AUSTRALIAN COMMISSION
ON SAFETY AND QUALITY IN HEALTH CARE

Infection prevention and control workbook

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Introduction

The Australian Commission on Safety and Quality in Health Care (the Commission) leads and coordinates national improvements in the safety and quality of health care. Infection prevention and control (IPC) is a key area in which the Commission works to improve care standards and patient outcomes by supporting implementation of evidence-based health care.

The Commission's online Infection Prevention and Control – Advanced Education Modules and this workbook have been developed to support healthcare workers to understand the principles of IPC and apply these principles to meet the actions of the National Safety and Quality Health Service (NSQHS) Standards, particularly the Preventing and Controlling Infections Standard, and the recommendations of the Australian Guidelines for the Prevention and Control of Infection in Healthcare.

The online Infection Prevention and Control – Advanced Education Modules can be undertaken individually, or as a suite, dependent on need.

Learners are encouraged to use this workbook alongside the online modules, as it provides additional material relating to the content of each module.

This workbook should not be used as a substitute for national, state, territory or local guidelines and policies.

This workbook is being progressively updated to complement the content of the Infection Prevention and Control – Advanced Education Modules. This version of the workbook contains updated content for:

- Module 1. Principles of infection prevention and control
- Module 2. Risk management for infectious agents and diseases
- Module 3. Basics of microbiology and multidrug-resistant organisms
- Module 4. Clean and safe healthcare environment
- Module 5. Basics of surveillance and quality improvement
- Module 6. Preventing and managing occupational exposures
- Module 7. Epidemiology and outbreak prevention and management
- Module 8. Health workforce screening and immunisation for vaccine- preventable diseases
- Module 9. Introduction to reprocessing reusable medical devices.

Content for Module 10. Renovation, repairs and redevelopment risk management will be updated in 2024 in line with the updated Australasian Health Facility Guidelines.

Module 1. Principles of infection prevention and control

Contents

Overview of Module 1

Module 1 contains four parts:

Part 1: Principles of infection prevention and control

Part 2: Standard precautions

Part 3: Transmission-based precautions

Part 4: Other strategies for infection prevention and control

The module provides an understanding of the basic principles of infection prevention and control, as well as a framework for further study. After completing this module, you will understand:

- how healthcare-associated infections occur
- the difference between colonisation and infection
- standard precautions and transmission-based precautions
- when and how transmission-based precautions should be implemented
- the elements of invasive device use and management
- the elements of antimicrobial stewardship.

Part 1: Principles of infection prevention and control

Part 1 covers the following topics:

- **Introduction to infection prevention and control**
- **Colonisation and infection**
- **The Chain of Infection**
- **Infection prevention and control strategies**

Introduction to infection prevention and control

Every person who works at or visits a healthcare facility, including administrators, staff, patients, and carers, has a role and responsibility in preventing and controlling infections. A healthcare-associated infection (HAI) is a common complication affecting patients in hospitals that can lead to additional complications for patients and their families, as well as longer hospital stays. HAIs can occur in various settings, from hospitals to community-based health services, putting both patients and health workforce members are at risk of acquiring them.

The National Safety and Quality Health Service (NSQHS) Preventing and Controlling Infections Standard[1] requires all health service organisations to have systems and strategies in place to:

- prevent infections
- manage infections effectively when they occur
- limit the development of antimicrobial resistance (AMR) through prudent use of antimicrobials as part of effective antimicrobial stewardship (AMS)
- promote appropriate and sustainable use of IPC resources.

Colonisation and infection

Microorganisms (infectious agents) are the main causes of infections and exist naturally in the environment. They do not always cause infection, and some microorganisms, like certain types of bacteria, are actually beneficial and are part of the body's normal flora, providing protection and other health benefits. However, there are various types of microorganisms that can lead to colonisation or infection, depending on the susceptibility of the host. These include parasites, prions, bacteria, viruses, fungi, and protozoa. Table 1.1 defines common terms used when discussing infection.

Table 1.1 Common terms related to infection

Term	Description
Colonisation	The sustained presence of replicating infectious agents on, or in, the body but without any evidence of infection or disease. Colonisation may progress to infection and is a potential source of transmission to others.
Infection	The invasion by, and reproduction of, pathogenic (disease-causing) organisms inside the body.
Healthcare-associated infection	Also known as 'HAI' or 'nosocomial' infection'. HAIs are infections that are acquired as a direct or indirect result of health care. HAIs may manifest after people leave a health service organisation.

[1] https://www.safetyandquality.gov.au/standards/nsqhs-standards/preventing-and-controlling-infections-standard

The Chain of Infection

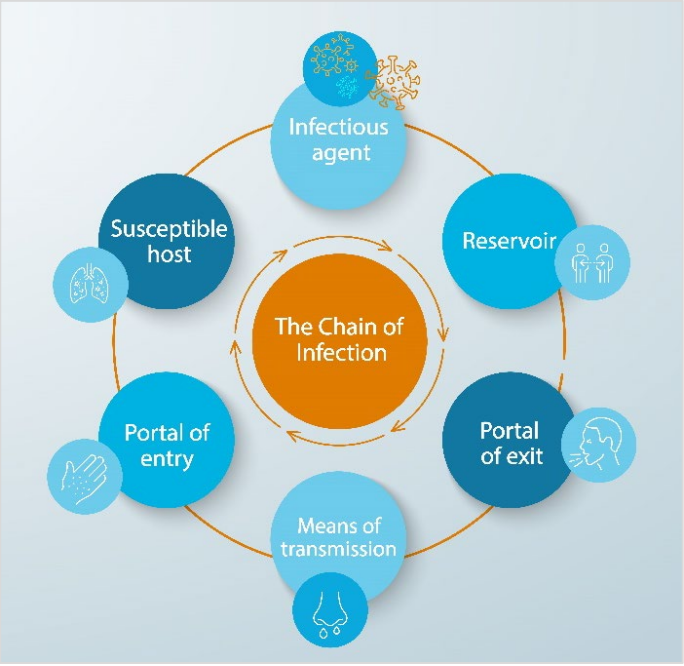
The transmission of infectious agents occurs via a series of interlinked events called the ‘Chain of Infection’.

For transmission of an infectious agent to occur, all the following elements are required:

- infectious agent (pathogen)
- reservoir
- portal of exit
- means of transmission
- portal of entry
- susceptible host.

The interactions that lead to the transmission of infection are illustrated in Figure 1.1.

Figure 1.1 The Chain of Infection



Source: The Australian Commission on Safety and Quality in Health Care

The 6 elements of the Chain of Infection are described in Table 1.2.

Table 1.2. The 6 elements of the Chain of Infection

Element	Description
Infectious agent (pathogen)	Microorganisms that may be transmitted during health care, such as bacteria, viruses, fungi, and protozoa.
Reservoir	Habitats where microorganisms survive. In a health service organisation, a reservoir may include individuals, contaminated water or food, or a fomite (an inanimate object that can carry microorganisms on its surface). In a hospital setting, fomites are important sources of infection. Fomites include items such as: • medical equipment and instruments • clothing, uniforms • soiled linen and dressings • keys, pens, and other utensils.
Portal of exit	The path by which an infectious agent leaves its host. The portal of exit usually corresponds to the site where the infectious agent is localised. Examples include: • the mouth and nose – droplets from coughing or sneezing • the anus – diarrhoea • a wound site or injury – blood or pus.
Means of transmission	The way an infectious agent is transmitted from the reservoir to a susceptible host. Transmission can be via contact, droplet, and airborne transmission.
Portal of entry	Refers to the way a pathogen enters a susceptible host. Infectious agents often use the same portal to enter a new host that they used to exit the source host. For example: • the nose by inhalation • the mouth by ingestion • breaks in skin by exposure to blood or body fluids.
Susceptible host	An individual who, due to a range of factors, may become infected after exposure to an infectious agent. Factors affecting the susceptibility of an individual include: • age • comorbidities • previous and recent health care • the presence of invasive medical devices (for example, intravascular cannula, mechanical ventilators) • immune status (influenced by immunosuppressive therapy or disease), previous exposure, pregnancy, age, and vaccination.

Infection prevention and control strategies

IPC aims to prevent the spread of infectious agents in the healthcare setting. There are two types of precautions that should be used to prevent and control infection in health care:

- Standard precautions
- Transmission-based precautions.

Both types will be discussed in detail in Part 2: Standard precautions and Part 3: Transmission-based precautions of this module.

It's critical to understand the means of transmission and how and when to use precautions to prevent and control the spread of infectious agents. Successful infection prevention and control (IPC) requires the use of a range of strategies. It should be an integral part of standard care, rather than an additional measure.

A risk management framework will help to prevent and minimise harm from HAIs. This framework should address both human and system factors associated with transmission, ensuring effective management of infectious agents, whether they are common (like gastrointestinal viruses) or evolving (such as influenza or multidrug-resistant organisms).

Involving patients and their carers is an essential component of IPC. Patients need to be sufficiently informed to participate in reducing the risk of transmission of infectious agents.

For more information on involving patients and their carers, refer to the NSQHS Partnering with Consumers Standard.[2]

➢ The objective of infection prevention and control is to interrupt the Chain of Infection.

[2] https://www.safetyandquality.gov.au/standards/nsqhs-standards/partnering-consumers-standard

Part 2: Standard precautions

Part 2 covers the following topics:

- Introduction to standard precautions
- Hand hygiene
- Personal protective equipment
- Respiratory hygiene and cough etiquette
- Aseptic technique
- Safe sharps management
- Environmental cleaning
- Reprocessing of reusable medical devices
- Waste management
- Handling linen

Introduction to standard precautions

Standard precautions are fundamental healthcare practices designed to prevent and control infections. They should be followed by all healthcare workers, regardless of whether a patient has a suspected or confirmed infection. Standard precautions aim to reduce or prevent the transmission of infectious agents and maintain a clean and safe healthcare environment. They should be applied when handling blood (including dried blood), any bodily fluid (except sweat), non-intact skin, and mucous membranes.

> ➢ Standard precautions are the minimum infection prevention and control practices that must be used at all times, for all patients, in all situations.

Standard precautions include:

- hand hygiene, consistent with the 5 Moments for Hand Hygiene[3]
- the use of appropriate personal protective equipment (PPE)
- the safe use and disposal of sharps
- environmental cleaning[4]
- respiratory hygiene and cough etiquette
- aseptic technique[5]
- reprocessing of reusable medical equipment and instruments
- waste management
- appropriate handling of linen.

