:

- The risk of surgical site infections, what is being done to reduce them and how they are managed
- How to care for their wound after discharge
- How to recognise a surgical site infection and who to contact if they are concerned.

An integrated care pathway helps to communicate this information to both patients and all those involved in their care after discharge. In so far as possible people should always be informed before they are given antibiotics.

Hand hygiene for surgery

Surgical hand preparation should reduce the release of skin bacteria from the hands of the surgical team for the duration of the procedure in case of an unnoticed puncture of the surgical glove. Surgical hand preparation must eliminate the transient and reduce the resident flora. There are special surgical scrub formulations available for use.

The use of an alcohol-based formulation for preoperative surgical hand preparation is recommended in accordance with WHO guidelines given its superior antimicrobial efficacy compared to other methods (Leaper and Edmiston 2016; Widmer *et al.* 2010). Specific policies and procedures on products and methods of surgical hand preparation should be developed locally.

PPE for surgical procedures including some oral/maxillofacial procedures

Personal protective equipment is designed and issued for a particular purpose in a protected environment and should not be worn outside that area. For surgical procedures and dentistry, the sequence for putting on PPE differs from that outlined previously. In these situations, masks and protective eyewear are applied first prior to hand preparation. Gown and gloves are then put on.

Double gloving is the process of wearing 2 sets of gloves with the intention of protecting against injury from sharps or the transmission of blood borne infections that can occur in the event of glove perforation. A systematic review found moderate quality evidence that double gloves reduce the risk of glove perforation and the risk of blood stains on the skin. Two studies (with high risk of bias) gave an indication of reduction in self-reported needlestick injury (Mischke *et al.* 2014).

Information on the use of surgical aseptic technique and standard aseptic technique for wound care can be found in earlier sections and sections 7.6.

3.5.3.1 Preventing surgical site infections (SSIs)

Considerations pre-procedure

Table 27 Preventing surgical site infections

Stage	Process
Hand preparation	• Operating team members must remove hand jewellery, nail polish and artificial nails. • If hands are visibly soiled, perform hand hygiene with liquid soap prior to scrubbing. • Remove debris from underneath fingernails using a nail cleaner, preferably under running water. • Use a surgical alcohol-based hand rub or suitable antimicrobial soap, preferably with a product ensuring sustained activity, as directed and for the length of time recommended by the manufacturer.
Operating suite/room or procedure attire	• Operating team members must wear sterile operation or procedure attire • All operating suite/room staff who are not operating within the critical aseptic field must wear dedicated non-sterile attire in all areas where operations are undertaken. This may contribute to minimising operating environment contamination and reduce the risk of SSIs • Movements in and out of the operating area should be kept to a minimum.
Patient preparation	• Advise people to shower or have a bath (or help patients to shower, bath or bed bath) using soap, either the day before or on the day of surgery. • Avoid routine removal of hair—if clinical circumstances require hair removal, it should be clipped on the day of surgery or as close as possible to the time of operation. Hair removal should be performed outside of the operating theatre (Managram *et al.* 1999). • Shaving hair is not appropriate (Tanner *et al.* 2021). • Provide antimicrobial prophylaxis where appropriate, using the appropriate duration and choice of agent in accordance with national and local guidelines https://www.hse.ie/eng/services/list/2/gp/antibiotic-prescribing/hospital-related-guidelines/antibiotic-prophylaxis-in-surgery.html • Consider testing pre-operatively for *S. aureus* and decolonise those with nasal carriage identified before high- risk surgery such as cardiothoracic or orthopaedic. • Avoid delaying surgery to provide parenteral nutrition, as there is no high-quality evidence to demonstrate the effectiveness of parenteral nutrition in reducing SSIs. • Use of oral antibiotics in adult patients undergoing colorectal procedures can lead to a reduced risk of SSIs (Espin Basany *et al.* 2020). • Patients colonised with MDRO can be scheduled as appropriate during the day (there is no requirement for them to be placed last on the list).

Table 28 Considerations during a surgical procedure

Stage	Process
Hand hygiene	• Perform hand hygiene before the first operation on the list using an antiseptic surgical solution, according to the manufacturer's instructions for the product that is being used. Use a single-use brush or pick for the nails, and ensure that hands and nails are visibly clean. • Before subsequent operations, perform hand hygiene using an antiseptic surgical solution. If hands are soiled during a procedure, hand hygiene should be performed again during the procedure with an antiseptic surgical solution.
Operating suite/ room attire	• Ensure that the operating room environment is appropriately maintained and that all systems (including control to temperature and ventilation) are functioning appropriately. • In hospital settings, wear sterile gowns during the procedure. • There is no available evidence that double-gloving reduces the risk of SSI or that glove perforation increases the risk of SSI. A systematic review found moderate quality evidence that double gloves reduce the risk of glove perforation and the risk of blood stains on the skin. Two studies (with high risk of bias) gave an indication of reduction in self-reported needlestick injury (Mischke et al. 2014).
Patient preparation	• Prepare the skin at the surgical site immediately before incision using an antiseptic preparation, preferably chlorhexidine 2% in alcohol (unless there is contraindication to chlorhexidine). Ensure that manufacturers recommendations are followed and that products are in date. • If diathermy is to be used, ensure that antiseptic skin preparations are dried by evaporation and there is no pooling of alcohol-based preparations. Evidence suggests there is no difference in rates of SSI when diathermy is used to make an incision compared with conventional techniques. • If an incise drape is required, use an iodophor-impregnated drape unless the person has an iodine allergy. Do not use non-iodophor-impregnated incise drapes routinely for surgery as they may increase the risk of surgical-site infection. Ensure skin preparation is dry before draping the patient. • Preoperative and intraoperative warming can be used to reduce SSI rates. • Administering supplemental oxygen intraoperatively and postoperatively can reduce the risk of SSI in people undergoing mechanical ventilation.
Wound management	• Avoid wound irrigation or intra-cavity antibiotic lavage as measures to reduce surgical site infection as there is no evidence that it reduces the incidence of SSI. • Evidence of benefit from postoperative lavage with povidione-iodine or other antiseptic is of low certainty (Norman et al. 2017). • There is no robust evidence to support the use of a dressing in the immediate postoperative period for the prevention of SSI. However, it is generally accepted good clinical practice to cover the wound with an appropriate interactive dressing for a period of 2 days unless otherwise clinically indicated—for example, if there is excess wound leakage or haemorrhage. • Instillation of antibiotics into wounds prior to closure is not appropriate.

Stage	Process
	• Using certain antimicrobial-coated sutures (for example triclosan-coated sutures) may help to reduce SSI rates. • There is no robust evidence to support the use of one dressing over another. However, in the majority of clinical situations a semi-permeable film membrane with or without an absorbent island is preferable. • Avoid routine use of intraoperative skin, repeat disinfection or topical antibiotics as measures to reduce the risk of surgical-site infection in abdominal surgery. • Single or double-ring surgical wound protector devices can reduce the rate of SSIs compared to regular wound protection. The use of wound protector devices should be determined by local need, and the availability and cost of the devices.

Table 29 Considerations post procedure

Stage	Process
Dressings	• Use aseptic technique for changing or removing surgical wound dressings. • Avoid the routine use of topical antimicrobial agents for surgical wounds that are healing by primary intention. • Use an appropriate dressing (such as semi-permeable film membrane with or without an absorbent island) to manage surgical wounds that are healing by secondary intention.
Cleansings	• If wound cleansing is necessary, a sterile normal saline solution should be used up to 2 days after surgery.
Patient care	• There is evidence that strict control of blood glucose levels during the immediate postoperative period reduces risk of SSI but with an increased risk of hypoglycaemic events (de Vries *et al.* 2017). • Maintaining normothermia in the perioperative period is recommended to reduce surgical site infection (WHO 2018)
Management of surgical site infection	• When surgical-site infection is suspected, take a specimen for culture • Antimicrobial treatment may not be required for all SSIs: minor infections may respond to drainage of pus (for example, by removal of sutures). Antibiotic therapy carries with it the risk of adverse drug reactions and the development of antimicrobial-resistant bacteria as well as the associated risk of *C. difficile* diarrhoea. • If systemic antimicrobial therapy is clinically indicated, the patient choice of agent should be based on institutional prescribing guidelines and reviewed in light of results of clinical response and microbiological tests. • If there is clinical evidence of sepsis follow the NCEC Sepsis Guideline https://www.hse.ie/eng/about/who/cspd/ncps/sepsis/resources/national-clinical-guideline-no-26-sepsis-management-for-adults-including-maternity-2021.pdf

Stage	Process
	• If there is not a satisfactory clinical response consultation with a Clinical Microbiologist or Infectious Disease Physician is generally appropriate. Changes in treatment should not be based solely on microbiological culture and susceptibility test reports
	• Avoid the use of Eusol and gauze, or dextranomer or enzymatic treatments for debridement in the management of SSI.

Clinical communication in infection prevention and control

Good practice point: 16
Healthcare facilities should have effective clinical communication processes in place that reflects the NCEC Guidelines NCEC Guidelines NCG No 5 Communication (Clinical Handover) in Maternity Services (DOH 2014) and NCG No 11 Communication (Clinical Handover) in Acute and Children's Hospital Services (DOH 2015). This communication should address infection risks and MDROs and include communication when people are transferring between healthcare facilities and when transferring from healthcare facilities to residential care facilities or to home.

Practical information

Relevant NCEC Guideline documents are available for Acute and Children's Hospitals at https://www.gov.ie/pdf/?file=https://assets.gov.ie/11589/774c4bb699144120946a091b481f2334.pdf#page=null and for Maternity Hospitals at https://www.gov.ie/en/collection/d3b3bd-clinical-handover-in-maternity-services/.

Clinical communication problems are a major contributing factor in a high proportion of adverse incidents in healthcare including incidents related to healthcare associated infection.

Patient safety and communication between healthcare workers can be maximised when effective clinical handover processes are in place. They should include consideration for transfers between wards and departments, transfers between different healthcare facilities and communication or alerts on readmission for long term infection risks such as colonisation with MDRO. Communication between hospital based services, General Practitioners, long-term residential care facilities, rehabilitation services and community hospitals is critical when people move to and from community and hospital.

All healthcare facilities should develop and implement an organisational system for structured clinical handover that encompasses IPC related patient information. These processes should be evaluated regularly to ensure the effectiveness of clinical handover is maximised.

Skin disinfection

Good practice point: 17
Skin disinfectants including chlorhexidine should be used only when clinically indicated.

Chlorhexidine-containing products, devices or solutions must never be used on or around patients with known chlorhexidine hypersensitivity.

Practical information

Chlorhexidine is an antiseptic antibacterial agent which is widely used in healthcare facilities including general practice and long-term residential care facilities. This product is available in numerous different forms: dressing, gel, lotion, solution, liquid, pad, sponge, cream. Skin cleansing with chlorhexidine plays an important role in reducing the incidence of healthcare associated infection.

It is good practice to use chlorhexidine in situations where there is a clear patient benefit and where it is safe to use it. Efforts should be made to ensure it is used correctly. In patients with known chlorhexidine hypersensitivity skin antiseptic products that do not contain chlorhexidine may be used where there is patient benefit.

For further information on appropriate chlorhexidine use, see the HPRA Safety Notice (SN201714). Risks associated with medical devices containing chlorhexidine / chlorhexidine gluconate at https://www.hpra.ie/docs/default-source/default-document-library/sn201714_chlorhexidinewipecutaneoussolutions_200317.pdf?sfvrsn=0

There is a need for greater understanding of how resistance mechanisms are changing the susceptibility of pathogenic bacteria to chlorhexidine and other antimicrobial agents. There is currently no standardised definition of chlorhexidine resistance.

Organisational Support

Summary

For IPC to be effective at the clinical level, much organisational support is needed. This includes:

- embedding infection prevention and control in governance and management structures
- ensuring adequate IPC resources proportionate to the scale and complexity of the service
- initiating procedures (for example vaccination programmes) and structures (adequate occupational health services) to ensure that healthcare workers are protected
- instituting processes for surveillance that feed into the overall quality and patient safety programme
- implementing systems for ongoing staff education and training
- incorporating infection prevention and control into planning for facility design and maintenance.

Infection prevention and control is also a workplace health and safety issue, which means that all those working in the healthcare facility managers, healthcare workers and support staff are responsible for providing a safe environment for people cared for, themselves and other staff.

Organisational support should aim to ensure that clinical work practices provide person centred care. This is not only essential from a safety and quality perspective, but out of consideration for the preferences of people who use healthcare services. This may require consultation with people who use healthcare services and relevant representative groups in the development of the healthcare services.

The information presented in this part is particularly relevant to managers of healthcare facilities. It outlines responsibilities for management of healthcare facilities, including governance structures that support the implementation, monitoring and reporting of effective IPC work practices.

While the focus of the information relates to acute care facilities, much of the information is relevant in other healthcare settings. The 2017 National Standards for the Prevention and Control of Healthcare-associated infections in acute healthcare services and the 2019 National Standards for Infection Prevention and Control in Community Services are key reference documents that should be considered in association with these guidelines.

This section covers:

- 3.6 Management and clinical governance
- 3.7 Staff health and safety
- 3.8 Education and training
- 3.9 Healthcare associated infection surveillance
- 3.10 Antimicrobial stewardship
- 3.11 Influence of facility design on healthcare associated infection.

3.6 Management and clinical governance

Summary

To be effective, IPC must be a priority in every healthcare facility and every healthcare service regardless of where care is delivered – this requires total commitment at every level of the organisation.

- Organisational capacity is achieved by having appropriate governance and management structures. This means that managers are aware of the healthcare facility's performance in terms of HCAI and AMR and there are systems in place to prevent the transmission of microorganisms and development of infection, reduce risk of infection and AMR and to address problems when they arise
- The management structure and processes associated with IPC and AMR will differ depending on the size of the organisation and the types of healthcare services it delivers. However, the principles of clinical governance apply regardless of the setting and all essential roles and responsibilities should be fulfilled
- The person in charge of the organisation (for example the General Manager or Chief Executive officer of a hospital, the principal of a General Practice or the Director of Nursing) must have overall responsibility for and direct involvement in the organisation's IPC programme
- There must be adequate resourcing for IPC. In acute hospitals, and other comparable services, this requires dedicated IPC staff and resources to run the IPC programme including professional development. In other services staff should have protected time for their infection prevention and control responsibilities
- In long-term residential care facilities there should at a minimum be an on-site IPC link practitioner with protected time for their role. It is suggested that that protected time from this role should be no less than one half day per week but much more may be required based on the complexity and scale of service. In any service where an on-site IPC link practitioner is not practical, such as small community housing units and care delivered in the home, a point of contact for IPC advice and support should be identified to all staff

- The role of IPC champion can also play an important role. This is typically a person without protected time but who undertakes to support and encourage colleagues in adhering to good practice
- Each organisation should define what the goals of their IPC policies and processes are so that they can monitor the effectiveness of their policies and processes
- All employees should understand their roles and responsibilities and have appropriate training at induction and in service to maintain a work environment that is safe for those who use healthcare services, for themselves and for their colleagues
- Person centred healthcare is safer healthcare. The expectations of those who use healthcare services must be considered during the development of programmes, policies and procedures.

3.6.1 Clinical governance in IPC

Addressing IPC is everybody's responsibility and requires a whole of organization approach. Individual facilities requires a facility wide programme. Organisations that operate multiple facilities should have IPC governance at each level of the organisation. Effective IPC governance is essential to meet a healthcare organisations responsibility to provide a safe work environment, safe systems of work for healthcare workers and a safe environment for those who use healthcare services and visitors.

Clinical governance refers to the system by which managers and clinicians in each healthcare facility share responsibility and are held accountable for patient care. This involves minimising risks for those who use healthcare services and staff and continuously monitoring and improving the quality of clinical care.

Preventing transmission of infectious microorganisms should be a priority in every healthcare facility. This will involve action to:

- develop a facility wide strategic plan for IPC
- establish a system to manage IPC (such as a committee) with input from across the spectrum of clinical services and management, and a mechanism for considering feedback from those who use healthcare services
- appoint IPC professionals and or IPC link practitioners as appropriate and support their continuing professional development (for example attendance at relevant professional organisation meetings)
- incorporate IPC into the objectives of the facility's quality and patient safety and occupational health programmes
- provide administrative and Information and Communications Technology (ICT) support as well as human resources, for maintaining the IPC programme
- provide adequate staff training and protective clothing and equipment and arrange workplace conditions and structures to minimise potential hazards.

All healthcare workers need to be aware of their individual responsibility for maintaining a safe care environment for those who use healthcare services for themselves and for other staff.

3.6.2 Roles and responsibilities

Management and clinical governance can have a positive impact on the effectiveness of IPC by driving continuous quality improvement and promoting a non-punitive culture of trust and honesty. It is important that healthcare managers and clinicians effectively collaborate and involve those who use healthcare services as partners in their healthcare in order to effect change and achieve the best possible outcomes.

The roles and responsibilities described below are most relevant to acute health care settings. However, all the roles described in this section are important for effective IPC. The principles can be easily adapted to other healthcare settings – for example, in General Practice the principal of the practice may fulfil the relevant roles and responsibilities of a Chief Executive Officer (CEO) and a member of staff with an interest in IPC may act as an infection prevention and control link practitioner with support from an external IPC practitioner.

(A) Chief Executive Officer / Administrator

The healthcare facility's CEO/GM or designated equivalent administrator for the service should support and promote IPC as an integral part of the organisations culture through the following strategies:

- Having a performance agreement that includes IPC outcomes as key performance indicators
- Endorsing the inclusion of specific written IPC roles, responsibilities and accountabilities for relevant staff within the facilities management plan
- Attending and participating in the majority of IPC committee meetings
- Ensuring that IPC professionals are supported and resourced in terms of co-workers, information technology, access to up to date information, designated office/workspace and tools to meet relevant IPC related legal, regulatory and accreditation requirements
- Achieving agreed healthcare associated infection reduction targets and ensuring that essential tasks outlined below are performed
- Ensuring that the healthcare facilities IPC programme includes involvement of one or more medical practitioners to support and play a shared leadership role
- Ensuring that the expectations of those who use healthcare services are integral to the IPC programme
- Committing to the IPC programme vision, mission, priorities, targets and annual IPC plan with specific and measurable goals for healthcare associated infection risk mitigation and reduction, these should be outlined in an annual business plan which the CEO (or his or her designate) and the IPC team develop together
- Supporting an organisational culture that promotes individual responsibility for IPC among all staff and values the IPC programme contribution to the safety of those who use healthcare services, healthcare workers and others. This support includes ensuring IPC programme staffing levels are sufficient and incorporating responsibility for IPC into every staff member's job description
- Authorising IPC (i) to intervene with clinical staff at all grades to draw their attention to observed deficits in practice (ii) to identify gaps in implementation of IPC programme recommendations and access relevant management support to address gaps (iii) to advise when clinical or other practices pose infection risks for example during outbreaks when continued operation of a service as normal may pose an IPC risk
- Recommending remedial action when IPC measures are compromised or breached.

(B) Infection prevention and control professionals/practitioners

IPC professionals should have skills, experience and qualifications relevant to their specific clinical setting and be able to fulfil the following requirements with the support of the institution and clinical colleagues:

- develop, manage and evaluate governance of IPC systems, related programmes and services
- provide expert IPC consultation and strategic direction to the healthcare facility and external agencies

In the case of IPC coordinators/IPC leads or IPC link staff who do not have a formal qualification in IPC, they should have access to relevant IPC professional support where they do not have the full range of skills needed to fulfil these requirements.

IPC professionals are primarily responsible for designing, coordinating, guiding implementation of and undertaking ongoing evaluation of the facilities IPC programme and policies. This includes supporting compliance with the respective accreditation, policy or regulatory requirements. They are also responsible for advising on IPC aspects of product evaluation.

IPC professionals need to be supported by the facility with resources, authority and time to maintain clinical and professional competence (including support to gain appropriate qualifications for example a postgraduate qualification relevant to IPC).

IPC professionals must be involved in decisions on facility construction and design, patient placement (for example single rooms and controlled ventilation rooms), and environmental assessments.

The IPC teams performance should be evaluated at least annually, along with agreement of individual professional development goals, support, opportunities and plan of work.

(C) IPC committee

A multidisciplinary IPC committee should review and guide the healthcare facilities IPC programme, strategies and plans. Membership must include, but not be limited to:

- The GM/CEO or Chief Operating Officer or equivalent
- An infection prevention and control nurse or equivalent
- One or more medical practitioners, preferably a Consultant Microbiologist or an Infectious Diseases Physician with training in Infection Prevention and Control.

The meeting frequency and content will depend on the facility size, case mix complexity and the infection risk of populations serviced. IPC committee activities should be measured against an operational plan with set priorities to target within key focus areas. In acute hospitals and hospital networks the frequency of IPC committee meetings should normally be at least quarterly.

The IPC committee should have a formal mechanism for regularly considering the experiences of those who use healthcare services, patients and their feedback and modifying the IPC programme if appropriate.

The IPC committee should have an organisational communication strategy to facilitate day to day activities and reporting activities, which should be able to be escalated in response to an incident or outbreak. Regular and ad hoc communication processes should exist between the IPC team and Department of Public Health. Healthcare facilities that do not have access to an IPC committee or infection prevention and control professional, should have access to and consult with an IPC professional in a larger health service for programme advice and support.

(D) IPC processes in general practice or dental practice and similar office-based practice

In practices based in the community, such as GP practices or dental practices, the processes associated with IPC will differ although the responsibilities are the same. The principal of the practice is equivalent to the CEO. He or she has overall responsibility for IPC in the practice and should demonstrate a strong commitment to an agreed IPC plan based on the identified risks for the practice. Local policies and procedures need to be developed and implemented as part of standard operating procedures. In the context of dental practice the development of policies and procedures is supported by the HSE National Guideline for Infection Prevention and Control in HSE Dental and Orthodontic Services at https://www.hse.ie/eng/about/who/healthwellbeing/our-priority-programmes/hcai/resources/dental/national-guideline-for-ipc-in-hse-dental-and-orthodontic-services.pdf. A nominated staff member must take on the role of infection prevention and control lead overseeing the implementation of IPC guidance. This staff member will need protected time and is likely to need additional training and access to ongoing external support in managing IPC issues. IPC should be considered at every staff meeting with discussion of procedures and processes of the practice and any problem areas.

3.6.3 IPC programme / plan

IPC programme / plan

The IPC programme or plan is the means by which IPC practice is implemented in every part of the healthcare facility. IPC programmes should be considered across all healthcare settings including acute care hospitals, community-based practices (for example general practice clinics, dental clinics, community health facilities) the setting in which paramedics work and long-term residential care facilities. This should involve the development of a risk management policy for each healthcare facility. The World Health Organisation has developed recommendations for the core components of an IPC programme (WHO 2016). These recommendations include:

- the need for a dedicated and trained team within each healthcare facility to run an IPC programme
- the development of IPC policies and procedures that are multi-modal and based on national guidelines
- education and training of healthcare workers to improve their understanding of healthcare associated infection and antimicrobial resistance and so they can implement relevant policies and procedures
- the need for a facility-based HCAI surveillance system which includes timely mechanisms for feedback and reporting to relevant healthcare professionals and senior management
- the use of multi-modal strategies to address prevention of HCAIs
- regular monitoring and review of healthcare practices to ensure that all policies and procedures are being correctly implemented against key performance indicators
- developing policies and procedures related to staff health and safety including vaccination policies and strategies to prevent occupational exposure to infection hazards
- evaluation of chemical disinfectants, products and equipment purchase
- ensuring at the facility level that healthcare environments are clean and appropriate materials and equipment are available to enable appropriate IPC procedures
- provide input during the planning, design and construction of healthcare facilities.

An IPC programme should also include or be associated with an antimicrobial stewardship programme supported by a multidisciplinary team including antimicrobial pharmacist and medical and nursing staff.

Resource allocation

The number of IPC professionals should be sufficient to ensure that healthcare facilities have the appropriate level of skills and resources and resilience required to develop IPC programmes and the capacity to respond to HCAIs.

Healthcare system managers should ensure that there are sufficient resources available to support all aspects of the IPC programme at healthcare system level including:

- adequate IPC capacity at facility level (see below)
- providing specific IPC whole time equivalents, determined according to the scope of the IPC programme, the complexity of the healthcare facility, the characteristics of the population served and the needs of the facility and community. Community based practices may choose to assign responsibilities and functions relating to IPC to a particular staff member. Long-term residential care facilities should at a minimum have an on-site IPC link practitioner. Staff members should have appropriate designated protected time for this activity
- meeting occupational health needs related to IPC (for example healthcare worker vaccination, post exposure evaluation and care for health care workers involved in outbreak management, evaluation and management of healthcare workers with communicable infections)
- providing clinical microbiology laboratory support, including a sufficient number of medical scientists and surveillance scientists with appropriate training as well as support for detecting endemic and emerging pathogens; monitoring transmission of microorganisms; planning and conducting epidemiological investigations
- ensuring access to appropriate reference laboratory and surveillance facilities to support IPC
- funding surveillance cultures, rapid diagnostic testing for viral and other selected pathogens, preparation of antibiotic susceptibility summary reports and trend analysis as appropriate to the service.

3.6.4 Risk management

Effective risk management is key for preventing and reducing harm arising from healthcare associated infection and underpins the approach to IPC throughout these guidelines. Information from incidents, near misses, risk assessments and patient/client feedback can be useful in developing the facility annual IPC plan.

Organisational support for risk management

For risk management within an organisation to be effective, there needs to be appropriate infrastructure and culture; a logical and systematic approach to implementing the required steps; and embedding of risk management principles into the philosophy, principles and business processes of an organisation, rather than it being a separate activity or focus. Factors that support risk management across the organisation include development of a risk management framework/policy; staff training in risk management; implementation of a risk register, risk treatment schedule and integrated action plans; monitoring and audit; and risk incident reporting.

An infrastructure and environment that encourages two-way communication between management and healthcare workers and among healthcare workers is an important factor in increasing the level of support for and compliance with IPC programmes.

Management should:

- provide direction (for example nominate issues for attention that are relevant to the core business of the organisation, such as respiratory hygiene and cough etiquette in general practice, prevention of diarrhoeal disease in paediatrics, appropriate management of urinary catheters in spinal injury care)
- establish goals and periodically evaluate performance (for example establish a target for reduced rates for device-related blood stream infection and assess progress)
- seek feedback on policy directives in particular with regard to changes in clinical care protocols for new technologies and how people who use healthcare services can be involved in policy formation
- provide information to individuals, self-directed work groups, people who use healthcare services and other stakeholders with an emphasis on continually improving performance.