The NSQHS Preventing and Controlling Infections Standard[1] Actions 3.06 to 3.09 require health service organisations to implement practices that support standard and transmission-based precautions.

[3] https://www.safetyandquality.gov.au/our-work/infection-prevention-and-control/national-hand-hygiene-initiative-nhhi/what-hand-hygiene/5-moments-hand-hygiene
[4] https://www.safetyandquality.gov.au/our-work/infection-prevention-and-control/environmental-cleaning-and-infection-prevention-and-control-resources
[5] https://www.safetyandquality.gov.au/our-work/infection-prevention-and-control/aseptic-technique

Hand hygiene

Hand hygiene is the single most effective intervention to reduce the risk of HAIs and the spread of infectious diseases. Hand hygiene is a general term referring to any action of hand cleansing, which includes:

- applying an alcohol-based hand rub (ABHR) to the surface of hands (including liquids, gels, and foams)
- washing hands with soap and water.*

*Soap refers to any soap solution including those with antimicrobial or non-antimicrobial properties.

Hand hygiene products

Both soap and ABHR products are necessary for hand hygiene in healthcare settings.

Soap and water should be used when hands are visibly soiled. Wet hands can more readily acquire and spread microorganisms, so the proper drying of hands is an integral part of routine hand hygiene. Single-use paper towels are the most effective way to dry hands and reduce the risk of the transmission of microorganisms.

ABHR containing 60–80% v/v ethanol or equivalent should be used for all routine hand hygiene practices in most healthcare environments.

There are some infectious agents against which ABHRs have limited effectiveness, such as *Clostridioides difficile* (also known as *Clostridium difficile*), norovirus, and other non-enveloped viruses.

When caring for patients who have diarrhoea, use soap and water for hand hygiene after contact with the patient and their immediate environment.

> ➢ Hand hygiene is essential even when gloves have been worn.

The National Hand Hygiene Initiative

The Commission established the National Hand Hygiene Initiative (NHHI) in 2008 as part of a suite of initiatives to prevent and reduce HAIs in Australian healthcare settings. The NHHI uses a multimodal approach to improving hand hygiene. Implementation of the NHHI is led by states, territories, and health service organisations (public and private), and includes:

- promoting the use of ABHR at the point-of-care
- ensuring uniform hand hygiene and IPC education
- monitoring hand hygiene compliance and performance feedback
- using hand hygiene programs that ensure culture change.

NSQHS Preventing and Controlling Infections Standard Action 3.10 (Hand hygiene) requires that health service organisations have a hand hygiene program incorporated into their overarching IPC program. The hand hygiene program needs to:

- be consistent with current NHHI and jurisdictional requirements
- address healthcare workforce noncompliance or inconsistency with benchmarks and the current NHHI
- provide timely reports on the results of, and actions responding to, hand hygiene compliance audits to the workforce, governing body, consumers, and other relevant groups
- use results of audits to improve hand hygiene compliance.

The NHHI website has more information on the 5 Moments for Hand Hygiene hand hygiene product selection, and hand hygiene auditing*

**https://www.safetyandquality.gov.au/our-work/infection-prevention-and-control/national-hand-hygiene-initiative-nhhi/what-hand-hygiene/5-moments-hand-hygiene*

The 5 Moments for Hand Hygiene

The 5 Moments for Hand Hygiene[3] is based on a theoretical model of how infectious agents can be transferred between healthcare workers and patients.

Hand hygiene must be performed at critical points during the provision of health care to prevent the spread of infection to patients and healthcare workers, and to limit contamination of the healthcare environment. Figure 1.2 illustrates the point at which each moment of hand hygiene should occur.

Figure 1.2. The 5 Moments for Hand Hygiene

Source: The Australian Commission on Safety and Quality in Health Care

Table 1.3 provides an overview of the 5 Moments for Hand Hygiene.

Table 1.3. The 5 Moments for Hand Hygiene

Moment	When	Why	To prevent
1. Before touching a patient	On entering the patient zone before touching the patient.	To protect the patient against microorganisms from the hands of the healthcare workers.	Patient colonisation with infectious agents.
2. Before a procedure	Immediately before a procedure. Once hand hygiene has been performed, the patient's environment should not be touched before the procedure.	To protect the patient against microorganisms (including their own) from entering the patient's body during a procedure.	Endogenous and exogenous infections in patients.
3. After a procedure or body fluid exposure risk	Immediately after a procedure or body fluid exposure (hands may be contaminated with body fluid).	To protect the healthcare worker and healthcare environment from becoming contaminated with the patient's microorganisms.	Colonisation/infection in healthcare workers, contamination of the healthcare environment, and transmission of microorganisms from a colonised site to a clean site on the same patient or another patient.
4. After touching a patient	Before you leave the patient zone.	To protect the healthcare worker and healthcare environment from becoming contaminated with the patient's microorganisms.	Colonisation/infection of the healthcare worker and contamination of the healthcare environment.
5. After touching a patient's surroundings	Hand hygiene after touching a patient's surroundings even when the patient has not been touched. Always perform hand hygiene before leaving the patient's room.	To protect the healthcare worker and the healthcare environment from becoming contaminated with the patient's microorganisms.	Colonisation/infection of the healthcare worker and contamination of the healthcare environment.

Enhancing hand hygiene

The effectiveness of hand hygiene is improved when:

- the skin is intact (breaks in the skin should be covered with an occlusive dressing)
- fingernails are natural, short, and unvarnished
- hands and forearms are free of jewellery and clothing (this is known as 'bare below the elbows')
- jewellery is kept to a minimum when caring for patients (for example, plain wedding band), and removed when performing hand hygiene to ensure that all surfaces of the hands are cleaned
- hand hygiene products are available at the point of care and easily accessible; staff are included in decisions about product choice and placement
- staff are provided with education and training on hand hygiene.

Measuring, monitoring, and improving hand hygiene

Improving healthcare worker hand hygiene is an important way to reduce the risk of HAIs. Hand hygiene compliance can be monitored using reliable indicators, such as hand hygiene product placement, product use, patient experience, and rates of HAIs.

Observational audits are the most common way to monitor and assess hand hygiene compliance. Using published guidelines as a standardised hand hygiene assessment tool enables accurate assessment of compliance. Data from hand hygiene monitoring can be used to identify gaps in knowledge or practice, or access issues to hand hygiene products or handwashing facilities.

See the National Hand Hygiene Implementation Guide[6] for More information on measuring, monitoring, and improving hand hygiene.

Personal protective equipment

Personal protective equipment (PPE) refers to barriers used to protect mucous membranes, airways, skin, and clothing from contact with infectious agents. A variety of barriers are available and may be used alone or in combination with each other.

Selection of PPE is based on the type of interaction with a patient, known or possible infectious agents, and likely mean(s) of transmission. PPE should always be available to healthcare workers at the point of care.

- As a **standard precaution**, PPE protects against anticipated blood and body fluid exposure.
- As a **transmission-based precaution**, PPE serves as a physical barrier against the specific means of transmission.

Factors to consider when selecting PPE are:

- probability of exposure to blood and body substances
- type and amount of body substance involved
- probable presence of an infectious agent and the means of transmission.

Types of PPE

PPE items include:

- aprons and gowns
- face and eye protection
- surgical masks
- gloves.

Aprons and gowns

The type of apron or gown required depends on the degree of risk. This is the anticipated degree of contact with infectious material, and the potential for blood and body substances to penetrate through to clothes or skin. Aprons and gowns used in clinical areas should be fluid-impervious.

Table 1.4 describes the recommended use and characteristics of aprons and gowns suitable for standard and transmission-based precautions.

[6] https://www.safetyandquality.gov.au/publications-and-resources/resource-library/national-hand-hygiene-initiative-implementation-guide

Table 1.4. Types of aprons and gowns: recommended use and characteristics

Type	Recommended use	Characteristics
Plastic apron	For general use when there is the possibility of sprays or spills, or exposure to blood or body fluids during low-risk procedures.	• Fluid-impervious • Single-use (one procedure or episode of patient care) • Disposable

Gown	To protect the healthcare worker's exposed body areas and prevent contamination of clothing with blood, body fluids and other potentially infectious material.	• Fluid-impervious
		• Single-use
		• Disposable
		• Choice of sleeve length depends on:
		  ○ procedure being undertaken
		  ○ extent of risk of exposure of the healthcare worker's arms
		  ○ volume of body substances likely to be encountered
		  ○ probable presence of an infectious agent and the means of transmission

Full body gown	For use when: • there is a risk of contact with a patient's broken skin, extensive skin-to-skin contact (for example, lifting a patient with scabies), or a risk of contact with blood and body fluids which are not contained (for example, vomiting) • there is the possibility of extensive splashing of blood and/or body fluids or risk of exposure to large amounts of blood or body fluids (for example, in some operative procedures).	• Fluid-impervious • Single-use • Long-sleeved to protect clothing and exposed upper body areas • Always worn in combination with gloves and other PPE where indicated
Sterile gown	For procedures that require an aseptic field.	• Pre-packaged • May be single-use or reusable

Adapted from the Australian Guidelines for the Prevention and Control of Infection in Healthcare (2019)[7] Section 3.3

Some types of gowns are designed to be re-used. However, these gowns should only be used for one procedure or patient care episode and then laundered or reprocessed according to AS/NZS 4146:2000 – Laundry practice.[8]

Face and eye protection

Protective eyewear reduces the risk of exposure to splashes or sprays of blood and body fluids. Protective eyewear should fit snugly with minimal gaps. While effective as eye protection, goggles and safety glasses do not provide splash or spray protection to other parts of the face. If this is anticipated, a face shield and/or mask should be considered. Contact lenses and personal eyeglasses do not provide adequate eye protection.

[7] https://www.safetyandquality.gov.au/publications-and-resources/resource-library/australian-guidelines-prevention-and-control-infection-healthcare
[8] https://store.standards.org.au/product/as-nzs-4146-2000

Table 1.5 provides examples of the different types of care where protective eyewear and face shields should be used as part of standard precautions.

Table 1.5. Types of care and recommended face and eye protection

Type of care	Examples of use	Face and eye protection required
Routine care	• General examination (for example, medical, physiotherapy, nursing) • Routine observations	Not required unless caring for a patient on droplet precautions (surgical mask) or airborne precautions (N95/P2 particulate filter respirator).
Procedures that generate splashes or sprays	• Dental procedures • Nasopharyngeal aspiration • Emptying wound drainage or catheter bags	• Protective eyewear/ full-length face shield • Surgical mask
Procedures involving the respiratory tract (including the mouth)	• Intubation • Nasopharyngeal suction	• Protective eyewear • Surgical mask

Adapted from the Australian Guidelines for the Prevention and Control of Infection in Healthcare (2019), Section 3.3

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.