Healthcare workers can contribute to the development of risk management structures and are integral to the success of such strategies. Strategies and examples to assist individual healthcare workers to reduce risk are included in Section 7.

New technologies and testing

Before purchasing any new technologies, consultation should occur with the IPC team.

Advice should be sought on:

- The impact on risk of infection to people who use healthcare services or other individuals as a result of the product
- Whether the product may be implicated in the transmission of microorganisms and the development of infection
- Whether the product will have IPC implications for other consumables, equipment or plans
- Whether any difficulties in cleaning and reprocessing the product might impact on the product functionality and safety
- Whether any alternative products that are available may present a lower risk of infection
- Whether the product has met all regulatory requirements relevant to IPC.

A risk assessment should be undertaken before purchasing new technologies which should consider:

- The design of the instrument - how this may impact the ease of cleaning
- Local capacity and expertise - whether staff will be able to adequately reprocess the instrument (assessed in association with decontamination lead).

3.6.5 Taking an organisational systems approach to IPC quality and safety

Addressing IPC issues requires a multi-component, facility wide programme and is everybody's responsibility. This section gives an outline of a systematic approach that has been shown to be effective at a facility level in relation to care bundles and to address 2 crucial areas of IPC – reducing sharps injuries to health care workers, and lowering the incidence of blood stream infections associated with intravascular devices. Sections 3.7 to 3.11 discuss the separate aspects of a systems approach to IPC.

Care bundles

Care bundling is an approach developed by the United States institute of Healthcare Improvements to improve consistency of practice in healthcare facilities particularly for conditions and procedures known to increase risk of healthcare associated infection.

Care bundles can be used to monitor care and care bundle results can provide feedback to clinical staff in order to decrease the rate of healthcare associated infection related to the condition or the procedure. It is important that bundles are designed, implemented and evaluated with measurement designed for quality improvement rather than research or judgment.

Examples of some procedural care bundles are given in other sections of this document.

Reducing sharps injuries

Safe handling of sharps is discussed in more detail previously. A systems approach can support reducing sharps injuries through (Centers for Disease Control and Prevention 2008):

- Clinical governance
    - Champion a culture of safety underpinned by concepts of person centred care
- Staff health and safety
    - Adopt and evaluate the use of safety engineered devices as an alternative to sharps without safety engineered features
    - Standardise changes to working practices that will reduce risks, for example using instruments rather than fingers to grasp needles, retract tissue and load or unload needles
- Education and training
    - Provide education on the use of new devices and work practices
- Surveillance
    - Ensure comprehensive reporting of injuries
- Facility design
    - Apply engineering controls (for example sharps disposal containers and sharps devices with integrated engineered sharps injury prevention features.

Lowering the incidence of intravascular device related blood stream infections

IPC guidance for health care workers to follow when inserting an invasive medical device such as a central venous catheter is outlined above (section 3.5.2) with the first consideration being whether the device is necessary.

The care bundle for central venous catheter insertion stipulates the use of hand hygiene, maximal barrier protection, optimal intravascular catheter site selection, topical chlorhexidine for skin disinfection and daily review to ensure the catheter is removed as soon as it is no longer necessary. Support infrastructure requirements to facilitate implementation of these measures include:

- Clinical governance
    - Champion a culture of safety underpinned by the concepts of person centred care
    - Utilise peer networks to promote and increase compliance with best practice techniques

- Education and training
  - Develop orientation programmes for staff including rigorous grounding and facility policies for standard precautions
  - Develop and promote an education programme that addresses facility procedures for the insertion, maintenance and removal of intravascular devices
  - Provide staff with ongoing education to maintain high levels of compliance with the facility policy
  - Engage people who use healthcare services so that they have the knowledge and skills to be actively involved in their own care
- Surveillance
  - Implement a quality adherence tool for best practice intravascular device insertion, maintenance and removal
  - Measure and evaluate performance through formal and informal audits of clinical practice
  - Provide feedback to staff
  - Measure blood stream infection rates to monitor performance
- Facility design and equipment
  - Ensure appropriate equipment is provided, such as intravascular device insertion kits with standardised content to enable a competent healthcare professional to perform the procedures
  - Ensure ready access to hand washing basins and alcohol-based hand rub.

3.7 Staff health and safety

Summary

- The protection of healthcare workers from infection must be an integral part of the IPC and occupational health and safety programmes of every healthcare facility.
- This includes implementing a risk assessment process related to exposure to biological agents in the workplace, implementing a staff health policy, promoting vaccination, instituting extra protection for healthcare workers in specific circumstances when required (for example pregnant healthcare workers) and having processes from minimising and managing risk exposure.
- While the organisation has a duty of care to healthcare workers, staff members also have a responsibility to deliver patient care, to protect themselves and to avoid putting others at risk.

Roles and responsibilities

Healthcare facilities

Workplace health and safety legislation places a duty of care on employers to ensure workplace health and safety to include managing the risk from occupationally acquired infections. Workplace facilities must have a robust risk assessment process in place which aims to eliminate the risk where possible and if not, to reduce the risk to ensure a safe working environment.

Information on health and safety legislation applicable in Ireland can be found at https://www.hsa.ie/eng/Legislation/

All healthcare workers and students should be informed of their facilities or training institution's policy on health screening. Support should be provided to any individuals whose ability to undertake work or complete study may be impacted due to transmissible infections.

Healthcare workers and student's privacy and other rights should always be respected. This can create significant challenges when staff members are asked to stay away from work for a period or have changes to their duties.

Five key measures of protection against infection prevention are:

- Health status screening and vaccination
- Education on safe work practices that minimise the transmission of infection
- Safe systems of work, with workplaces that are designed to minimise the transmission of infection
- Physical protection including the use of appropriate PPE when required
- Reporting systems for compliance to include reporting as required to statutory bodies and identifying breaches of IPC protocols.

Healthcare workers

Healthcare workers may be exposed to infectious microorganisms in a number of ways including through direct contact with a person who has an infection, as a result of a sharps injury, exposure to contaminated waste or laundry, inappropriate eating or drinking in a patient care area or working with a microorganism in a laboratory facility. Healthcare workers may represent a risk of infection to users of healthcare services and colleagues if they attend for work when they have an infectious condition or do not follow good IPC practice (for example safe disposal of sharps).

Healthcare workers should be required to follow IPC policies as part of their contract of employment. Although the success of an IPC programme is built on a quality improvement ethos and a shared commitment to users of healthcare services, consistent failure to engage with policies and procedures essential to the safety of users of healthcare services and/or colleagues may become grounds for disciplinary action.

Healthcare workers with transmissible infections need to manage their condition including through seeking medical care and receiving treatment and if appropriate seeking support to review their work options.

Information about exclusion periods for health care workers with acute infections is in section 3.7.2

Information for health care workers in specific circumstances (for example pregnant healthcare workers) is in section 3.7.4

Information about healthcare workers who carry a blood borne virus and how this impacts on their ability to perform exposure prone procedures is in section 3.7.5.

3.7.1 Health status screening and vaccination

Staff health screening policies

All healthcare facilities and healthcare providers should specify a framework for the assessment, screening and vaccination of healthcare workers to minimise the risk of transmission of vaccine preventable diseases. This must align with relevant national guidance and legislation.

Before beginning employment, all staff and students undertaking clinical placements should be assessed and offered testing or vaccination for specific infectious diseases before being allowed to work in clinical areas. Particular attention should be paid to immune status, skin conditions, pregnancy as well as risk factors for specific groups of people. It is important that there is clear communication with healthcare workers regarding the vaccination programme and requirements and that they have an opportunity to have individual questions addressed.

Routine screening and assessment

Routine screening at the start of employment occurs in 3 forms:

- Personal assessment of disease and immune status - the questionnaire (with recording of information) should check for details of medical history, particularly for rubella, measles, mumps, chicken pox, Hepatitis B and C, HIV, immune disorders, skin conditions and for prior exposure to tuberculosis (including working in high risk settings or high-risk demographic background)
- Vaccination
- Laboratory and other testing - this may include testing for evidence of immunity to hepatitis B and exposure to tuberculosis.

These principles for screening and immunisation also apply to any healthcare students, work experience students and volunteers who are likely to spend time in areas where they may be at risk or may pose a risk.

Vaccination

Pre-vaccinations screening

Guidance on vaccination is available at https://www.hse.ie/eng/health/immunisation. Healthcare facilities should have education programmes to support their vaccination policy and reinforce the need for compliance.

Occupational vaccination programme

All healthcare service providers should take all reasonable steps to ensure that staff members are protected against vaccine preventable diseases. Where healthcare workers may be at significant occupational risk of acquiring or transmitting a vaccine preventable disease, a comprehensive occupational vaccination programme should be implemented. Such a programme should include:

- a vaccination policy
- maintenance of current staff vaccination records
- provision of information about the relevant vaccine preventable diseases
- the management of vaccine hesitancy (which should include, for example measures to reduce the risk of a healthcare worker transmitting the disease to a vulnerable person).

Healthcare facilities and all healthcare providers should advise healthcare workers of the potential harm to them if they do not avail of vaccination made available to them. Such advice and non-acceptance should be documented. It may be necessary to modify duties if healthcare workers have confirmed infection that may directly affect the risk of transmission of infection during exposure prone procedures.

Vaccine non-acceptance, contraindication to vaccination and vaccine non-response may be managed by ensuring appropriate work placements, work adjustments and work restrictions.

Recommended vaccinations

Healthcare workers should be up to date with recommended vaccines, such as DTaP (diphtheria, tetanus, acellular pertussis) and MMR vaccines and catch up vaccinations.

Healthcare workers should check which vaccines they ought to have received and what documentation they need to support this.

Staff records

Employers and healthcare facilities need to retain information of health screening results and vaccinations provided, including vaccine preventable infection history, date and results of serology, record of vaccinations consented or refused, date given, batch number, type and brand name of vaccine.

Information needs to be secure and accessible by authorised personnel when needed, updated when relevant events occur and maintained in accordance with data protection requirements.

Vaccination

Good practice point: 18
All healthcare workers should be appropriately vaccinated in accordance with current national recommendations (Immunisation Guidelines for Ireland).

(Supported by strong evidence of the effectiveness and safety of vaccines)

Practical information

Healthcare facilities and all healthcare providers should maintain a record of healthcare workers vaccination status.

For further information on healthcare worker screening and vaccination see section 3.7.1

3.7.2 Exclusion periods for health care workers with acute infections

Every healthcare facility should have comprehensive written policies regarding disease specific work restriction and exclusion, which include a statement of authority defining who can implement such policies.

Any employee who has an infectious disease has a responsibility to:

- Consult with an appropriate medical practitioner to determine that they are capable of performing their tasks without putting users of healthcare services or other workers at risk
- Undergo regular medical follow up and comply with all aspects of informed clinical management regarding their condition.

These policies should encourage healthcare workers to seek appropriate preventive and curative care and report their illnesses, medical conditions or treatments that can render them more susceptible to opportunistic infection or exposures. They should not penalise healthcare workers with loss of income, benefits or job status.

The overarching principle for exclusion periods is that staff members should not come to work if they have signs or symptoms of a communicable infectious disease.

Table 30 Staff exclusion periods for infectious illnesses

Note public health guidance with respect to exclusion periods is subject to change in particular for recently emerging diseases such as COVID-19. It is important to follow authoritative public health guidance in effect at the time.

Acute infection	Exclusion period
COVID-19	Healthcare workers with COVID-19 should stay away from work for 5 days from onset of symptoms or as advised by current Public Health Guidance or their Occupational Health Service.
Conjunctivitis	Must not provide care to users of healthcare services for the duration of symptoms (that is while eye discharge is present)
Gastroenteritis including norovirus	Must not come to work while symptomatic and until 48 hours after symptoms have resolved.
Glandular fever	No need for exclusion even if having direct contact with users of healthcare services provided staff members are well enough to return to work and implement standard precautions.
Hand foot and mouth disease	Healthcare workers should be excluded until all blisters have dried. Those who may have been in contact with someone who has hand foot and mouth disease do not need to be excluded from work however consideration should be given to those who care for users of healthcare services who are more susceptible to infection.
Herpes simplex (cold sores)	Must not provide direct care to neonates, new-borns, patients in delivery suites, severely immunocompromised patients, burns patients, patients with extensive eczema or patients in operation room if there is an exposed herpetic lesion. May provide direct patient care to other people and do not need to wear a mask. However, sores should be covered with a dressing where possible and hygiene practices to minimise the risk of transmission maintained.

Acute infection	Exclusion period
Herpes zoster (shingles)	Must not provide any direct patient care if active lesions cannot be covered. If active lesions can be covered they can provide care to people except for pregnant women, neonates, severely immunocompromised patients, burns patients and patients with extensive eczema.
Influenza	Healthcare workers should remain off work until at least 48 hours after the resolution of fever provided: • they have received 72 hours of anti-influenza medication or • 5 days have elapsed since onset of respiratory symptoms. If healthcare workers are involved in the care of people who are more susceptible to infection then exclusion from those people or areas should be for 7 days from the onset of symptoms or until symptoms have completely resolved whichever is longer.
Pertussis (whooping cough)	Remain away from work until at least 5 days after commencement of appropriate antimicrobial therapy or for 21 days after the onset of symptoms if not receiving antimicrobial treatment; or 14 days after the onset of paroxysmal cough if the date of onset is known.
Scabies and lice	Healthcare workers should remain off work until 24 hours after first treatment started.
Staphylococcal infection	Any staphylococci lesions, for example boils or wound infections, must be covered with occlusive dressing while at work. Even if lesions can be covered, the healthcare worker should not work in operating theatre or ICU or with other individuals that are at exceptionally high risk of infection. If lesions cannot be covered, the healthcare worker must not perform patient care or prepare hospital food until they have received appropriate antimicrobial therapy and the infection has resolved.
Streptococcal infection	Any healthcare worker with streptococcal lesions, for example impetigo, most ensure that lesions are covered with an occlusive dressing while at work. Even if lesions can be covered, the healthcare worker should not work in operating theatre or ICU or with other individuals that are at exceptionally high risk of infection. If lesions cannot be covered, the healthcare worker must not provide direct patient care until 24 hours after commencement of appropriate antimicrobial therapy. Healthcare workers with streptococcal pharyngitis or tonsillitis should avoid patient contact for at least 24 hours after starting appropriate antimicrobial therapy.