When using a surgical mask, the wearer should:

- change masks between patients and when masks become soiled or wet
- never reapply a mask once it has been removed
- do not leave masks dangling around the neck
- avoid touching the front of the mask while wearing it
- perform hand hygiene upon touching or discarding a used mask.

Surgical masks are categorised into three types, based on the level of protection (barrier) provided.

Table 1.6 describes the characteristics and recommended use for each type of mask.

Table 1.6. Surgical mask types and recommended usage

Characteristics*	Level 1 barrier	Level 2 barrier	Level 3 barrier
Application	For general purpose medical procedures where the wearer is not at risk from blood or body fluid splash or spray, or to protect staff and/or the patient from droplet exposure to microorganisms.	For use in emergency departments, dentistry, or changing dressings on wounds where minimal blood droplet exposure may occur.	For all surgical procedures, major trauma first aid, or in any area where the healthcare worker is at risk of blood or body fluid splash or spray.
Bacterial filtration efficiency (BFE)%	≥95	≥98	≥98
Differential pressure, mm, H20/cm^2	<4.0	<5.0	<5.0
Resistance to penetration by synthetic blood, minimum pressure in mmHg for pass result	80 mmHg	120 mmHg	160 mmHg

Adapted from the Australian Guidelines for the Prevention and Control of Infection in Healthcare (2019)[7], Section 3.3

Gloves

Gloves should be used as a standard precaution when there is anticipated contact with blood and body fluids. Gloves can also be used by healthcare workers when touching surfaces that may be contaminated.

Multiple tasks with the same patient should progress from cleanest to dirtiest (where possible). Gloves should be changed between each task and hand hygiene performed at each glove change.

There are two types of materials used in gloves for clinical use:

- Natural rubber latex (NRL)
- Synthetic (for example, nitrile).

NRL gloves are preferable for clinical procedures that require manual dexterity and/or will involve more than brief patient contact. Select powder-free latex gloves to minimise the risk of latex sensitivity or allergy. Synthetic gloves are preferable for procedures involving high-risk exposure to blood-borne viruses where high barrier protection is needed. They are a suitable alternative to latex if there are no issues with glove fit or sensitivity.

Table 1.7 describes types of gloves and indicative uses in health service organisations.

Table 1.7. Types of gloves and indicative use

Glove	Indication of use	Examples
Non-sterile gloves	• Potential for exposure to blood, body fluids, secretions, and excretions • Contact with mucus membranes • Anticipated contact with chemicals and chemotherapeutic agents	• Venipuncture • Vaginal examination • Dental examination • Emptying of a urinary catheter bag • Naso-gastric aspiration • Management of minor cuts and abrasions • Administration of chemotherapeutic agents • Handling chemicals, such as cleaning agents/wipes
Sterile gloves	• Potential for exposure to blood, body fluids • Contact with susceptible sites or clinical devices where aseptic conditions should be maintained	• Aseptic technique • Urinary catheter insertion • Complex dressings • Central venous line site dressing • Lumber puncture • Clinical care of surgical wounds or drain sites • Dental procedures requiring a sterile field
Reusable utility gloves	• Activities not involving patient care • May be decontaminated for reuse (according to the glove manufacturer's directions) provided the integrity of the glove is not compromised	• Worn for cleaning the environment or cleaning and disinfecting patient care equipment • Instrument cleaning in sterilising services units

Adapted from the Australian Guidelines for the Prevention and Control of Infection in Healthcare (2019), Section 3.3

Putting on and removing PPE

Healthcare workers should follow the sequences shown in Table 1.8 and Table 1.9, respectively, for putting on and removing PPE. Hand hygiene should be performed before putting on PPE and between each step when removing PPE, especially before touching the face.

Table 1.8. Sequence for putting on personal protective equipment

Description	Demonstration
1. Perform hand hygiene	
2. Put on gown • Fully cover torso from neck to knees, wrap around the back • Fasten at the back of the neck and waist	
3. Put on mask • Secure ties or elastic bands at the middle of head and neck	
4. Put on protective eyewear or face shield • Place over face and eyes and adjust to fit	
5. Perform hand hygiene	
6. Put on gloves • Extend to cover wrists of gown	

Adapted from the Australian Guidelines for the Prevention and Control of Infection in Healthcare[7] (2019), Section 3.3

Table 1.9. Sequence for removing personal protective equipment

Description	Demonstration
1. Remove and dispose of gloves • When removing gloves, care should be taken not to contaminate the hands. Hand hygiene must be performed immediately after the removal and disposal of gloves, in case infectious agents have penetrated through unrecognised holes, or have contaminated the hands during glove removal.	
2. Perform hand hygiene	
3. Remove and dispose of gown • Aprons and gowns are single-use and should always be removed immediately after use and before leaving the patient care area. Aprons and gowns should be removed in a manner which avoids contaminating clothes or skin. This can be done by pulling from the shoulders, turning the gown inward and rolling it into a bundle for disposal into the appropriately labelled waste bin. • Reusable aprons and gowns should be used for one procedure or patient care episode only. These gowns need to be laundered or reprocessed according to AS/NZS 4146:2000 – Laundry practice.[8]	
4. Remove protective eyewear or face shield • Face shields, protective eyewear and masks should be removed after gloves have been removed and hand hygiene performed. The back of the face shield, protective eyewear or mask should only be touched when removing. The front is considered contaminated. If the item is reusable, it should not be touched with bare hands before cleaning. • 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 a TGA-included sterilant or medical device low-level disinfectant listed on the Australian Register of Therapeutic Goods (ARTG), or by heat as per Standard AS/NZS 4187:2014 – Reprocessing of reusable medical devices in health service organisations.[9]	
5. Perform hand hygiene	

[9] https://store.standards.org.au/reader/as-nzs-4187-2014

Description	Demonstration
6. Remove mask and dispose of mask	
7. Perform hand hygiene	

Adapted from the Australian Guidelines for the Prevention and Control of Infection in Healthcare[7] (2019), Section 3.3

Respiratory hygiene and cough etiquette

Respiratory hygiene and cough etiquette must always be used as a standard IPC precaution to prevent the dispersal of respiratory secretions into the air.

Healthcare workers and visitors who are unwell with respiratory or other infections should not attend a healthcare service while symptomatic.

Patients, visitors, and healthcare workers should always:

- cover their nose and mouth when coughing or sneezing
- use tissues
- dispose of tissues after use
- cough or sneeze into their inner elbow rather than the hand if tissues are not available
- perform hand hygiene after coughing or sneezing, or after having contact with respiratory secretions and contaminated objects or materials.

Aseptic technique

Aseptic technique is a set of practices that protects patients from HAIs and healthcare workers from contact with blood, body fluids and body tissue. When performed correctly, aseptic technique will:

- minimise contamination of key sites
- protect patients from their own pathogenic microorganisms that may cause infection
- reduce the transmission of microorganisms
- maintain the sterility of equipment and key parts used for aseptic procedures.

- **A key site** is a site on the patient that must be protected from contamination during an aseptic procedure (for example, a drain site, a cannula site, a wound site).
- **A key part** is the equipment or item that must be protected from contamination during an aseptic procedure (for example, the hub of an injection port, or the contents of a dressing pack).

The difference between aseptic technique and sterile technique

Often the terms aseptic technique and sterile technique are incorrectly used interchangeably. There are important differences between these two techniques, as described in Table 1.10.

Table 1.10. Aseptic and sterile techniques

Technique	Description
Aseptic	Aims to prevent pathogenic organisms, in sufficient quantities to cause infection, from being introduced into susceptible body sites by the hands of healthcare workers, or from surfaces or equipment. Protects patients during invasive clinical procedures by using IPC measures that minimise the presence of microorganisms. Is achievable in clinical and non-clinical settings by applying the five principles of aseptic technique (see below) and modifying practice to mitigate infection risks.
Sterile	Uses practices that are aimed at preventing the introduction of all microorganisms into a sterile field, onto equipment, or into a procedure site. Is near impossible to achieve in the clinical setting due to the presence of microorganisms in the air and the clinical environment. True sterile conditions are only achievable in strictly controlled environments, such as laminar flow hoods used in laboratories and pharmacies.

The five essential principles of aseptic technique

When performing a procedure that requires aseptic technique, there are five essential principles that should be applied:

1. Sequencing
2. Environmental control
3. Hand hygiene
4. Maintenance of aseptic fields
5. PPE.

1. Sequencing

Sequencing involves a series of actions that ensures each procedure is performed in a safe and appropriate order. Sequencing includes assessing for risks to the patient and the healthcare worker and identifying strategies to mitigate these risks before starting the procedure.

When considering the steps for sequencing, the healthcare worker should undertake the following:

Perform a risk assessment – ask the following questions:

- Are there environmental or patient factors that increase the risk for this procedure?
- Is the procedure technically difficult or being performed in an emergency?
- Will the procedure require a standard or surgical aseptic technique?
- Is there a risk of infection transmission or contamination risk with the procedure?
- Does the practitioner know how to perform this procedure?
- What PPE is needed for the procedure?
- What action is required to mitigate these risks?

In conducting pre-procedure preparation, the healthcare worker should:

- prepare the environment
- select the correct equipment; check the condition, integrity and expiry date of each item required for the procedure
- plan each step of the procedure to avoid a breach in asepsis
- inform the patient and prepare them for the procedure.
- set up the equipment immediately before performing the procedure.

During the procedure, the healthcare worker should:

- maintain standard precautions
- perform the procedure in a safe, logical order.

After the procedure, the healthcare worker should:

- remove gloves and perform hand hygiene
- settle the patient
- pack away equipment and dispose of waste
- document the outcome from the procedure, including:
  - any breaches in asepsis
  - any corrective actions taken during the procedure to minimise infection risks
  - whether multiple attempts were required to complete the procedure.

2. Environmental control

There are many factors in the clinical environment which can increase the risk of infection and patient harm during a procedure. Part of the risk assessment should include the removal of the risk factor, where practical. Consider the following:

- Are there other activities that are occurring in the nearby environment that may increase the risk of contamination (for example, bed-making, dusting, cleaning, open windows or fans that can cause air turbulence)?
- Is the environment a controlled setting, such as a laboratory, pharmacy, or operating suite; or an uncontrolled setting, such as an emergency department?
- What is the condition of the work area, surface and equipment used for this procedure? For example, how clean is the equipment? Is the equipment damaged or rusty?

To reduce the risk of contamination and infection transmission, these factors should either be removed or controlled where practical. For example, wait until cleaning has finished before performing the procedure, or replace damaged equipment.

3. Hand hygiene

Healthcare workers should always follow the 5 Moments for Hand Hygiene[3] during aseptic procedures. There are critical moments before, during and after an invasive procedure, or a procedure requiring aseptic technique, when hand hygiene should be performed. These moments are:

- before and after collecting the equipment
- after setting up an aseptic field
- immediately before putting on gloves (if gloves are required)
- immediately after completing the procedure and removing gloves
- immediately after cleaning up and disposing of equipment and waste.

Hand and wrist jewellery must be removed before the procedure and before performing hand hygiene. If gloves become grossly contaminated or torn during a procedure, the gloves must be removed, hand hygiene must be performed, and new gloves applied.

4. Maintenance of aseptic fields

The healthcare worker should ensure that the aseptic field, the key parts, and the key sites are always protected. The healthcare worker should:

- prepare the key sites with the correct solution (for example, cleanse with normal saline, chlorhexidine, or other suitable solutions)
- clean and/or disinfect all the equipment and key parts to be used
- establish an aseptic field (for example, by using a sterile tray or using a laminar flow hood)
- use techniques that protect the key sites and all key parts used for the procedure
- use the most suitable technique for the type of procedure (for example, a non-touch technique if suitable or sterile gloves if sterile equipment or the procedure site requires handling).

5. PPE

PPE is important for protecting both the patient and healthcare worker during an aseptic procedure. The healthcare worker should consider the following points:

- Is sterile or non-sterile PPE required (gowns, gloves)?
- What is the correct sequence for putting on and removing PPE?

Simple procedures

Simple procedures are generally technically simple, use simple equipment with minimal key parts, involve small key sites, and are of a short duration (usually less than 20 minutes). Examples include:

- simple wound dressings
- maintenance of vascular access devices
- collection of clinical specimens (blood, swabs, or urine)
- parental medication preparation.

Complex procedures

Complex procedures are generally technically difficult, invasive, require specialised equipment, involve many key parts, large or many key sites, and require extended periods of time to complete. These procedures may be performed in dedicated clinical environments such as operating theatres, procedural suites, or at the bedside. Examples include:

- surgery
- wound debridement
- vascular access insertions
- drain insertions
- catheterisations (urinary, cardiac, or peritoneal dialysis).

The Commission has resources for aseptic technique* available to support health service organisations implement the recommendations from the NSQSH Standards† and the Australian Guidelines for the Prevention and Control of Infection in Healthcare.‡

**https://www.safetyandquality.gov.au/our-work/infection-prevention-and-control/aseptic-technique*
†https://www.safetyandquality.gov.au/standards/nsqhs-standards
‡https://www.safetyandquality.gov.au/publications-and-resources/resource-library/australian-guidelines-prevention-and-control-infection-healthcare

Safe sharps management

Using sharp devices exposes the user to the risk of sharps injuries and to bloodborne infectious agents, such as hepatitis B virus (HBV), hepatitis C virus (HCV), and human immunodeficiency virus (HIV).

Hollow-bore needles are implicated in the transmission of bloodborne infections more than any other device. Hollow-bore needles used for blood collection or intravascular catheter insertion are of particular concern because they are more likely to contain residual blood. Other sharps, including suture needles and blades, have also been associated with the transmission of bloodborne infections.

Sharps handling and disposal

When handling and disposing of sharps, the following practices should be observed:

- Handling should be kept to a minimum.
- Sharps must not be passed directly from hand to hand.
- Needles must not be recapped, bent, broken, or disassembled after use.
- The person who used the sharp is responsible for its immediate safe disposal.
- Used sharps must be discarded into a sharps disposal container at the point of use. If this is not possible, then the used sharp must be transported in a puncture-resistant container to the nearest sharps container and discarded.
- Sharps containers should be clearly labelled, puncture- and leak-proof, and conform to Standards AS 4031:1992[10] and Amendment 1:1996, AS/NZS 4261:1994[11] and Amendment 1:1997 or relevant international standard for example, ISO 23907-1:2019.[12]
- Sharps containers must not be filled above the maximum fill level.

Safety-engineered devices

A broad range of devices have been designed with built-in safety features that reduce the risk of injury involving a sharp. These include:

- needles with guards
- sliding sheaths
- shields, blunted tips, or retracting needles
- blunt suture needles and surgical blades with protective covers.

Devices designed with built-in safety features reduce the risk of sharps injury. Users should be educated to use these devices properly and safely.

[10] https://store.standards.org.au/reader/as-4031-1992
[11] https://store.standards.org.au/reader/as-nzs-4261-1994
[12] https://www.iso.org/standard/71506.html

A systems approach to sharps injury reduction

The elements of a systems approach to sharps injury reduction includes:

- championing a culture of safety underpinned by the concepts of patient-centred care
- adopting and evaluating the use of passive or active safety-engineered devices as an alternative to sharps without safety-engineered features
- standardising changes to work practices that will reduce risks (for example, using instruments rather than fingers to grasp needles, retract tissue and load/unload needles; using appropriately designed single-handed devices to unload needles and scalpels)
- providing education in the use of new devices and work practices
- ensuring comprehensive reporting of injuries and preventive strategies
- applying engineering controls (for example, sharps disposal containers and passive or active sharps devices engineered to prevent sharps injury)
- applying occupational exposure protocols
- implementing occupational vaccination programs.

Information on the management of sharps injuries is covered in full detail in workbook Module 6. Preventing and managing occupational exposures.

The Commission's Management of Peripheral Intravenous Catheters Clinical Care Standard*contains 10 quality statements and 13 indicators to guide quality care for the management of cannulas, and is accompanied by supporting resources.

**https://www.safetyandquality.gov.au/standards/clinical-care-standards/management-peripheral-intravenous-catheters-clinical-care-standard*

Environmental cleaning

Environmental cleaning involves the use of water and neutral detergent to physically remove dirt and foreign material from environmental surfaces. Environmental cleaning is an essential component of any IPC program to ensure a clean and safe environment for patients, visitors, and healthcare workers.

Patient care environment and equipment

The patient care environment includes the immediate area around the patient and any equipment that may directly, or indirectly, come into contact with the patient. The environment in a healthcare setting is the physical space including floors, walls, and the ceiling. It also includes the furnishings that are in that space, such as curtains, bedside lockers, taps, sinks and door handles.

Some surfaces and equipment need to be cleaned more often. These include frequently touched surfaces, such as door handles, bed rails, telephones, taps and light switches. Other areas may need to be cleaned less often, such as minimally touched surfaces including floors, walls, ceilings, windows, and blinds. Other considerations are listed below:

- Items that are used for more than one patient must be cleaned between patients to reduce the risk of infection transmission (for example, blood pressure cuffs, thermometers, mobility aids).
- Where common use of equipment for multiple patients is unavoidable, a risk assessment should be performed, and cleaning carried out according to the manufacturer's instructions.
- The use of disposable equipment should be balanced against consideration of environmental and resource sustainability.

Cleaning frequency

Health service organisations should have a local cleaning policy in place and use a cleaning schedule that is tailored to the needs of the organisation and local disease epidemiology.

The risk of transmission of infectious agents should be regularly assessed, and the cleaning schedule adjusted to respond to a new or increased infection risk.

The organisation should have a mechanism in place to monitor the quality of environmental cleaning within the organisation.

Processes and product selection for routine environmental cleaning

Routine cleaning with detergent and water, followed by rinsing and drying, is the most effective method for removing microorganisms from surfaces. Mechanical cleaning (scrubbing) physically reduces the number of infectious agents and dirt on a surface, which can then be rinsed away with clean water.

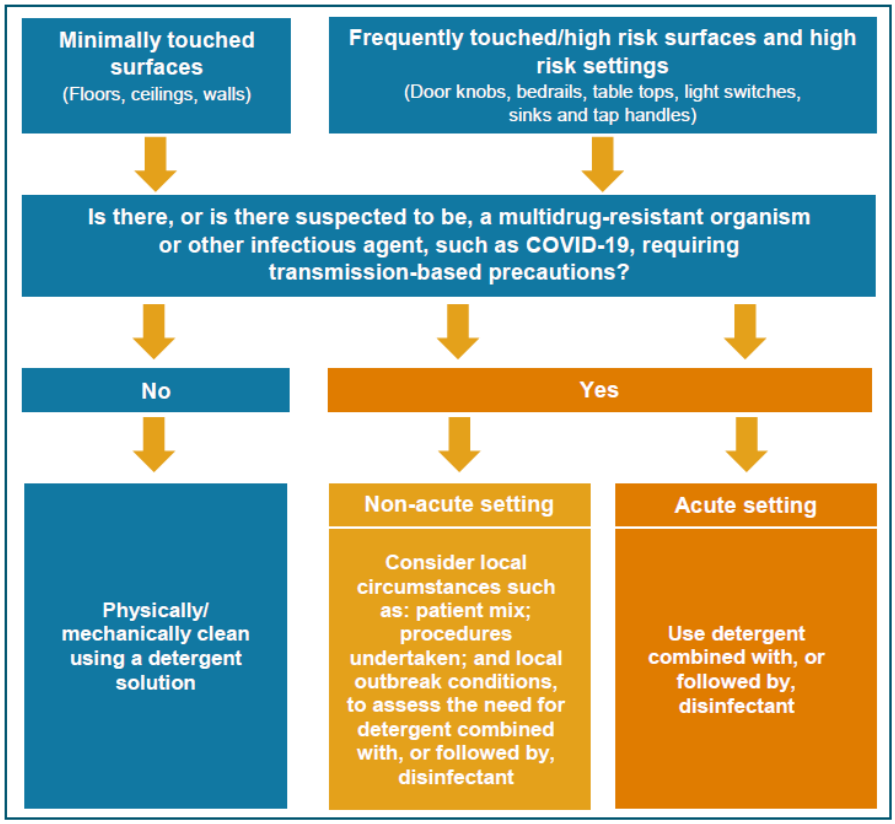
Neutral detergents contain a surfactant that facilitates the removal of dirt and organic matter. A neutral detergent and warm water are suitable for most cleaning processes.

Disinfectants are chemical agents that rapidly kill or inactivate most infectious agents. Disinfectants are not to be used as general cleaning agents, unless combined with a detergent as a combination cleaning agent (detergent/disinfectant). If required, disinfection should always be undertaken following a detergent cleaning.