Acute infection	Exclusion period
Tuberculosis	If tuberculosis is suspected or is present the healthcare worker should be cared for by a physician with specific expertise. Healthcare workers with pulmonary tuberculosis should be excluded from the workplace until considered fit to return to work by the physician supervising care of their condition and or by an occupational health physician.
Viral rashes	Before starting employment, healthcare workers should be screened by completing a pre-employment health assessment for measles, mumps, rubella and varicella. Non-immune healthcare workers should be offered vaccination unless contraindicated. Measles- if suspected must remain off work until appropriate test results are known. May return to work if they have serological evidence of immunity but must be excluded until 4 days after the appearance of the rash if they develop measles. Mumps- if suspected must remain off work until appropriate test results are known. May return to work if they have serological evidence of immunity. If mumps develops, they must be excluded from work for 9 days after the onset of parotid gland swelling or until the swelling goes down. Rubella - if suspected must remain off work until appropriate test results are known. May return to work if they have serological evidence of immunity. If they develop rubella they must be excluded for at least 4 days after the appearance of the rash. Chicken pox - if healthcare worker develops varicella, they must be excluded until all blisters have dried. This usually takes at least 5 days. Human parvovirus B19 (slapped cheek syndrome) does not require exclusion from work and is not infectious once rash develops.
Common cold	Healthcare workers with viral respiratory tract infections other than COVID-19 or Influenza should stay at home at least until they feel acute symptoms have resolved or for longer if required by specific advice in effect. In the context of an epidemic or pandemic of viral respiratory tract infection a more rigorous approach to exclusion of healthcare workers with respiratory virus symptoms is generally appropriate.

Avoiding work when potentially infectious for others

Good practice point: 19
Healthcare workers must exclude themselves from work and visitors must stay away from healthcare facilities when they have symptoms of a communicable infectious disease. They must adhere to exclusion periods related to all infectious diseases.

Practical information

The period of maximum shedding of pathogens varies. In many cases the period of infectivity may precede onset of symptoms. If infectivity precedes onset of symptoms managing the risk is more difficult however if a specific exposure is identified (for example contact of a non-immune healthcare worker with a patient with chickenpox on a particular day) and the interval to infectivity is known it may be possible to exclude the healthcare worker before symptoms develop. Exclusion may also be applied to healthcare workers designated as contacts in the context of epidemic or pandemic infectious diseases such as COVID-19.

3.7.3 Managing exposures to occupational hazards

Exposures that might place a healthcare worker at risk of hepatitis B virus, hepatitis C virus, HIV or human T cell lymphotropic virus type 1 are percutaneous injury or contact of a mucous membrane or non-intact skin with blood, tissue or other potentially infectious body substances.

Each healthcare facility and all health care service providers require a policy on the management of needle stick injuries and on providing immediate post exposure advice for sharps injuries and other blood or body substance incidents involving healthcare workers. This is because generic policies may not be relevant to individual settings, for example, access to care and laboratory diagnostics especially after hours. Please note the 2020 Biological Agents Code of Practice Code of Practice for the Safety, Health and Welfare at Work (Biological Agents) Regulations 2013 and 2020 (S.I. No. 572 of 2013 as amended by S.I. No. 539 of 2020) https://www.hsa.ie/eng/publications_and_forms/publications/biological_agents/cop_biological_agents_2020.pdf

Managing exposures

Some general components relevant to all occupational exposure to blood borne viruses include:

- the healthcare workers should receive immediate care and treatment
- a risk assessment of the exposure should be performed - including the type of exposure, type and amount of fluid involved, infectious status of the source and susceptibility of the exposed healthcare worker
- if the source of exposure can be identified they should be asked to accept testing for HBV, HCV and HIV if their status is not already known
- the healthcare worker should have a baseline serum sample taken for storage or testing as required
- counselling and follow up should be provided to the healthcare worker.

Treatment protocols include removal of contaminated clothing, thorough washing of the injured area with soap and water and flushing of affected mucous membranes with large amounts of water.

Post exposure prophylaxis

For the purpose of this section post exposure prophylaxis is used to refer to the medical response given to prevent the transmission of blood borne pathogens following a potential exposure to HIV. The decision to prescribe Post Exposure Prophylaxis (PEP) should be made on a case by case basis. The decisions should take into account consideration of the need for first aid, counselling, the assessment of risk of exposure to the infection, testing and depending on the outcome of the exposure assessment, the prescription of anti-retroviral drugs with appropriate support and follow up.

When PEP is recommended, it should be prescribed and started as close to the time of exposure as possible. Ideally it should commence within 2 hours of exposure and certainly within 72 hours. Eligibility for PEP and the type of regime prescribed should be based on national or local guidance individualised as appropriate for the healthcare worker taking account of a number of factors, including the transmission risk associated with the exposure.

If PEP is commenced the continuing requirement for PEP should be reviewed in the context of subsequent laboratory results on the person who represents the source of exposure. If there is a confirmed requirement for PEP the duration should be in accordance with current guidance. For additional information see https://www.hpsc.ie/a-z/EMIToolkit/

Management of possible exposure to other conditions:

- Hepatitis B - healthcare workers with evidence of previous immunity to hepatitis B require no follow up. Non-immune individuals require vaccination and follow up
- Hepatitis C - healthcare workers potentially at risk require a baseline blood sample and follow up testing. Follow up testing may include testing for Hepatitis C virus. Healthcare workers should be informed about the symptoms of Hepatitis C and advised to seek medical advice if any symptoms are displayed
- Tetanus - tetanus status should be assessed for any healthcare workers who sustain abrasions or wounds.

3.7.4 Healthcare workers with specific circumstances

Healthcare workers with specific circumstances

Healthcare facilities need to assist healthcare workers who experienced circumstances that place them at greater risk of infection to develop management plans that ensure their wellbeing.

Where healthcare workers are known to be particularly susceptible to healthcare associated infection, work duties are assessed to ensure that the welfare of the healthcare worker, those who use healthcare services and other healthcare workers is safeguarded. This may involve appropriate work placements; adjustments and restrictions or deployment to a role involving less risk. Healthcare workers in this situation may require counselling on what tasks they can perform, what they should avoid and the possible impact of their work on their health.

Pregnant healthcare workers

Employers should provide information on the workplace risks associated with pregnancy. It is the responsibility of pregnant healthcare workers to advise their doctor or employer of their pregnancy and this information must remain confidential.

Once an employer becomes aware that an employee is pregnant, they have a legal duty under health and safety legislation to assess the specific risks from the employment to that employee and take action to ensure that she is not exposed to anything, which would damage either her health or that of the developing child.

All pregnant healthcare workers should adhere to standard and transmission-based precautions and ensure that they are appropriately vaccinated. Where the role of a healthcare worker in the care of a person infected with an infectious microorganism poses a specific risk to a pregnant healthcare worker, that role should generally be performed by a non-pregnant healthcare worker.

Immunocompromised healthcare workers

Healthcare workers with immune deficiencies are more at risk of acquiring infections. The type of employment they can undertake should be appropriate to their risk of infection. Conditions associated with with immunocompromised status include neutropenia, disseminated malignancy, infections that may produce immunodeficiency, for example HIV. In addition, there is a broad range of medications that are associated with immunocompromise.

Healthcare workers with skin conditions

Skin integrity is a critical barrier to transmission of infectious microorganisms. When staff members have damaged skin or weeping skin conditions they may be readily colonised by healthcare associated microorganisms. This may have implications for their health and there is also a risk that they may disseminated these microorganisms to others. Healthcare workers in this situation should be identified by personal history screening when they start employment and need to be informed of the risks they may pose to people who use healthcare services. Any damaged skin must be appropriately covered before healthcare workers carry out procedures. Consideration must be given to providing these staff members with appropriate, individual PPE such a specific types of gloves, hand hygiene products and moisturising lotion.

Healthcare workers with Cystic Fibrosis

Healthcare workers with cystic fibrosis may be at greater risk of cross infection from healthcare workers without cystic fibrosis. They may also pose an infection risk to people who use healthcare services; however, this will vary according to the severity of their disease, the frequency of coughing and the type of cystic fibrosis pathogens evident.

It is recommended that healthcare workers with Cystic Fibrosis do not work with patients or other healthcare workers with Cystic Fibrosis. Healthcare workers are encouraged to disclose their diagnosis during pre-employment screening to determine the safest workplace arrangements.

Healthcare workers living with a blood borne virus (BBV)

Healthcare workers living with a BBV including Hepatitis B, Hepatitis C and HIV must be under the care of a treating clinician and must be managed in accordance with current guidance to manage risk of transmission to people who use healthcare services.

Healthcare workers living with a BBV deserve a supportive work environment including retraining if required, counselling and appropriate infection-control measures.

3.7.5 Exposure prone procedures

Non exposure prone procedures (NPP) are procedures where the hands and fingers of the healthcare worker are visible and outside of the body at all times and procedures or internal examinations that do not involve possible injury to the healthcare workers hands by sharp instruments and/or tissues, provided routine IPC procedures are adhered to at all times. Examples include routine oral examination with appropriate personal protective equipment, insertion and maintenance of intravenous or central lines.

Exposure prone procedures (EPP) are invasive procedures where there is potential for direct contact between the skin, usually finger or thumb of the healthcare worker and sharp objects or surgical instruments – such as needles, sharp body parts (for example fractured bones) spicules of bone or teeth – in body cavities or in poorly visualised or confined body sites, including the mouth of the patient. During EPPs there is an increased risk of transmitting blood borne viruses between healthcare workers and people who use healthcare services.

There are two major risks related to healthcare workers that arise out of EPPs:

- Healthcare workers can become infected with BBV
- Healthcare workers who already have a BBV may transmit the virus to a patient.

Some procedures that are generally considered not to be EPP may have the potential to escalate to EPPs. These procedures include:

- Minimally invasive procedures including laparoscopy, endovascular procedures, thoracoscopic procedures, Natural Orifice Transluminal Endoscopic Surgery, cystoscopic procedures, arthroscopic procedures and robotic surgery
- Trauma/emergency procedures where a previously non-EPP may escalate into an EPP.

The following table provides advice on EPPs in specific areas of clinical care as well as general procedures that are not considered to be EPPs.

Table 31 EPPs and non EPPs in specific areas of clinical care

Area of clinical care	Exposure prone procedure	Non-exposure prone procedure
General		• Routine non-trauma related vaginal or rectal examination in the absence of a sharp • Insertion and maintenance of arterial or intravenous cannula whether inserted centrally or peripherally • Open incision and drainage of superficial abscesses or haematomas • Percutaneous drainage of abscesses, fluid collections or haematomas under radiation or ultrasound guidance • Suturing of uncomplicated skin lacerations.
Cardiothoracic	Generally, all cardiothoracic procedures	
Dentistry	• All maxillofacial surgery • All oral surgical procedures • The extraction of teeth, with some exceptions: o Periodontal surgical procedures o Endodontic surgical procedures o Implant surgical procedures	Extraction of highly mobile or exfoliating teeth. • Assessment and management of removable dentures and mouth guards. • Taking impressions of teeth. • Applying decay preventative agents. • Removing dental plaque and stains (if performed without sharp instruments such as rubber polishing cups).
Emergency/ trauma	• Open head injuries resulting from trauma. • Insertion of intercostal catheter, where the procedure requires insertion of the finger into the pleural cavity in a trauma situation. • Reduction of facial or jaw fractures from within the oral cavity. • Rectal or vaginal examination in the presence of suspected pelvic trauma. • Placement of thoracic aortic clamp, packing a deep wound in a body cavity or deep suturing to arrest haemorrhage.	• Percutaneous insertion of intercostal catheter, for example by Seldinger technique , where the procedure does not require insertion of the finger into the pleural cavity. • Insertion of intercostal catheter where the procedure requires insertion of the finger into the pleural cavity in a non-trauma situation. • Endotracheal intubation. • Bag valve mask ventilation. • Simple suturing under direct vision.

Area of clinical care	Exposure prone procedure	Non-exposure prone procedure
General surgery	Open abdominal or thoracic procedures	• Excision of skin lesions • Breast surgery where hands remain in view
Gynaecology	• Perineal surgery • Trans-vaginal surgery • Open abdominal • Gynaecological surgery • Local aesthetic administered to the cervix other than under direct vision, for example with fingers concealed in the vagina	• Vaginal examination in absence of a sharp • Laparoscopy • Colposcopy • Surgical insertion of depot contraceptive implant or devices • Fitting intrauterine contraceptive devices • Cone biopsy • Dilation and curettage
Neurosurgery	Any surgical procedures that involve exposure to sharp bone fragments, for example trauma and some spinal surgery	
Obstetric or midwifery	• Caesarean birth • Instrumental birth • Infiltration of the perineum with local anaesthetic • Episiotomy • Repair of an episiotomy or perineal/ vaginal tear • Application of foetal scalp electrodes • Foetal blood sampling	• Vaginal examination in absence of a sharp • Trans-vaginal egg collection provided fingers remain visible at all times when sharp instruments are in use
Ophthalmology	• Orbital surgery • Oculoplastic and lachrymal surgery where bony reconstruction and bone fragments are involved	Routine ocular surgery
Orthopaedic	• Cutting or fixation of bones or the distant transfer of tissues from a second site, such as in a thumb reconstruction • Open procedures where there is the possibility of bone fragments, mechanical drilling, deep tunnelling using sharp instruments	• Closed fracture reduction • Diagnostic arthroscopy • Endoscopic carpal tunnel decompression

Area of clinical care	Exposure prone procedure	Non-exposure prone procedure
Otolaryngology, head and neck	• Bony facial reconstructive surgery , elective or after trauma	• Otological procedures for example stapedectomy/stapedotomy, insertion of ventilation tubes, insertion of a titanium screw, for a bone anchored hearing aid • Most head and neck cancer operations except where fingers are not visible at all times • Most rhinological procedures • Functional endoscopic sinus surgery (FESS)
Paediatric surgery	• Extensive cosmetic procedures that involve bony reconstruction • Free tissue transfer involving bone or in the thorax	• Herniorrhaphy • Orchidopexy • Superficial procedures
Plastic surgery	• Extensive cosmetic procedures that involve bony reconstruction • Free tissue transfer involving bone or in the thorax	• Excision of superficial lesions • Superficial skin excision and reconstruction
Podiatry	• Procedures undertaken by podiatric surgeons including open surgical procedures on bones and soft tissue of the foot and lower leg • See also orthopaedics	• Routine procedures undertaken by podiatrists, including nail avulsion performed in the clinic setting
Urology	Open urological procedures	• Image guided biopsies • Scrotal procedures
Vascular surgery	Open abdominal or thoracic vascular surgery	• Carotid endarterectomy • Percutaneous dilation, stenting or recanalization of arteries • Percutaneous treatment of varicose veins • Diagnostic angiography • Peripheral embolectomy or thrombectomy

Table 31 does not encompass all possible EPPs. Healthcare workers must consider the risks in each situation.

Responsibilities of healthcare workers

All healthcare workers (including students) who are performing EPPs should take reasonable steps to know their BBV status and should have appropriate and timely testing after potential BBV exposure, both occupational and non-occupational.

Responsibilities of employers

Employers should support employees who perform EPPs with access to appropriate information, testing, training, support and vaccination programmes.

Healthcare facilities should aim to achieve voluntary compliance and self-disclosure by providing an environment in which healthcare workers know their confidentiality will be maintained. Employers of healthcare workers must consider the relevant public health and privacy obligations and legal obligations with respect to employment rights.

Responsibilities of treating doctors

A treating medical practitioner should fulfil any obligation to inform the relevant registration authority if they are aware that a healthcare worker is putting patients at risk through non adherence to recommendations for safe practice.

All healthcare workers and healthcare students

All healthcare workers should have the right to access confidential testing, support and treatment.

All healthcare workers in all settings should be vaccinated against hepatitis B virus.

Healthcare workers who perform EPPs

Healthcare workers who undertake EPPs must consider if they are at particular risk for infection with BBVs and seek treatment and care if required.

All healthcare Workers who undertake EPPs should understand their obligations to report to occupational health for care and guidance if they have or believe they may have acquired infection with BBVs.

Healthcare workers should understand their obligations to report all sharps injuries whether or not there was a risk of patient exposure.

Healthcare workers must be offered testing for BBVs after the occurrence of relevant occupational exposure incidents.

Healthcare workers must cease performing all EPPs if diagnosed with a BBV until they have been fully assessed and certified as safe to resume EPP.

Healthcare workers living with a BBV

All healthcare workers with a BBV must be under the care of a treating doctor with relevant expertise.

All healthcare workers living with one or more BBVs must adhere to treatment and testing is required to manage risk of transmission to people who use healthcare services.

3.8 Education and training

Summary

- Education and training underpin efforts to integrate IPC practices into practice at all levels of every healthcare facility.
- Essential education for all healthcare workers should cover IPC work practices and their role in preventing the spread of microorganisms and the development of infection. Healthcare workers must have protected time to participate in IPC education and training.
- IPC work practices should be a part of undergraduate education, staff orientation and any continuing professional development.
- Specific postgraduate education of IPC professionals is strongly recommended.
- Engaging people who use healthcare services, their carers' and families in their own healthcare is integral to effective IPC. All healthcare workers should be informed about the rights and responsibilities of people who use healthcare services and learn how to apply this understanding in the way that they deliver care.

Continuous professional development for IPC practitioners

Good practice point: 20
Infection prevention and control professionals should participate in ongoing professional development in order to maintain the necessary expertise to fulfil their role.

IPC staff at all levels should be supported to access formal and informal education and training relevant to their role.

Practical information

Postgraduate education

A range of postgraduate education programmes are currently available for healthcare professionals seeking to develop the competencies required to establish a career in infection prevention and control. These courses include higher diplomas and Master's degrees in IPC. IPC is also a major component of the curriculum in higher specialist training for Medical Microbiology.

Mentoring, support and networking

While there are no formal mentoring programmes in place at national level, many IPC professionals provide mentoring to less experienced colleagues. Mentoring requires the support of health facility administrators so that it is recognised as being part of healthcare worker core time.

Some healthcare facilities have successfully established link practitioner and train the trainer programmes to support their IPC programmes and to facilitate mentoring of healthcare professionals at varying levels of expertise in IPC.

Auditing

Auditing of healthcare worker behaviour is important for surveillance and to reinforce positive signs of culture change within a facility. Auditing to measure compliance with IPC policies and procedures can occur through:

- Direct observation
- Examining logs and registers of specific activities, for example equipment such as autoclaves and washer disinfectors
- Monitoring the use of PPE or hand hygiene products.

Timely feedback is a critical aspect of auditing. In all settings, measurement and feedback should be provided at the at individual ward/unit/service level to support local ownership and quality improvement.

3.8.1 Education strategies

On the job training

All healthcare workers need to understand the foundation for and importance of IPC. This information should be provided to healthcare workers by the healthcare facility where they work and to students by the educational institute providing training. This teaching should reflect information contained in these Guidelines and ensure that healthcare workers understand standard and transmission-based precautions. The education should be tailored specifically to the healthcare facility and where necessary, to a healthcare workers specific role in this workplace.

Job specific training should be provided as part of orientation, when new procedures affect the employee's occupational exposure and before rostering to a hazardous area. Healthcare worker's competency should be assessed to the greatest extent possible and records should be maintained of their participation in education programmes.

Third Level Education

Up to date information on IPC foundations, policy, procedures, quality assurance and incident monitoring should be included in the curriculum of all undergraduate and postgraduate courses in health-related areas.

Third level institutes also have an obligation to inform prospective students about the impact that particular infections may have on their ability to complete the course and to engage in the full spectrum of clinical practice after graduation. This information should include advice about specific measures, including vaccination, that reduce the risk of acquiring infection.

Effective educational strategies

There are a variety of educational strategies that can be used in healthcare settings to improve knowledge and understanding of IPC.

These include:

- Multimodal strategies which consider the needs of the target group, potential barriers and facilitators and the context in which educational strategies are applied. These are likely to be more effective than single strategies as learning is reinforced through repetition and variation
- Interactive educational interventions that are repeated with some frequency have a greater chance of changing behaviour than a single didactic session. Repetition and interactivity have both been shown to be important factors in achieving behaviour change that is sustained
- The use of multiple forms of media including printed materials and videos

- The materials used in education and training should be carefully designed and produced based on sound communication principles to ensure that they are engaging and understandable for the intended audience
- Materials should be provided in languages other than English as appropriate to ensure that they are engaging and understandable to the intended audience
- Educational outreach visits have been found to be an effective method, especially when combined with other strategies such as interactive education and printed materials but are costly to implement.

Specifically with respect to hand hygiene, a systematic review conducted to support the development of this guideline concluded that, there is low certainty of evidence that implementing a WHO compliant strategy (that is, three or more of the five key components) compared to usual care will improve hand hygiene adherence. For WHO Plus strategies (all five components plus at least one additional component) there is very low certainty of evidence that adding additional components can lead to additional improvement.

Educational activities can be integrated into staff orientation programmes, formal training required for certification, annual training and continuing professional development requirements, implementation of policy and procedure manuals, and in decision support tools available on IT systems. The IPC professionals contact details should be readily available to all staff and included in all resources.

eLearning, for example interactive web-based training, may be a useful addition to other education strategies. eLearning modules on IPC are freely available at www.hseland.ie

The competency framework for infection prevention and control practitioners is a valuable resource at https://www.hse.ie/eng/about/who/healthwellbeing/our-priority-programmes/hcai/resources/general/competency-framework-for-infection-prevention-control-practitioners.pdf

Local programmes for education, audit and feedback should be refined regularly and promoted widely in healthcare facilities by senior staff members.

3.9 Healthcare associated infection surveillance

Summary

- Appropriate surveillance can substantially reduce healthcare associated infection, morbidity and mortality.
- Both outcome and process measures are used for surveillance in large healthcare facilities; process measures alone can provide a useful alternative, particularly in smaller facilities.
- Timely targeted feedback is critical for effective surveillance.
- All staff involved in surveillance should be appropriately trained in data collection and analysis techniques.

See also section 3.4.1 and Good Practice Statement 11 related to surveillance of MDRO and Healthcare Associated Infection.

3.9.1 Role of surveillance in reducing healthcare associated infection

Many infections can be prevented using approaches based on quality and safety theories such as:

- Quality improvement methodologies
- Creating a safety culture (individuals taking responsibility for ensuring safety and of themselves and others and the quality of the service they deliver)
- Application of systems thinking (that is understanding the factors in the system that allow errors to occur).

To be successful, all these approaches need to be based on comprehensive information obtained through surveillance - the ongoing systematic collection, analysis, interpretation and dissemination of data regarding health-related events, for use in public health action to reduce morbidity, mortality and to improve health.

Surveillance is important for wider systems of quality management, but the main purpose of collecting reliable data are to improve quality within a service or facility. Collecting such data can provide the impetus for change and make it possible to evaluate the effectiveness of an intervention (Russo *et al*. 2013 and Wilson *et al*. 2013). Note: that National Standards for infection prevention and control in community services advise that staff be supported and facilitated to undertake infection and antimicrobial resistance surveillance, monitoring or quality improvement activities. For example, monitoring both hand hygiene compliance and the rate of blood stream infections and disseminating this information within the facility, can improve hand hygiene practices.

Surveillance of healthcare associated infection draws information about the microorganism, host, environment and risk factors from a number of data sources and:

- Provides baseline information on the frequency and type of HCAI
- Enables breakdowns in IPC to be identified
- Allows for timely investigation and appropriate IPC measures to be instituted.

All healthcare facilities, to the greatest extent possible, should systematically collect data on HCAIs, IPC breaches, outbreaks of infectious disease and antimicrobial resistance. Post discharge surveillance should also be considered. Staff must be allocated time to participate in surveillance activities.

National Standards for the prevention and control of healthcare-associated infections in acute healthcare services Standard 2.3 specifies the requirement that *"an infection surveillance programme is in place to ensure a rapid and effective response to healthcare-associated infections and antimicrobial resistance trends".* The document indicates relevant data includes but is not limited to standardised incidence rates of:

- Alert organisms
- Multidrug-resistant organisms
- Invasive medical device-related infections
- Surgical site infections, including caesarean sections and prosthetic surgeries
- Bloodstream infections
- Intensive care unit-acquired infections
- Neonatal infections.

The surveillance system used by a healthcare facility depends on the type and size of the facility, its case mix and on the resources available. Non-acute healthcare services including primary care services should also record and review observed incidents of healthcare associated infection.

It is important that the collection of surveillance data is guided by a clear purpose that is understood by all relevant stakeholders (Russo *et al*. 2013).

To drive the success of surveillance, relevant staff members need appropriate and continuing training to ensure consistency in the application of definitions and data collection (Russo *et al*. 2016).

3.9.2 Types of surveillance programmes

It is not feasible to conduct facility wide surveillance for all events all the time; therefore, surveillance is often targeted with a focus on specific events, processes, microorganisms, medical devices or high-risk patient populations. Healthcare associated infection surveillance programmes may focus on:

- Specific sites of infection, for example blood stream or surgical sites
- Specific populations, for example neonates, healthcare worker occupational exposure to blood and body substances
- Specific microorganisms or types of microorganisms for example CPE
- Specific locations in the healthcare facility or community, for example intensive care unit, neonatal intensive care unit and residential care facilities.

There are 2 main methods of surveillance - process and outcome. Process measurements are usually easier to measure, less ambiguous and more widely applicable than outcome indicators. Process surveillance may be an adjunct to outcome surveillance. Alternatively, it can entirely replace outcome surveillance for practices or locations that have too few adverse outcomes for statistical analysis (for example small facilities where the number of patients at risk of infection may be too small to calculate valid infection rates).

Process surveillance

Process surveillance involves auditing practice against a certain standard, guideline or policy.