Disinfectants are only necessary if a surface may have been or is known to have been contaminated by a multi-resistant organism or potentially infectious material, including blood and other bodily fluids. Disinfectants might be used after routine cleaning during an outbreak.

When assessing and selecting a disinfectant in the healthcare setting, factors such as kill claims, wet contact time, compatibility, safety, ease of use and value for money should be considered. Figure 1.3 provides general advice for cleaning product selection.

Figure 1.3. Cleaning product selection



Source: Principles of Environmental cleaning: Product Selection, Australian Commission on Safety and Quality in Healthcare (2020)[13]

Management of blood and body fluid spills

A spill kit should be readily available in each clinical area and should include the following:

- a scoop and scraper
- single-use PPE including gloves, protective apron, surgical mask, and protective eyewear
- absorbent agent to absorb fluids
- clinical waste bags and ties
- detergent.

To manage biological spills:

- ensure the affected area is safe and no further spills occur
- put on PPE from the spill kit
- confine and contain the spill
- use disposable absorbent material provided in the spill kit or paper towel to absorb the spill and then discard into the clinical waste bag
- use detergent and water to clean the area with disposable cloth or paper towel, dispose of cloth or paper towel into the clinical waste bag
- remove and dispose of PPE into the clinical waste bag
- dispose of the clinical waste bag into a clinical waste bin.

The area may require a second clean with a disinfectant based on an assessment of the risk of transmission of infectious agents involved in the spill.

[13] https://www.safetyandquality.gov.au/publications-and-resources/resource-library/process-and-product-selection-routine-environmental-cleaning-flowchart-october-2020

More information on environmental cleaning is covered in this workbook at Module 6. Clean and safe healthcare environment.

Resources

The Commission has a suite of resources available to support organisations to implement the recommendations from the NSQHS Standards[14], and the Australian Guidelines for the Prevention and Control of Infection in Health Care[7] for environmental cleaning. These resources include:

- Environmental cleaning practices for small HSOs[15]
- Environmental cleaning: Information for cleaners[16]
- Environmental cleaning: Emerging environmental cleaning technologies[17]
- Principles of environmental cleaning product selection[18]
- Principles of environmental cleaning auditing[19]
- Benefits of environmental cleaning – infographic[20]
- The process and product selection for routine environmental cleaning – flowchart[21]

Reprocessing of reusable medical devices

Why do reusable medical devices need reprocessing?

Any medical device (instruments or equipment) that is to be reused requires reprocessing.

For the purposes of reprocessing, reusable medical devices are categorised into three categories. The categories, descriptions and examples are described in Table 1.11.

Table 1.11. Categories of reusable medical devices

Category	Description	Examples
Critical	Devices that have a high risk for infection if they are contaminated with microorganisms. These devices must be sterile at the time of use.	Surgical instruments, intravascular devices, cystoscopes, and bronchoscopes.
Semi-critical	Devices that come into contact with mucous membranes or non-intact skin. These devices 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.	Laryngoscope blades, endoscopes, vaginal ultrasound transducers and breast pump accessories.

[14] https://www.safetyandquality.gov.au/standards/nsqhs-standards
[15] https://www.safetyandquality.gov.au/publications-and-resources/resource-library/environmental-cleaning-practices-small-health-service-organisations
[16] https://www.safetyandquality.gov.au/publications-and-resources/resource-library/environment-cleaning-information-cleaners
[17] https://www.safetyandquality.gov.au/publications-and-resources/resource-library/environmental-cleaning-emerging-environmental-cleaning-technologies
[18] https://www.safetyandquality.gov.au/publications-and-resources/resource-library/principles-environmental-cleaning-product-selection-october-2020-fact-sheet
[19] https://www.safetyandquality.gov.au/publications-and-resources/resource-library/principles-environmental-cleaning-auditing-august-2020-fact-sheet
[20] https://www.safetyandquality.gov.au/publications-and-resources/resource-library/benefits-environmental-cleaning-infographic
[21] https://www.safetyandquality.gov.au/publications-and-resources/resource-library/process-and-product-selection-routine-environmental-cleaning-flowchart-october-2020

Category	Description	Examples
Non-critical	Devices that come into contact with intact skin but not mucous membranes. Thorough cleaning is sufficient for most non-critical devices after each individual use, although either intermediate or low-level disinfection may be appropriate in specific circumstances.	Bedpans, commodes, blood pressure cuffs, pulse oximeter probes and stethoscopes.

These categories are based on the level of infection risk related to the use of the device. Cleaning of semi-critical and critical instruments to remove organic material must always precede any further processing, including disinfection and sterilisation.

More information on the reprocessing of reusable medical devices is covered in full detail in this workbook at Module 9. Introduction to reprocessing of reusable medical devices.

Waste management

Health service organisations, including community healthcare settings, need to conform to relevant state or territory legislation and regulations on the management of clinical and related wastes. Organisations should also refer to the Waste Management Association of Australia's industry code of practice Standard AS/NZS 3816:2018.[22]

When handling waste:

- use standard precautions and perform hand hygiene to protect against exposure to blood and body fluids
- segregate waste into appropriate streams at the point of generation
- ensure waste is contained in an appropriate receptacle (identified by colour and label) and disposed of according to the organisation’s waste management plan
- ensure healthcare workers are trained in the correct procedures for handling waste.

More information on waste management is covered in full detail in workbook Module 4. Clean and safe healthcare environment.

Handling linen

Health service organisations must have documented polices on the collection, transport, and storage of linen. Organisations that launder linen must have documented operating policies consistent with Standard AS/NZS 4146:2000.[8]

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.

When handling used linen:

- use care to avoid dispersal of microorganisms into the environment and contact with healthcare worker clothing
- wear appropriate PPE to prevent exposure of skin and mucous membranes to blood and body substances
- ensure linen is ‘bagged’ at the location of use into an appropriate laundry receptacle

[22] https://www.standards.org.au/standards-catalogue/sa-snz/health/he-011/as--3816-colon-2018

- do not rinse or sort laundry in patient-care areas
- do not wash laundry in domestic washing machines
- place linen soiled with body substances into leak-proof laundry bags for safe transport
- perform hand hygiene after handling.

Domestic-type washers and dryers

Some organisations may use domestic-type washers and dryers on site for laundering patient or resident clothes. Domestic-type washing machines may be used for a patient's personal items only, using appropriate detergent and hot water. If hot water is not available, items from different patients should not be mixed in the same load.

Domestic-type clothes dryers must only be used for drying clothes. Organisations should have a schedule in place for the cleaning and maintenance of these machines.

More information on handling linen is covered in full detail in this workbook at Module 6. Clean and safe healthcare environment.

Part 3: Transmission-based precautions

Part 3 covers the following topics:

- **Introduction to transmission-based precautions**
- **Contact precautions**
- **Droplet precautions**
- **Airborne precautions**

Introduction to transmission-based precautions

Transmission-based precautions are precautions that interrupt the specific means of transmission of a particular infectious agent. They are used in addition to standard precautions. Understanding the means of transmission of an infectious agent is important for deciding the most appropriate transmission-based precautions to use.

Key elements of transmission-based precautions include:

- PPE
- patient placement
- minimising patient movement.

Clear and accurate communication and documentation is essential to support the application of transmission-based precautions. The Commission has a suite of standardised standard and transmission-based precautions signage[23] available for download.

There are three categories of transmission-based precautions:

- **Contact precautions**
- **Droplet precautions**
- **Airborne precautions**

For some infectious agents, a combination of precautions may be required (for example, influenza and respiratory syncytial virus [RSV] require both contact and droplet precautions).

Contact precautions

Contact precautions are used for infectious agents that may be transmitted by direct or indirect contact with the patient or the patient's environment.

Direct contact transmission

Direct contact transmission occurs when infectious agents are transferred from one person to another 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.

[23] www.safetyandquality.gov.au/our-work/infection-prevention-and-control/standard-and-transmission-based-precautions-and-signage

Indirect contact transmission

Indirect contact transmission involves the transfer of an infectious agent through a contaminated intermediate object (fomite) or person. Contaminated hands of healthcare workers have been shown to be important contributors to indirect contact transmission. Other examples of indirect contact transmission in the healthcare environment include:

- shared patient equipment which is not cleaned and disinfected between patients
- contaminated environmental surfaces.

Infectious agents for which contact precautions are indicated include:

- *Clostridioides difficile* (also known as *Clostridium difficile*)
- norovirus and other intestinal tract pathogens
- hepatitis A
- methicillin-resistant *Staphylococcus aureus* (MRSA)
- vancomycin-resistant *Enterococcus* (VRE)
- multidrug-resistant gram-negative (MRGN) organisms, including Carbapenemase-producing *Enterobacterales* (CPE)
- highly contagious skin infections, such as impetigo
- infestations, such as scabies.

The key elements of applying contact precautions are:

- using appropriate PPE such as aprons, gowns, and gloves
- patient placement (for example, single room cohorting)
- minimising patient movement.

The key elements of applying contact precautions are described in Table 1.12.

Table 1.12. Key elements of applying contact precautions

Element	Description
Appropriate PPE	Putting on an apron or gown, followed by gloves, upon entering the patient care area helps to contain infectious agents that can transmit disease via the contact route. A surgical mask and protective eyewear or face shield must also be worn as part of standard precautions if there is the potential for generation of splashes or sprays of blood and body substances to the face and eyes. When moving between patients, PPE must always be changed, and hand hygiene must always be performed.
Patient placement	A single-patient room is recommended for patients who require contact precautions. If a single room is not available, consultation with local IPC expertise is recommended to assess the risks associated with other patient placement options (for example, cohorting). To assist in cohorting patients with known or suspected infectious conditions, see the Ensuring Appropriate Patient Placement[24] tool. If cohorting is required, it is recommended that patient beds are separated by 1.5 metres.
Minimising patient movement	Limiting the movement of a patient on contact precautions reduces the risk of environmental contamination. If transferring the patient within or between organisations is necessary, it is important to ensure that infected or colonised areas of the patient's body are contained and covered. Both the transferring and receiving organisations must be made aware of the precautions required before the transfer.

[24] https://www.safetyandquality.gov.au/our-work/infection-prevention-and-control/ensuring-appropriate-patient-placement

➢ There is a high risk for infection in patients sharing isolation with non-identical strains of disease.