As no single intervention will prevent every healthcare associated infection, packages of evidence-based interventions have been developed and are increasingly being used in processes surveillance (for example care bundles)

Process measures that are linked by evidence to important incomes:

- Do not require risk adjustment
- Can predict outcomes
- Can easily be acted on because potential improvements are usually the responsibility of the clinical service
- Can be captured quickly
- Are sensitive because many episodes of inappropriate care do not cause harm.

Examples of published process indicators of high value include:

- Aseptic insertion and management of peripheral or central intravascular devices
- Healthcare workers compliance with hand hygiene and the techniques they used
- Peri-operative and intra-operative practice such as antimicrobial prophylaxis, normothermia, normoglycemia and appropriate hair removal
- Healthcare workers uptake of vaccination.

Outcome surveillance

Outcome surveillance involves measuring adverse events, a proportion of which are preventable. The sensitivity and specificity of events definitions and the reliability of data collection need to be considered when developing methods to detect adverse events. It is important to create a balance between avoiding false positives (specificity) and picking up true positives (sensitivity) given that true positives are rare events in the overall patient population.

Certain outcome measures for example the incidence of hospital acquired *Staphylococcus aureus* blood stream infection appear to be reliable and have driven practice change, leading to significant improvements in patient safety.

Ireland has no dedicated system wide approach to measurement of patient mortality caused by or associated with healthcare associated infection however, note that any death which may be due to any healthcare acquired infection must be reported to the Coroner www.coroners.ie

A particular challenge in measuring patient deaths related to HCAI is assessing the extent to which a HCAI present at the time of death contributed to the outcome (that is was the death attributable to the infection). One new approach to evaluate such patient deaths is to determine whether mortality was unexpected and then analyse the contributing factors to determine preventable root causes that might be modified in future. In this approach, infection events (usually deaths or BSI) are considered and investigated individually. Although mandated by the UK's National Health Service, evidence of the value of this approach is lacking.

Incident analysis

An incident analysis should be performed for all cases of hospital acquired *Staphylococcus aureus* blood stream infection, for most other hospital acquired blood stream infections, for severe cases of *C. difficile* infection amongst others. Use of standard definitions for these conditions, such as those used for monthly reporting to the HSE-Business Information Unit, will help to ensure consistency and facilitate comparison of experience in different sites.Incident analysis will also help to understand and prevent other hospital acquired infections including deep surgical site infection and device related infection.

If there has been a breakdown in an IPC procedure or protocol, a look back investigation may be necessary to identify, trace, recall, counsel and test patients or healthcare workers who may have been exposed to an infection, often a blood borne virus.

Look back investigations must be managed with due regard to open disclosure requirements, ethical and legal considerations. In the event of an incident likely to be associated with a HCAI incident, for example failure of sterilisation or disinfection that may result in infection all appropriate authorities should be informed including the Department of Public Health.

Where a healthcare facility has access to an organisation wide platform for reporting incidents (such as the HSE National Incident Management System) incidents should be reported.

Monitoring of critical incidents and other sentinel events is an important part of surveillance. Incident analysis of sentinel events is a structured process for identifying the process and contributing factors, exploring and identifying risk reduction strategies and implementing solutions.

3.9.3 Data collection and management

Surveillance involves:

- Defining surveyed events precisely
- Systematic collection and validation of data
- Analysis and interpretation
- Communication of findings to relevant people.

The following epidemiologic principles should be applied during healthcare associated infection surveillance:

- Use standardised definitions of infection or colonisation
- Use laboratory-based data when available
- Collect epidemiologically important variables, for example range of clinical service in hospitals and other large facilities, population specific risk factors, underlying conditions that predispose to serious adverse outcomes
- Analyse data to identify trends that may indicate increased frequency of transmission
- Feedback information on trends in the incidence and prevalence of HCAI, probable risk factors and prevention strategies and their impact to the appropriate healthcare workers, administrators and as appropriate to Department of Public Health.

Surveillance data for quality improvement must be of high quality. The characteristics that qualified data as evidence for action include (Booth 1995):

- Representativeness - the data fairly represent the thing measured
- Accuracy - the data reflect what it is intended to measure
- Precision - the data and the target of measurement correspond closely
- Authoritativeness - the data are appropriate for drawing a meaningful conclusion
- Clarity - the data are presented in a form that the target audience can understand.

Data of this nature is more likely to arise from surveillance processes:

- That involve all stakeholders in design and implementation
- For which there are agreed organisational objectives and processes that are relevant to the population served
- That use trained staff to collect and manage data and that have appropriate information technology support

- That use definitions of surveillance events that are unambiguous, practical, specific and can be validated
- That have reliable and practical methods for detecting events
- For which the processes that determine an outcome are thoroughly understood
- For which appropriate denominators are collected for risk adjustment
- For which reporting links measurement to prevention efforts and meets the needs of both clinicians and managers.

3.9.4 Outbreak Surveillance

An outbreak may be defined as the occurrence of infections at a rate greater than that expected within a specific geographical area and over a defined period of time or as two or more linked cases of infection.

Ideally, surveillance systems should facilitate the early detection of outbreaks. Increasingly, microbiological data (including data from reference laboratories) are being relied on for this purpose, although outbreaks may be detected based on clinical observation or using other sources such as pharmacy records.

In some instances, the occurrence of an outbreak is obvious, such as in an episode of gastroenteritis that affects both healthcare workers and people who use healthcare services. It is more usual, however, for the outbreak to have an insidious onset that is not immediately apparent. When an outbreak is detected an Outbreak Control Team should be formed and the Department of Public Health notified. Details on the steps involved in the management of an outbreak are provided above in section 3.4.2.

3.9.5 Disease surveillance and primary care or other community-based practice

All staff members in community-based practices such as GP practices, need to be aware of the possibility that people will present with suspected or confirmed infectious diseases.

For certain diseases, notifiable diseases, timely notification to the Department of Public Health is required, sometimes by telephone. The relevant legislation if the Infectious Disease Regulations 1981 and related amendments. Medical practitioners and clinical directors of diagnostic laboratories are required to communicate written or electronic notification of cases of certain infectious diseases to the Medical Officer of Health. The list of currently notifiable diseases is available at: https://www.hpsc.ie/notifiablediseases/listofnotifiablediseases. Systems need to be in place so that authorities are able to trace those with whom infectious people have been in contact. A staff member should be responsible for checking national websites for relevant guidelines.

In most community-based practices, there will not be enough procedures performed to undertake outcome surveillance. Process surveillance can be used to evaluate processes and procedures and to monitor sentinel events. There should be an awareness and capacity to observe and respond to threats of outbreaks, for example chickenpox, measles and emerging diseases.

Community-based practices can also play an important role in supporting the surveillance undertaken in acute care facilities by enabling post discharge surveillance. Many surgical site infections for example will be identified up to 30 days after surgery, however people are often discharged during this period. Community-based practices can participate in post discharge surveillance case findings and report on these findings in order to maintain accurate data on surgical site infections.

3.9.6 Notifiable diseases

National notifiable diseases

The list of currently notifiable diseases is available on the website of the Health Protection surveillance centre. https://www.hpsc.ie/notifiablediseases/listofnotifiablediseases/

3.10 Antimicrobial stewardship

Summary

- Resistance to antimicrobial agents is commonly found in hospitals and in the community. This resistance can have a significant impact on morbidity mortality and treatment costs.
- The key driver of antimicrobial resistance is the use of antimicrobial agents and a good deal of this is avoidable. It is estimated that around one third of all antimicrobial use in healthcare is unnecessary.
- Antimicrobial stewardship is a suite of coordinated strategies which together aim to promote the appropriate use of antimicrobial agents to maximise their benefit while causing the least harm.
- Appropriate antimicrobial use occurs when antimicrobial agents are prescribed according to evidence-based guidelines with drug choice, indication, dose and duration selected to optimise clinical outcomes and minimises adverse consequences (including toxicity antimicrobial resistance and unnecessary costs).
- Surveillance of antimicrobial usage and resistance can be used to identify areas for improvement and measure the impact of antimicrobial stewardship programmes.
- IPC is an essential part of an effective response to antimicrobial resistance.

Useful tools and resources to assist in implementation of antimicrobial stewardship are located at the following link: https://bit.ly/3rPt7tq

3.10.1 Antimicrobial resistance

Antimicrobial resistance

Antimicrobial resistance is recognised as a significant national and global health priority. The relationship between the use of antimicrobials in all human health settings, agriculture and animal husbandry and the emergence of antimicrobial resistance is well documented.

The drivers of antimicrobial resistance are interlinked, with the use of particular antimicrobial classes associated with the emergence and amplification of specific antimicrobial resistant pathogens. Examples include MRSA, VRE and MDROs. High levels of antimicrobial use is associated with increase in the number of people who are colonised or infected with resistant organisms, both in healthcare facilities and in the community (Cosgrove and Carmeli 2003; van den Sande Bruinsma *et al.* 2008)

The significance of antimicrobial resistance for Ireland and the scale of response required is outlined in Ireland's national action plan for antimicrobial resistance (Department of Health 2017) and Ireland's second One Health Action Plan on Antimicrobial Resistance 2021-2025 (iNAP2) https://www.gov.ie/en/publication/d72f1-joint-action-on-antimicrobial-resistance/

The additional costs of infections caused by antimicrobial resistant organisms include:

- The need for more expensive and broader spectrum antimicrobial agents to treat the infections
- The need to isolate people colonised with resistant organisms in order to minimise cross transmission
- The need for additional requirements such as PPE.

HIQA have published a report on the economic burden of antimicrobial resistance in Ireland. https://www.hiqa.ie/reports-and-publications/health-technology-assessment/economic-burden-antimicrobial-resistance.

The role of IPC

IPC practices are recognised internationally as a key part of an effective response to antimicrobial resistance. Preventing infection reduces the need for antimicrobials and the opportunity for microorganisms to develop resistance. Vaccination can also reduce antimicrobial resistance through preventing infectious diseases and reducing the prevalence of primary viral infections which are often inappropriately treated with antimicrobials.

Antimicrobial use in Ireland

Ireland's use of antimicrobials is higher than in many other European Union member states. Data is available from a number of prevalence studies carried out in acute hospital and in long-term care facilities and from surveillance of consumption in hospital and community. About 1 in 3 patients in acute hospitals are on antimicrobial treatment at any one time. Data on antimicrobial consumption in acute hospitals shows substantial variation in consumption. There is also significant concern regarding use of antimicrobial agents in residential care facilities for older people and in the community as reflected in the 2016 HALT study and in a report of the findings of the Extended Point Prevalence Survey of Antimicrobial Use in HSE Older Persons Residential Care Services October 2020 to August 2021. https://www.hse.ie/eng/services/list/2/gp/antibiotic-prescribing/prescribing-ltcf/national-report-extended-pps-of-antimicrobial-use-in-hse-rcfs-for-older-persons-nov-2021.pdf

3.10.2 Antimicrobial stewardship programmes

What is antimicrobial stewardship?

Antimicrobial stewardship is a suite of coordinated strategies which together aim to promote the appropriate use of antimicrobial agents to maximise their benefit whilst causing the least harm. Antimicrobial stewardship programmes should be implemented across the entire spectrum of healthcare facilities including in community and residential care and should be based on current guidelines.

Antimicrobial stewardship programmes in hospital and acute settings

Successful antimicrobial stewardship programmes have been associated with reduced facility antimicrobial resistance rates as well as reduced morbidity, mortality and associated costs. Some hospitals have also demonstrated significant cost savings through a reduction in drug costs. Antimicrobial stewardship programmes require a multidisciplinary approach which utilise the expertise and resources of infectious diseases physicians, clinical microbiologist, antimicrobial pharmacists, surveillance scientists and nurses. Antimicrobial stewardship programmes should be tailored depending on the organisational context and factors such as size of the facility, staffing and resourcing.

The literature demonstrates that the success of antimicrobial stewardship programmes depends on the support of the service management, the allocation of adequate resources and the cooperation and engagement of prescribers (Cruickshank and Duguid 2011).

The density of antimicrobial use within specialist units such as intensive care units, haematology and oncology units and solid organ transplant units is several-fold higher than in other hospital settings. This increased use is associated with high rates of antimicrobial resistance; therefore, these areas should be a particular focus for surveillance and intervention.

Key requirements of a healthcare facility antimicrobial stewardship programme

For hospitals:

- Implement appropriate clinical guidelines that comply with national guidance where this exists and that take into account local microbiology and antimicrobial resistance patterns
- Develop review and maintain antimicrobial prescribing policies. They should include formulary restriction and approval systems that cover restriction of broad-spectrum antibiotics to those patients where use is clinically justified
- Review individual antimicrobial prescribing with intervention and direct feedback to the prescriber
- Monitor antimicrobial prescribing and report on antimicrobial use and outcomes
- Ensure selective reporting of susceptibility testing results that is consistent with antimicrobial treatment guidelines by the clinical microbiology laboratory
- Ensure on going education and training for health professionals and people who use healthcare services about antimicrobial stewardship, antimicrobial resistance and safe and appropriate antimicrobial use
- Use information technology such as electronic prescribing with clinical decision support for online approval systems
- Use point of care interventions including streamlining or de-escalation of therapy, dose optimization, parenteral to oral conversation
- Annually published antimicrobial usage and antimicrobial susceptibility data.