Droplet precautions

Droplet precautions prevent transmission of infectious agents spread through respiratory droplets (that is, droplets >5microns in size). These are generated by a patient who is coughing, sneezing, or talking. Transmission via droplets requires close contact as the droplets do not remain suspended in the air, and generally only travel short distances. Therefore, special air handling and ventilation are not required.

Droplets can contaminate horizontal surfaces close to the source patient, and the hands of healthcare workers can become contaminated through direct contact with those surfaces.

Infectious agents for which droplet precautions are indicated include:

- seasonal influenza virus
- *neisseria meningiditis*
- whooping cough (pertussis)
- parainfluenza
- adenovirus
- rhinovirus
- group A streptococcal species.

The key elements of applying droplet precautions are:

- use of appropriate PPE (surgical mask always required, apron, gown, gloves, and protective eyewear as appropriate)
- patient placement
- minimising patient transfer or transport.

The key elements of applying droplet precautions are described in Table 1.13.

Table 1.13. Key elements of applying droplet precautions

Element	Description
Appropriate PPE	Surgical masks that meet Australian Standard 4381:2015 for Surgical Face Masks[25] should be worn when entering the patient care area of a patient who requires droplet precautions. A surgical mask and protective eyewear should also be worn to minimise the risk of contamination of mucous membranes when near the patient. When moving between patients, PPE must always be changed, and hand hygiene must always be performed.
Patient placement	Placing patients on droplet precautions in a single room reduces the risk of patient-to-patient transmission. If single rooms are in short supply: • prioritise patients who have excessive cough and sputum production • consider the patient's ability to perform hand hygiene and use respiratory hygiene and cough etiquette • consider placing surgical-style masks on coughing patients, if appropriate, which can also prevent infected patients from dispersing respiratory secretions into the air • place patients who are infected with the same pathogen in the same room (cohort). If it is necessary to place a patient who requires droplet precautions in a room with a patient who is not infected with the same infectious agent: • ensure patients are physically separated by at least 1.5 metres and draw privacy screens • avoid atomisation procedures/treatment, such as nebulisers, and induced sputum collection • avoid placing patients on droplet precautions in the same room with patients who may have increased risk of adverse outcomes from infection or may facilitate transmission (for example, immunocompromised, prolonged lengths of stay, cystic fibrosis, cardiac conditions, or muscular dystrophy).
Patient transfer	Limiting the transfer of a patient on droplet precautions reduces the risk of transmission. If transferring the patient within or between organisations is necessary, the patient should wear a surgical mask and use respiratory etiquette during the transfer. Both the transferring and receiving organisations must be made aware of the precautions required before the transfer.

➢ There is a high risk for infection in patients cohorted together with non-identical strains of disease.

Airborne precautions

Airborne precautions prevention transmission of infectious agents that are disseminated through airborne droplet nuclei and remain infective over time and distance. These agents may be inhaled by individuals who have not had face-to-face contact with, or been in the same room as, the infectious individual. Airborne droplet nuclei can also be generated through aerosol-generating procedures (AGPs), such as intubation, suctioning, bronchoscopy, or the use of nebulisers.

Airborne precautions are based on evidence that shows that:

- the use of particulate filter respirators (PFR), such as P2 or N95, prevents the inhalation of small particles that may contain infectious agents transmitted via the airborne route
- the use of negative pressure rooms may reduce the transmission of infection

[25] https://www.medcart.com.au/blog/australian-standard-4381-2015-for-surgical-face-masks

- the wearing of correctly fitted surgical masks by coughing patients prevents dispersal of respiratory secretions into the air.

Infectious agents for which airborne precautions are indicated include:

- rubeola (measles),
- varicella zoster (chickenpox)
- active pulmonary *Mycobacterium tuberculosis* (TB)
- disseminated Herpes zoster (shingles).

The key elements of applying airborne precautions are:

- use of appropriate PPE, particularly correctly fitted particulate filter respirators (PFRs), such as P2 and N95
- patient placement (for example, use of negative pressure rooms)
- minimising patient movement.

Specialist procedural areas also should refer to their discipline-specific guidelines for detailed advice on applying airborne precautions relevant to the field of practice.

The key elements of applying airborne precautions are described Table 1.14.

Table 1.14. Key elements of applying airborne precautions

Element	Description
Appropriate PPE	A particulate filter respirator should be worn by the healthcare worker to prevent airborne transmission. Healthcare workers should be trained in the correct use of particulate filter respirators and follow manufacturer's instructions when putting on and removing the particulate filter respirator. The filtration efficiency of particulate filter respirators protects the wearer from inhaling small respiratory particles, but to be effective the respirator must fit so that inhaled air only travels through the filter medium. Table 1.15 provide information on the characteristics of P2 and N95 respirators. When moving between patients, PPE must always be changed, and hand hygiene must always be performed.
Patient placement	It is good practice to place patients on airborne precautions in a negative pressure room (Class N/Type 5) with bathroom facilities or in a room from which air does not circulate to other areas. If a negative pressure room is unavailable, the patient should be managed in a single room, or placed with patients with the same infectious agent. The door to the room must remain closed if patient care requires airborne precautions. When moving between patients, PPE must always be changed, and hand hygiene must always be performed.
Minimising patient movement	Limiting movement of a patient on airborne precautions reduces the risk of transmission. If transferring the patient is necessary, the patient should wear a correctly fitted surgical mask and follow respiratory hygiene and cough etiquette, as well as covering any skin lesions associated with the condition (for example, chickenpox [varicella]). If the patient is a child, their oxygen saturation should be monitored while they are wearing a surgical mask. **DO NOT put a P2 and N95 respirator on the patient**. Both the transferring and receiving organisations must be made aware of the precautions required before the transfer.

Fit-testing of particulate filter respirators

The purpose of fit-testing is to identify which size and style of particulate filter respirator is suitable for an individual, and to ensure that it is worn correctly. Fit-testing should be undertaken based on relevant state/territory jurisdictional requirements, in conjunction with a risk assessment with relevance to the healthcare setting.

Fit-testing programs may be considered:

- at the beginning of employment for healthcare workers who will be working in clinical areas where there is a significant risk of exposure to infectious agents transmitted via the airborne route
- when there is a significant change in the wearer's facial characteristics that could alter the facial seal of the respirator
- at regular intervals; Standard AS/NZS 1715: 2009[26] recommends annual fit-testing and outlines the method by which fit-testing is conducted.

*Table 1.15. Characteristics of P2 and N95 respirators**

Characteristics	P2 respirator	N95 respirator
Raised dome or duckbill	✓	✓
4–5 layers (outer polypropylene, central layers electret [charged polypropylene])	✓	✓
Filtration through mechanical impaction and electrostatic capture	✓	✓
Designed to provide a good facial fit to minimise aerosol contamination of the mucous membranes of the nose and mouth	✓	✓
Minimum required filter efficiency tested with NaCl aerosol	94% at a flow rate of 95 L/min	95% at a flow rate of 85 L/min
Aerosol testing	Under the EN system, similar to Standard AS/NZS 1716:2012 but additional filter efficiency testing with paraffin oil aerosol that must meet the minimum 94% filter efficiency.	Can only be used for oil-free aerosols.
Particle size of aerosol (mass median diameter)	0.3 to 0.6 microns with a range of particles in the 0.02 to 2-micron size range.	0.3 microns

**Adapted from The Australian Guidelines for the Prevention and Control of Infection in Healthcare (2021)*

Fit checking

Organisations should provide healthcare workers with information and training on how to perform a fit check. Always refer to the manufacturer's instructions for fit checking of individual brands and types of particulate filter respirators.

[26] https://www.standards.org.au/standards-catalogue/sa-snz/publicsafety/sf-010/as-slash-nzs--1715-2009

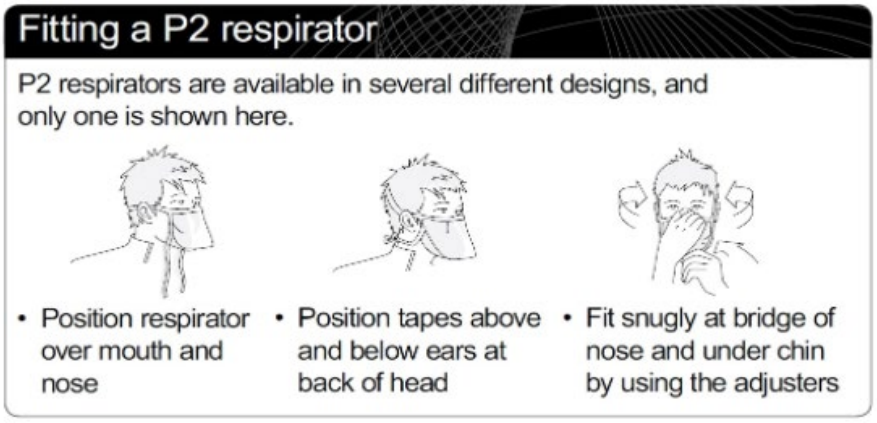
Healthcare workers must perform fit checks every time they put on a particulate filter respirator. The procedure for fit checking includes the following steps:

1. Place the particulate filter respirator on the face.
2. Place the headband or ties over the head and at the base of the neck.
3. Compress the particulate filter respirators to ensure a seal across the face, cheeks, and bridge of the nose.
4. To check the particulate filter respirators for a positive pressure seal, gently exhale. If air escapes from around the edges of the particulate filter respirator, the mask needs to be adjusted.
5. To check for a negative pressure seal, gently inhale. If the mask is not drawn in towards the face or air leaks around the face seal, readjust the particulate filter respirator.
6. After adjusting the particulate filter respirator to ensure there is a good seal around the face, repeat steps 5 and 6. If necessary, change to a different style that fits the wearer's face.

Healthcare workers who have facial hair (including a 1- to 2-day beard growth) must be aware that an adequate seal cannot be guaranteed between the particulate filter respirators and the wearer's face.

Figure 1.4 shows the correct way to check the fit of a particulate filter respirator. Additional information on suitable masks for airborne precautions and fit-testing and checking can be found in The Australian Guidelines for the Prevention and Control of Infection in Healthcare.[7]

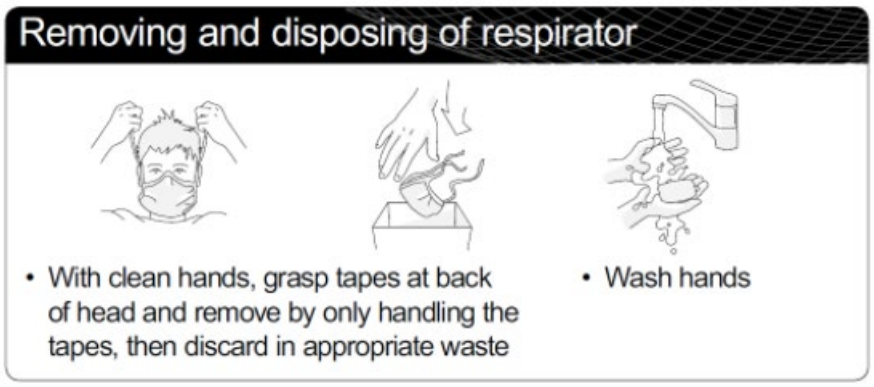
Figure 1.4. Fitting a particulate filter respirator



Source: Section 3.3 (2021) Australian guidelines for the prevention and control of infection in healthcare

Figure 1.5 shows the correct way to remove and dispose of a particulate filter respirator.

Figure 1.5. Removing and disposing of a particulate filter respirator



Source: Section 3.3 (2021) Australian guidelines for the prevention and control of infection in healthcare

Part 4: Other strategies for infection prevention and control

Part 4 covers the following topics:

- **Invasive medical devices**
- **Antimicrobial resistance**
- **Antimicrobial stewardship**

Invasive medical devices

Invasive medical devices are a common source of HAIs and provide a route for infectious agents to enter the body. Invasive medical devices include:

- catheters inserted for drainage (for example, urinary catheters)
- catheters for intravascular access (for example, peripheral intravenous catheters, peripherally inserted central venous catheters, central venous catheters)
- devices for mechanical ventilation (for example, intubation)
- devices for feeding (for example, enteral feeding tubes).

Key concepts for managing invasive devices

Organisations should have processes in place for:

- the appropriate use, management and removal of invasive medical devices
- the appropriate training for healthcare workers to use, manage and remove invasive medical devices
- monitoring device-related infection rates.

Before inserting any invasive medical device, patients should always be assessed to determine:

- whether their condition can be managed without the insertion of an invasive medical device
- the most appropriate invasive device, if required
- how long the device will be required
- what plan is in place to ensure timely removal of the device.

All invasive medical devices should be inserted using aseptic technique. The healthcare worker inserting the invasive medical device should be adequately trained and competent in the skills required for safe insertion, maintenance, and removal.

Strategies that can be used to minimise the risk of device-related infection during insertion and maintenance procedures include:

- training and education in the insertion, maintenance and removal of invasive medical devices
- the use of sterile equipment
- the use of appropriate skin preparation solutions (for example, normal saline, chlorhexidine)
- adherence to the 5 Moments for Hand Hygiene[3]
- the use of appropriate PPE (for example, the use of sterile or non-sterile gloves and gowns).

The patient should be provided education on the infection risk associated with the device and the importance of self-care, hygiene, and proper device maintenance.

When the device is *in situ*, the patient should be regularly monitored, including observations of the insertion site and the invasive device for signs and symptoms of infection.

There should be clear documentation of the insertion, maintenance, and plan for the removal of the device, as well as daily review of the ongoing need for the device. The dwell time for an invasive medical device should be as short as possible. The longer the time the invasive medical device is in place, the greater the risk of infection or other complications developing related to the device.

The following steps can be taken to minimise the dwell time of an invasive medical device:

- Organisations should consider including advice on the maximum dwell time for invasive medical devices in local policies or procedures based on best clinical evidence.
- Clinicians who have ordered the insertions of an invasive medical device should include instructions for the removal for the device in the patient's care plan or clinical notes.
- The ongoing need for an invasive medical device should be reviewed routinely as part of the patient's clinical care.
- The insertion site should be reviewed at least daily and details about the site condition should be documented in the patient's clinical care notes.
- If the patient develops signs of infection (temperature, swelling or redness at the insertion site) or other indications of complications related to the invasive medical device, the patient's care provider (treating medical team, general practitioner, nurse) should be notified immediately and consider removing the device if safe to do so.
- Remove the device as soon as it is no longer necessary.

Antimicrobial resistance

Antimicrobial resistance (AMR) is recognised as a significant global health priority. Resistance to antimicrobials is commonly found in Australian hospitals and is increasing in the community. This resistance can have a significant impact on morbidity, mortality, and treatment costs.

A significant driver of antimicrobial resistance is the unnecessary or inappropriate use of antimicrobials. Around one-third of all antimicrobial use in healthcare is unnecessary or inappropriately prescribed, as shown through the National Antimicrobial Prescribing Survey.[27]

The additional costs of infections caused by resistant organisms include:

- the need for more expensive and broader spectrum antimicrobials to treat infections
- the need to isolate patients colonised with resistant organisms to minimise cross-infection
- the need for additional requirements such as PPE, single-room accommodation, single-use patient equipment, and additional cleaning resources
- extended length of hospital admission, invasive treatments, further antimicrobial use, and potentially long-term health complications for the patient.

IPC practices are recognised as a key part of an effective response to antimicrobial resistance. Preventing infection reduces the need for antimicrobials and the opportunity for organisms to develop resistance.

In the Australian healthcare setting, antimicrobial resistance is most associated with resistant bacterial strains, such as methicillin-resistant *Staphylococcus aureus* (MRSA), vancomycin-resistant *enterococci* (VRE), and multidrug-resistant gram-negative bacteria (MRGN). These are commonly referred to as multidrug-resistant organisms (MROs). However, antimicrobial resistance occurs in fungi (*Candida auris*) and viruses (for example, some strains of influenza) as well.

[27] https://www.naps.org.au/Default.aspx

A risk management approach should be used to prevent and control multidrug-resistant organisms (MROs) in all health service organisations.

This should include:

- standard precautions for all patient care always
- the use of transmission-based precautions where a patient is known or suspected to be colonised with a multidrug-resistant organism.

Additional strategies that may be required to control multidrug-resistant organisms include:

- identifying high-risk settings and patients for multidrug-resistant organism acquisition (for example, intensive care or haematology/oncology units)
- targeted screening for early identification and management of colonised and high-risk patients
- strategies to communicate information about positive MRO results
- decolonisation programs, such as whole-body washes (using chlorhexidine) or topically applied antimicrobial agents and/or orally administered antimicrobials
- MRO surveillance programs may be appropriate to monitor the effect of interventions designed to control these organisms. Surveillance information should be fed back to healthcare workers and facility management promptly.

Antimicrobial stewardship

Antimicrobial stewardship (AMS) is a suite of coordinated activities which promote the appropriate prescribing and use of antimicrobials. AMS is conducted at all levels of the healthcare system, from local hospitals and general practices to national programs. It is intended to improve the safety and appropriateness of use, and maximise the benefit, of antimicrobials to reduce patient harm and prevent and contain antimicrobial resistance in Australia.

Actions 3.18 and 3.19 (Antimicrobial stewardship) of the NSQHS Preventing and Controlling Infections Standard[1] require all health service organisations to have systems in place for the safe and appropriate prescribing and use of antimicrobials, and describe the elements necessary to support an effective AMS program.

Antimicrobial stewardship programs should include:

- local AMS policies and procedures which implement clinical guidelines consistent with Therapeutic Guidelines: Antibiotic[28]
- establishing a multidisciplinary AMS team that includes, at least, a lead doctor and pharmacist
- antimicrobial formulary restrictions and approval processes that limit the use of broad-spectrum and later-generation antimicrobials to patients in whom their use is clinically indicated
- a clinical microbiology service, which can provide guidance and support for optimal specimen collection, reporting of clinically meaningful pathogens and their susceptibilities
- ongoing education and training for prescribers, pharmacists, nurses, midwives, and consumers about antimicrobial resistance, AMS and optimal antimicrobial use
- processes for reviewing antimicrobial prescribing, with intervention and direct feedback to the prescriber
- implementing point-of-care interventions (including directed therapy, intravenous to-oral switching, and dose optimisation).

[28] https://tgldcdp.tg.org.au/topicTeaser?guidelinePage=Antibiotic&etgAccess=true

Some key points healthcare workers should consider when prescribing and administering antimicrobials include:

- Is this the right antimicrobial/ dose for this patient's condition?
- Should this patient receive this antimicrobial medication as an oral or intravenous mediation?
- How frequently should this patient receive this antimicrobial medication?
- How long will this patient require this antimicrobial medication?
- Are there other patient factors that may affect the choice of antimicrobial medication (such as age, weight, renal function, allergies, other medicines prescribed and other health conditions)?
- Is this antimicrobial being prescribed for surgical or other prophylaxis? How many doses have been charted? Will this prescription be required for greater than 24 hours?

Resources

The Commission has produced a range of resources to support organisations implement an AMS program. The following resources can be found on the Commission's Antimicrobial Stewardship web page:

- Antimicrobial Stewardship in Australian Health Care[29] (the AMS Book) which provides a comprehensive range of advice to guide AMS in different settings.
- Antimicrobial stewardship clinical care standard[30] which supports quality improvement programs to reduce antimicrobial resistance.
- Antimicrobial stewardship in primary care[31] which focuses on implementing AMS programs in the primary care setting.
- Antimicrobial stewardship in aged care[32] which focuses on implementing AMS programs in the age care setting.
- Surgical antimicrobial prophylaxis[33] which provides information on the use of antimicrobials for surgical prophylaxis

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[29] https://www.safetyandquality.gov.au/our-work/antimicrobial-stewardship/antimicrobial-stewardship-australian-health-care-ams-book
[30] https://www.safetyandquality.gov.au/our-work/clinical-care-standards/antimicrobial-stewardship-clinical-care-standard
[31] https://www.safetyandquality.gov.au/our-work/antimicrobial-stewardship/antimicrobial-stewardship-primary-care
[32] https://www.safetyandquality.gov.au/our-work/antimicrobial-stewardship/antimicrobial-stewardship-aged-care
[33] https://www.safetyandquality.gov.au/our-work/antimicrobial-stewardship/surgical-antimicrobial-prophylaxis

Module 2. Risk management for infectious agents and diseases

Contents

Overview of Module 2

Module 2 contains two parts:

Part 1: Risk management and the hierarchy of controls

Part 2: Risk management for specific infectious agents and diseases

The module describes how to use risk management systems to minimise transmission of infectious agents in health service organisations. Many of the infectious agents covered in this module are classified as notifiable diseases. Refer to your local state or territory guidelines for more information on reporting these specific diseases.