Antimicrobial stewardship in other healthcare settings

There is a strong need to implement antimicrobial stewardship programmes in other healthcare settings particularly in long-term residential care facilities where the infection risk for older people is high. There is increasing concern about the widespread use of antimicrobial agents in these settings (HALT study). Many prescriptions may be unnecessary or inappropriate. Guidance on antimicrobial prescribing in the community is available on www.antibioticprescribing.ie

Whilst there may be barriers to implementing antimicrobial stewardship programmes in long-term residential care facilities including resourcing issues and limited laboratory data, antimicrobial stewardship activities that are tailored to this setting can be very effective.

Some strategies which may be feasible to implement in long-term residential care facilities can include:

- Educating healthcare staff in appropriate antimicrobial prescribing and antimicrobial resistance and providing feedback on their prescribing practices
- Implementing facility wide tracking and reporting on antimicrobial use and resistance
- Designating staff members such as the medical director or director of nursing, to be accountable for promoting and overseeing antimicrobial stewardship activities
- Implementing policies that support optimal antimicrobial use.

3.10.3 Antimicrobial stewardship surveillance methods

Healthcare facilities

Continuous surveillance of the appropriateness of antimicrobial prescribing should be the ultimate aim of any stewardship programme. There are two main methods of antimicrobial consumption, collection, patient level surveillance and population surveillance:

- Patient level surveillance - involves collecting data about the dose, dosage interval, indication, antimicrobial choice and duration of therapy for individual patients usually collected as a point prevalence survey. This approach can be used to measure the appropriateness of the use of antimicrobial agents. Such information is usually only available through reviews of patient records although electronic prescribing and recording of drug administration make patient level surveillance more practical where this is available
- Population surveillance - involves aggregating antimicrobial use data mostly supplied through pharmacy reports and summarised at the level of a hospital or unit. Currently this type of surveillance is used in Ireland for ongoing and systematic monitoring of antimicrobial use and is supported by the HPSC. Another data collection method is to use pharmacy purchase data.

Participation in national data collection programmes as operated by the Health Protection Surveillance Centre allows healthcare facilities to monitor antimicrobial use against similar facilities and and to access auditing tools.

Community

Measurement of community antimicrobial use in Ireland is currently based on data of antimicrobials supplied to community pharmacies collated by the Health Protection Surveillance Centre. The records of the HSE Primary Care Reimbursement Service (PCRS) also provides a very valuable source of detailed prescription data on antimicrobials dispensed by community pharmacies for patients covered by the GMS scheme and is now used to provide regular feedback to GPs.

3.11 Influence of facility design on healthcare associated infection

Summary

The design of a healthcare facility can influence the transmission of healthcare associated infection by air, water and contact with the physical environment. Whilst there is very little high-quality evidence relevant to the effects of specific design features on HCAI outcomes, data from case reports in published literature relating to outbreaks shows that the design of buildings can have an impact on rates of healthcare associated infection. IPC requirements need to be taken into account during the planning, design and construction of all healthcare facilities. The Health Building Notes 00-009: Infection control in the built environment (https://www.england.nhs.uk/publication/infection-control-in-the-built-environment-hbn-00-09/) , 04-02 Critical care units planning and design (https://www.england.nhs.uk/publication/critical-care-units-planning-and-design-hbn-04-02/) and Infection Control Guiding Principles for Buildings Acute Hospitals and Community-Healthcare Settings (https://www.hse.ie/eng/about/who/healthwellbeing/our-priority-programmes/hcai/resources/general/infection-control-guiding-principles-for-buildings-acute-hospitals-and-community-healthcare-settings.pdf) are valuable references.

Services operating in existing facilities that do not meet with current IPC requirements should consider how they can adapt their facilities and services in a practical way to meet as many of the required features as possible.

Key design features that minimised the transmission of infection include:

- Surface finishes that are easy to maintain and clean (floors, walls, benches, fixtures and fittings)
- Adequate space, toilet and bathing facilities
- Adequate facilities for safe handling and disposal of body fluids and excreta
- Adequate storage space
- Ventilation, air conditioning, cooling towers and water systems that meet acceptable standards for the facility they are to service
- The ability to isolate patients:
    - in a single room with ensuite facilities (infectious people)
    - in a room with appropriately controlled ventilation (to prevent transmission of airborne pathogens)
    - separation of patients in waiting rooms with separation of infectious patients
- Rooms with appropriately controlled ventilation for immunocompromised patients
- Appropriate workplace design:
    - separation of procedural and cleaning areas.
    - ready access to hand hygiene facilities.
    - adequate storage for all patients care items.
    - easily accessible storage for personal protective equipment.
    - adequate facilities for waste management and linen handling
- involvement in demolition, construction and renovation projects of a multidisciplinary team that includes IPC staff to coordinate preventive measures.

3.11.1 Mechanisms for influencing HCAI through environmental design

Infection rates are likely to be lower when there is adequate physical separation of patients, adequate space per patient and appropriate provision of single person rooms (for isolation where appropriate), very good air and water quality and good drainage services.

Facilities Design

Recommendation 21:
When determining the number and type of single rooms in a health care facility, project planning teams should consider

- trends in disease in the general population and the particular population served.
- demographic trends in the population served.
- specialties of the health care facility.
- projected changes in future clinical activities.

Quality/level of evidence: weak evidence
+ Strength of recommendation: strong recommendation

Practical information

It has been recommended, that all new acute hospital buildings should comprise only of single-patient rooms. A systematic review of evidence performed to support development of this guidance indicates that there is not sufficient evidence to support a recommendation for the exclusive use of single-patient rooms in acute hospitals on infection prevention and control grounds. There are many considerations other that IPC that are important in relation to preference for single rooms. These may include patient preference, noise reduction, privacy and ease of patient flow. These factors while clearly important in design are not considered in this guideline. However, if there is clear rationale for provision of a limited number of two-person rooms in a healthcare facility there is not a sufficient evidence base to exclude this option on infection prevention and control grounds. If two person rooms are included in new builds to meet a specific need there should be a dedicated toilet and shower for each person within the two-person room. Rooms for more than two people are not recommended.

Reducing transmission through the air

Reservoirs for airborne pathogens include (Lankford *et al*. 2006):

- Dust for example spores of *Aspergillus spp*.
- Aerosols for example of *M. tuberculosis*, chickenpox or measles virus.

Approaches to manage transmission through the air

Approaches to reducing airborne transmission include:

- Optimising natural ventilation
- Installation of effective air filtration where required
- Specifying appropriate ventilation systems and air change rates
- Employing monitoring and control measures during construction or renovation
- Using single room instead of multi bedrooms
- The use of anterooms.

Specific examples

Gastrointestinal endoscopy should be organised and planned carefully to ensure endoscopes are not re-contaminated or damaged. Endoscopy suites should have good ventilation to minimised staff inhalation of biological aerosols.

Filtration

An effective way to prevent infections is to control the source of pathogens. Heating, ventilation and air conditioning systems can be used to control the concentration of airborne particulates in high risk areas, to minimise the risk of infection. The level of control should be proportional to the risk.

In acute healthcare settings a commonly used approach to filtration is the high efficiency particulate air (HEPA) filter. There is evidence that there is a lower incidence of infection when immunocompromised and other highly vulnerable patients are housed in HEPA filtered isolation rooms. HEPA filters must comply with relevant standards (Hahn *et al*. 2002).

Stand-alone air cleaning devices have been demonstrated to reduce the level of microorganisms in the air in healthcare environments (Conway-Morris *et al*. 2021). They have not been demonstrated to reduce the incidence of infection in healthcare settings. They may be considered for use in some settings where ventilation is inadequate.

Ventilation systems and air flow control

Optimal ventilation rates, air flow patterns and humidity can help to minimises the spread of infection.

The ventilation rate is a measure used to control indoor air quality and in healthcare facilities is usually expressed as room air changes per hour (ACH). The peak efficiency for particle removal in the airspace often occurs between 12 ACH and 15 ACH. A study of 17 Canadian hospitals found that the risk of healthcare workers acquiring tuberculosis was strongly linked with exposure to infected patients in rooms with low ACH rates such as waiting areas (Menzies *et al.* 2000). Air flow direction is also important:

- Negative pressure room or neutral pressure room with a positive pressure ventilated lobby is preferred for rooms housing people with airborne infections to prevent the dispersion on of pathogen-laden aerosols (examples include measles and chicken pox virus and *M. tuberculosis*). A review of 40 studies concluded that there was strong evidence to support and recommend the use of negatively pressurised isolation rooms (Li *et al.* 2007)
- Positive or neutral pressure is desirable in the care of some immunocompromised people (for example some surgical patients, some people with underlying chronic lung disease or requiring haemodialysis, people who are profoundly neutropenic), to safeguard them from airborne pathogens and environmental spores entering from adjacent spaces.

Maintenance systems

Ventilation and air flow control systems need to be maintained regularly by suitably qualified staff according to an agreed maintenance plan and accurately documented in a maintenance record.

Maintaining air quality during construction or renovation

Effective control and prevention measures are necessary during construction and renovation within a healthcare facility because such activities have frequently been implicated in outbreaks of airborne infection, notably with *Aspergillus spp*. The key to preventing such infection is to minimise the dust generated during the construction activity and to prevent dust infiltration into patient care areas near the construction. Examples of such measures include installing barriers between patient care areas and construction or renovation areas, generating negative air pressure for construction or renovation areas relative to patient care areas, using portable HEPA filters and sealing patient windows.

For more information refer to the national guidelines for control of risk of aspergillosis (HPSC 2018).

Reducing infection spread through the physical environment

The prevention of infections spread by contact is of paramount importance in healthcare settings. Contact contamination is generally recognised as the principle transmission route of healthcare acquired infections including pathogens such as *C. difficile*, CPE, MRSA and VRE, which survive well on environmental surfaces and other reservoirs.

Environmental routes of contact spread infections include direct person-to-person contact and indirect contact transmission via environmental surfaces.

Reducing surface contamination through hand hygiene compliance

Healthcare workers hands play a key role in both direct and indirect transmission. Given the importance of maximising hand hygiene compliance it is absolutely essential that all areas of the facility are designed to facilitate compliance with hand hygiene requirements. Clinical hand wash basins should conform to HBN 00-10 part C Sanitary Assemblies or equivalent standards.

Accessibility

Conveniently located alcohol-based product dispensers, sinks and basins can facilitate healthcare worker compliance with hand hygiene requirements.

Hand hygiene compliance can be increased by providing a greater number of alcohol-based product dispensers particularly if they are placed in appropriate locations (where clinical care is provided, for example at the bedside, or were indirect care tasks are performed). Other aspects of design that may increase compliance include automated dispensers of hand hygiene products, electronic monitoring and computerised voice prompts.

Alcohol based hand rub dispensers need to be suitably located out of the reach of children or in supervised locations. Placement of dispensers must be carefully considered in facilities where there is an increased risk of ingestion of the alcohol-containing product.

Hand wash stations for healthcare workers should be dedicated to the purpose and should be of an appropriate design. An assessment should be made of the need for a hand wash station at a location in advance of a decision to install this station. Unused or inappropriately used hand wash stations confer no benefit and may represent a reservoir of infectious microorganisms.

As well as being readily accessible in all patient care areas, hand hygiene facilities should be placed in all areas where careful attention to hygiene is essential such as kitchens, laundries, pharmacies, laboratories and staff amenities (for example bathrooms, toilets and changing rooms). This also includes specific settings such as treatment or procedure rooms.

Personal protective equipment

It is also essential that all areas of the facility are designed to facilitate appropriate use of PPE. All rooms in an acute hospital and comparable settings and in community based congregated residential care settings should have ready access to areas for storage of gowns, aprons, gloves, masks and protective eyewear.

Separation of procedural and cleaning areas

The instrument reprocessing area also requires sufficient physical space to allow unidirectional flow and separation of soiled instruments from those that have been cleaned, disinfected or sterilised. The area were instruments are cleaned should be physically separated from the areas were cleaned instruments are packaged and sterilised.

Control of surface contamination through material selection

Ease of cleaning should be a key consideration in selecting appropriate floor and furniture covering. Several design related factors should be considered to minimise the risk of infection stemming from contaminated surfaces:

- The nature and type of contamination that is likely to occur
- If a suitable cleaning method for that surface can be implemented.

In general surfaces such as benchtops, need to be made of impervious material that is smooth and easy to clean.

Healthcare flooring

A wide range of floor covering materials are used in healthcare settings these include but are not limited to ceramic tiling, linoleum, rubber textile floor covering and vinyl.

When selecting floor covering for a healthcare setting consideration needs to be given to the following:

- Who is at risk of acquiring infection among the population served?
- What is the risk of exposure to infectious microorganisms?
- What is the nature of the possible infectious microorganisms?
- How can the microorganism be transmitted?
- Are there important considerations other than infection prevention and control (noise reduction, comfort)?

Floor covering should be clean and easy to repair. In areas subject to frequent wet cleaning, floor materials must be able to tolerate the use of disinfectants. In areas where sterilising services take place flooring should be non-slip and have smooth surfaces for cleaning.

Carpeting should generally not be used in clinical areas. Exceptions may be appropriate in certain specific settings for example family rooms within clinical space or end of life settings if noise management and comfort are the priority. If carpet is used there should be a comprehensive maintenance and replacement programme in place. Manufacturer’s recommendations need to be considered in the care and maintenance of floor covering.

Furnishings

It has been identified that fabric covered furniture can be a source of VRE and other MDRO in hospitals. Therefore, the use of easily cleanable, non-porous material is preferable (Noskin *et al*. 2000).

A study comparing the performance of a variety of furniture upholstery types with respect to VRE and *Pseudomonas aeruginosa* (PSAE) contamination indicated that performance was similar across different furniture coverings in terms of reductions in VRE and *P. aeruginosa* after cleaning. However, while there were no differences in the ability of different upholstery types to harbour *P. aeruginosa*, VRE survived less well or for shorter periods on vinyl (Lankford *et al*. 2006).

Requirements for finishes of items may vary depending upon the location used for example fabric upholstery on chairs should be avoided in clinical areas unless there are very specific requirements.

Blinds and curtains should be easy to clean and discourage the accumulation of dust.

Reducing water borne transmission

Compared with air borne and contact transmission of infection, fewer studies describe direct water borne transmission in relation to healthcare facility design factors. The literature nonetheless is clear that water borne infections can be a serious threat to patient safety. Many bacterial and some protozoan microorganisms can proliferate or remain viable in moist environments or aqueous solutions in healthcare settings such as sinks, shower trays, hydrotherapy and spa pools. Inadequate drainage systems that lead to pooling of water in shower trays and sinks may serve as reservoirs of MDROs.

The potential for water sources and water drainage systems to contribute to healthcare associated infection is an area of growing interest and concern (Kanamori *et al*. 2016). In addition to *Legionella pneumophila*, water sources are recognised as important sources of infection with mycobacteria other than tuberculosis (MOTT) also referred to as non-tuberculous mycobacteria (NTM) and a variety of Gram-negative bacteria including *Pseudomonas spp*. and *Enterobacterales*.

The Health Protection Surveillance Centre have published National Guidelines for the Control of Legionellosis in Ireland. https://www.hpsc.ie/a-z/respiratory/legionellosis/guidance/nationalguidelinesforthecontroloflegionellosisinireland/File,3936,en.pdf.

In addition, there is a useful review of healthcare associated infection with water-borne MOTT by Li and colleagues (Li *et al*. 2016). Contamination of water reservoirs in heater-cooler devices was implicated in the global outbreak of with *Mycobacterium chimaera* infection associated with cardiovascular surgery. This was linked to *M. chimaera* contamination of water reservoirs used during certain types of cardiac surgery (Schreiber *et al*. 2021). There are numerous reports of healthcare associated infection associated with water-borne *P. aeruginosa* (Loveday *et al*. 2014). Water drainage points are also a key focus of concern. Experience in multiple hospitals in Ireland points to a strong link between acquisition of carbapenemase-producing Enterobacterales (CPE) in hospitals and persistence of CPE in hospital drains. This phenomenon is widely recognised internationally and has led to a recent studies that indicate that removal of sinks and introduction of water-free patient care was associated with reduction in acquisition of Gram-negative bacilli in the Intensive Care Unit setting (Hopman *et al*. 2017).

Contaminated water systems in healthcare settings such as inadequately treated wastewater, may lead to the pollution of municipal water systems, enter surface or groundwater and affect people in the community.

Sources of water contamination

The following categories of environmental routes or sources of water borne transmission are significant (Decker and Palmore 2013):

- Contact with fittings attached to water drains (for example sinks and showers)
- Direct contact such as hydrotherapy
- ingestion of water such as drinking water
- Inhalation of aerosols dispersed from contaminated water sources such as improperly cleaned or maintained cooling towers, respiratory therapy equipment and room air humidifiers
- Aspiration of contaminated water
- Contaminated dental unit waterlines.

Approaches to reducing water borne transmission

Water supply system

The water supply system should be designed and maintained with proper temperature and adequate pressure. Stagnation and back flow should be minimised and dead-end pipes should be avoided.

To prevent the growth of *Legionella spp*. and other bacteria, the US CDC guideline recommends that healthcare facilities maintain cold water at a temperature below 20 degrees Celsius, store hot water above 60 degrees Celsius and circulate hot water with a minimum return temperature of 51 degrees Celsius.

When the recommended standards cannot be achieved because of inadequate facilities that are unable to be renovated, other measures such as chlorine treatment, copper silver ionization, ultraviolet lights or filtration at point of use are recommended to ensure water quality and prevent infection.

Point of use fixtures

Water fixtures such as sinks, faucets, aerators, showers and toilets have been identified as reservoirs for pathogenic microorganisms including CPE. Such fixtures can produce liquid particles that can disperse microbes from the drain. They have wet surfaces on which moulds and other microorganisms can proliferate. Evidence to define the contribution of these fixtures to HCAIs is growing (Amoureux 2017; Cholley *et al*. 2008; De Geyter *et al*. 2017; Walker 2020). There is growing experience that these fixtures can be important reservoirs of MDROs in particular MDRGNs and that they can contribute to dissemination of such MDROs within healthcare facilities. Therefore, regular cleaning, disinfection and preventative maintenance programmes should be provided. Microbiological monitoring of such fixtures is appropriate in settings where there is concern regarding ongoing dissemination of MDRGNs. Some healthcare services have removed such sources of contamination from critical care areas.

Dental Unit Waterlines

There are specific issues related to dental unit waterlines which may be contaminated by oral and environmental microorganisms. Microbial biofilm in waterlines is a potential source of cross infection. This document does not provide detailed guidance on care of dental waterlines however the HSE provides information on dental unit waterlines at the following link: https://www.hse.ie/eng/about/who/healthwellbeing/our-priority-programmes/hcai/resources/dental/sop-13-care-of-dental-unit-waterlines-duwl-and-water-quality.pdf and NHS Scotland provides a useful literature review and recommendations on management of dental unit water lines at https://www.nss.nhs.scot/media/2221/1-duwl-lr-v20.pdf

Ice machines & chilled water dispensers

Ice storage receptacles, ice making machines and water dispensers should be properly maintained and regularly cleaned. Ice and ice making machines may be contaminated through improper handling of ice by patients or staff. Ice for human consumption should be differentiated from ice for first aid or storage of clinical specimens. Pharmaceuticals or medical solutions should not be stored on ice intended for consumption.

Machines that dispense ice are preferable to those that require ice to be removed from bins or chests with a scoop. Ice machines and their dispensers should be flushed and cleaned if they have not been disconnected before anticipated lengthy water disruptions.

All ice storage chests should be cleaned, disinfectant and maintained on a regular basis as per manufacturer's instructions.

Suggested steps to avoid improper handling of ice include:

- Avoiding handling ice directly by hand
- Washing hands before obtaining ice
- Using a smooth surface ice scoop to dispense ice
- Keeping the ice scoop on a chain short enough that the scoop cannot touch the floor or keeping the scoop on a clean hard surface when not in use
- Avoid storing the ice scoop in the ice bin.

There is some experience that water from dispensers containing filters may become contaminated with *Legionella pneumophila* and other microorganisms from biofilm that forms within the unit. Water dispensing units in clinical areas, particularly those for the most vulnerable patients, should be regularly maintained and periodic monitoring should be considered.

Water features

Despite the absence of empirical documentation linking properly maintained fountains to healthcare acquired infections fountains should not be installed in a closed spaces in healthcare facilities, as they serve no necessary purpose.

3.12 Summary budget impact analysis

A BIA (budget-impact analysis) is a required step in the development of National Clinical Effectiveness Committee (NCEC) National Clinical Guidelines in Ireland. The purpose of the BIA was to quantify the resource implications of ensuring the ongoing implementation of, and adherence to, the recommendations within the guideline.

According to the WHO, 'IPC is a practical, evidence-based approach preventing patients and health workers from being harmed by avoidable infection'. https://www.who.int/teams/integrated-health-services/infection-prevention-control

Practicing hand hygiene is one of many examples of effective IPC measures that can prevent infections. Studies have demonstrated that IPC measures such as cleaning hands with an alcohol-based hand rub can help prevent healthcare associated infections (HCAIs). HCAIs are a significant problem for patient safety; they can lead to prolonged hospital stay, long-term disability, additional financial burden, and excess deaths. Hospital acquired infections (HAIs) are a subset of HCAIs.

A point prevalence survey in Ireland, performed in 60 hospitals (46 acute public and 14 private hospitals) in May 2017, found that the overall HAI prevalence amongst inpatients was 6.1%. HCAIs occur in all types of healthcare settings, including but not limited to, inpatient, outpatient, acute care, primary care and long term care facility (LTCF) settings. The first national prevalence study of HCAI in Irish long-term care facilities was carried out in 2010. This study surveyed 4,170 residents in 69 Irish LTCFs in June 2010. Using a McGeer definition of a HCAI, which uses a complex set of criteria to diagnose a HCAI in the LTCF setting, the study found the prevalence of HCAIs among residents to be 2.4% Of note requirement for antimicrobial use to treat HCAI also contributes to the problem of antimicrobial resistance. Adherence to effective IPC measures and recommendations within the healthcare system can help to reduce the incidence of HCAIs and antimicrobial resistance which in turn results in a safer environment for staff and patients.

The BIA accompanying this Guideline aims to quantify the additional resource implications, and savings, of implementing all the guideline recommendations. The BIA was conducted in accordance with HIQA guidelines for budget impact analysis and economic evaluation in Ireland using Microsoft Excel 2013.

The key points are summarised as follows:

- Development and delivery of eLearning modules relevant to all recommendations are expected to cost €360,975 over years 1 to 3 (range from €279,027 to €524,871). The total cost associated with webinars throughout the five-year time frame of the BIA is estimated at €601,625 (range from €465,045 to €874,785)
- Development, preparation and delivery of webinars is relevant to all recommendations and are expected to incur an annual cost of €24,281 (range from €9,429 to €38,898). It is expected that similar costs will be incurred in each year of the BIA. It is estimated that webinar costs accumulated after three years will be €72,843 (range €28,287 to €116,694). The total cost associated with webinars throughout the five-year time frame of the BIA is estimated at €121,405 (range €47,145 to €194,490).

The uncertainly around the costs incurred in each year of the BIA reflects the uncertainty in the number of webinars that will be developed and delivered annually.

Recommendation 16; includes a requirement for fit testing of healthcare workers who are required to use respirator masks. Costs associated with fit testing depend on the day of the week on which testing is performed and the rate at which testing is carried out. The cost per healthcare workers is in the range €38.46 to €64.10. Respirator mask fit testing costs will be incurred annually. However given the variability in annual fit testing requirements, it is it not possible to estimate annual fit testing costs.

Recommendation 21; relates to the design of patient accommodation and the requirement for single patient rooms. In 2008, *Infection Prevention and Control Building Guidelines for Acute Hospitals in Ireland* were published by the HPSC stating that newly built acute hospital inpatient accommodation should comprise 100% SPRs and newly built non-acute hospital inpatient accommodation should comprise a minimum of 50% SPRs. Guidance published by HIQA in 2017 states there should be adequate SPRs in acute healthcare settings with no percentage stated. A systematic review was conducted by HRB-CICER on the clinical and cost-effectiveness of single patient rooms compared with multibed rooms in reducing the incidence of healthcare-associated infection. HRB-CICER found that overall, due to the lack of high quality evidence on the impact of SPR design on patient and healthcare outcomes, it is not possible to conclude whether SPRs are effective in reducing HCAI rates or reducing the incidence of colonisation rates by AMROs compared to MBR accommodation. There was also insufficient evidence to suggest that the use of SPRs leads to an increase in adverse events, including physical and or psychological harm. In addition, no cost-effectiveness studies were identified. The two costing studies that were included in the systematic review did not link costs with benefits.

Recommendation 21 of this guideline states:

When determining the number and type of single rooms in a health care facility, project planning teams should consider:

- Trends in disease in the general population and the particular population served
- Demographic trends in the population served
- Specialties of the health care facility
- Projected changes in future clinical activities.

Given that the HPSC guidance states that newly built acute hospital inpatient accommodation should comprise 100% SPRs, the BIA consider the potential cost savings associated with changes to this practice potentially leading to the following 3 scenarios:

- In scenario 1, (base-case), that is, 100% SPRs, there are 12 SPRs on a ward. Each single patient room has its own ensuite
- In scenario 2, there are 10 SPRs, each with their own ensuite. There is also one MBR with two beds in one room. In the MBR each bed has access to its own ensuite
- In scenario 3, there are eight SPRs, each with its own ensuite. There are also two MBRs. In each MBR, there are two beds. Every bed in a MBR has access to its own ensuite.

Scenario 1 would incur the most costs with potential cost savings associated with scenario 2 and scenario 3. Scenario 1 has been identified as the most expensive option, with scenario 2 achieving a potential saving of €2,000 to €3,000 with scenario 3 achieving a further reduction in cost.

The total potential cost-savings per year cannot be estimated due to the uncertainty with regard to the volume of new beds which will be added to the bed stock each year over the time frame of the BIA. In any case, potential cost-savings are not likely to be material in the context of overall construction costs.

The overall budget impact of the Infection Prevention and Control National Clinical Guideline was estimated at €723,030 (€512,190 to €1,069,275) over five years, with €601,625 (€465,045 to €874,785) attributed to e-learning modules and €121,405 (€47,146 to €194,490) attributed to webinars. Over a three year period, the overall budget impact was estimated at €433,818 (€307,314 to €641,565). Of this, €360,975 (€279,027 to €524,871) was attributed to e-learning modules and €72,843 (€28,287 to €116,694) attributed to webinars.

Additionally, fit testing costs will be incurred annually. It is difficult to estimate the annual frequency of fit testing among HCWs as the number of people required to be fit tested annually is highly variable.

There are potential cost savings associated with having fewer than 100% SPRs in newly built acute hospital inpatient accommodation (recommendation 21). It appears that the cost-savings accrued will not be of material significance in the context of the overall construction costs.

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