After completing this module, you should:

- understand risk management and the use of the hierarchy of controls in infection prevention and control (IPC)
- be able to apply risk management strategies to help reduce infectious disease transmission
- understand the means of transmission of an infectious agent and how this relates to standard precautions, transmission-based precautions, and other IPC strategies used to limit the spread of infection.

Organisations that are required to be assessed against the National Safety and Quality Health Service (NSQHS) Standards (second edition) should refer to the Preventing and Controlling Infections Standard,[34] which sets the framework for IPC in health service organisations.

More information on risk assessment can be found in the Australian Guidelines for the Prevention and Control of Infection in Healthcare.[35]

[34] https://www.safetyandquality.gov.au/standards/nsqhs-standards/preventing-and-controlling-infections-standard
[35] https://www.safetyandquality.gov.au/publications-and-resources/resource-library/australian-guidelines-prevention-and-control-infection-healthcare

Part 1: Risk management and the hierarchy of controls

Part 1 covers the following topics:

- **What is risk management?**
- **The hierarchy of controls**
- **Risk management in infection prevention and control programs**

What is risk management?

Risk management is ongoing and proactive processes aimed at identifying and responding to risks which impact infection prevention and control (IPC). The Work Health and Safety Act[36] requires employers to have systems and processes to identify hazards and assess and control the risks for patients, visitors and members of the workforce, so far as is reasonably practicable. This means doing what is possible in the circumstances to ensure health and safety and continuity of health service delivery.

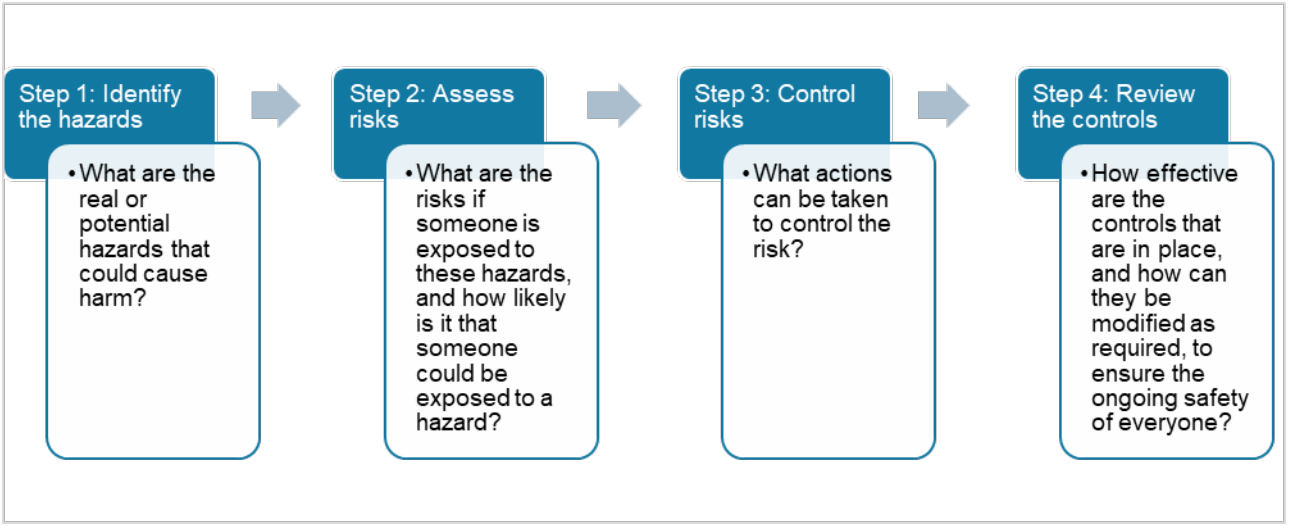
Key concepts used in risk management are described in Table 2.1.

Table 2.1. Risk management key concepts – general

Concept	Description
Hazard	A situation or thing that has the potential to harm a person.
Risk	The possibility that harm (death, injury, illness) might occur when exposed to a hazard. Risk assessments should be undertaken to determine what could happen if someone is exposed to a hazard, and the likelihood of this occurring. A risk assessment can help determine: • the severity of the risk • the effectiveness of current control measures • what action is required to control the risk • how urgently action should be taken.
Risk control	Taking action to eliminate or control the risks, so far as is reasonably practical. Controls should be constantly reviewed and measured to evaluate their effectiveness.

Risk management is a four-step process, as illustrated in Figure 2.1:

Figure 2.1. Risk management process



[36] https://www.legislation.gov.au/Details/C2018C00293

Risk management in infection prevention and control

Examples of the key concepts of risk management in the context of IPC are provided in Table 2.2.

Table 2.2. Examples of risk management key concepts in infection prevention and control

Concept	Examples
Hazards	Microorganisms that may colonise or infect patients, healthcare workers or visitors.
Risks	Healthcare-associated infections, occupational exposures and sharps injuries.
Risk control	The elements of standard and transmission-based precautions.

Risk management is the basis for preventing and reducing harm arising from a healthcare associated infection (HAI). A successful approach to risk management occurs on many levels within a healthcare facility. Table 2.3 provides some examples of how the risk management approach could be used on different levels in a health service organisation.

Table 2.3. Risk management approach used at specific levels within a healthcare facility

Level	Risk management approach
Facility-wide	Providing support for effective risk management through an organisational risk management policy, educating staff, following up outcomes, monitoring and reporting.
Ward or department based	Embedding risk management into all local policies to ensure risks are considered in every setting.
Individual	Considering the risks involved in carrying out specific procedures, assessing the necessity of a procedure as part of clinical decision-making, and attending education sessions (for example, hand hygiene or respirator fit-testing).

All organisations need to be able to determine the risks in their own context and select the appropriate course of action. Therefore, it is necessary for organisations to regularly conduct infection prevention risk assessments and ensure that all staff understand their responsibility in managing these risks.

The hierarchy of controls

Actions 3.02a (Integrating clinical governance) and 3.07b (Standard and transmission-based precautions) of the NSQHS Preventing and Controlling Infections Standard require all health service organisations to establish multidisciplinary teams to identify and manage risks associated with infections. This is to be done using the hierarchy of controls in conjunction with IPC systems.

The hierarchy of controls (Figure 2.2) is a model used in work health and safety management. It is a step-by-step approach to controlling risk, ranking controls from most to least effective.

The hierarchy of controls, used in conjunction with IPC systems, supports the design of IPC programs and strategies to prevent and control the risk of transmission of infection.

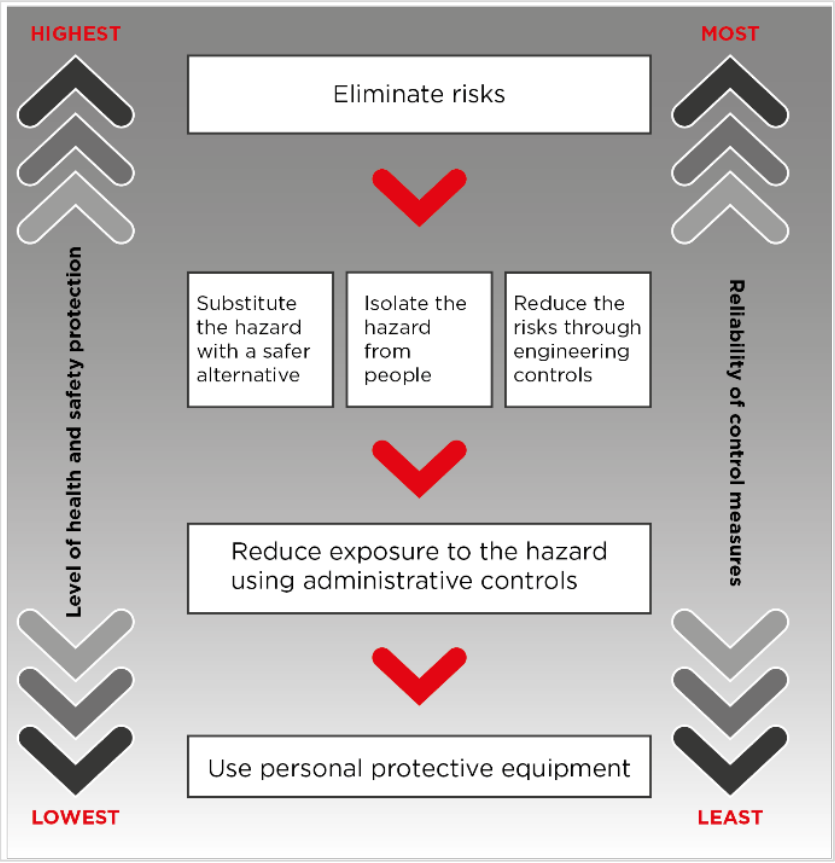
The most effective control measure involves eliminating the hazard and associated risk. If it is not reasonably practicable to eliminate the hazards and risks, then risks must be minimised. This can be done using one or a combination of controls, such as:

- substitution
- isolation
- engineering controls
- administrative controls

- personal protective equipment (PPE).

The ways of controlling risk are ranked from the highest to lowest levels of protection and reliability. Administrative controls and PPE are the least effective, as they do not control the hazard at the source, but rather rely on human behaviour and supervision.

Figure 2.2.The hierarchy of controls



Source: Safe Work Australia. How to manage work health and safety risks: code of practice. Canberra: SWA; 2018:19, 'Hierarchy of control measures' licensed under CC BY-NC 4.0.

Applying the hierarchy of controls

Some examples relevant to each of the controls for IPC programs are provided below. More information is available in the Commission's fact sheet Use of the hierarchy of controls in infection prevention and control.[37]

Specific guidance for COVID-19[38] has also been developed.

Eliminate risks

Elimination is used to remove the infection risk entirely. Examples include:

- prompt management of spills to eliminate the risk of exposure to clinical and biological waste
- immediate disposal of sharps after use to prevent sharps injury
- the use of telehealth to eliminate exposure to potentially infectious patients
- restricting entry of potentially infectious healthcare workers and visitors to the organisation.

[37] https://www.safetyandquality.gov.au/publications-and-resources/resource-library/use-hierarchy-controls-infection-prevention-and-control-factsheet
[38] https://www.health.gov.au/committees-and-groups/infection-control-expert-group-iceg

Substitute the hazard with a safer alternative

Substitution is often used to minimise infection risks. Examples include:

- replacement of reusable medical devices that are difficult to clean, such as cannulated or channelled devices, with single-use equipment
- introduction of safety-engineered devices for cannulation and injections to prevent sharps injury
- administration of aerosolised medicines with spacers instead of nebulisers, to prevent exposure to aerosols.

Isolate the hazard from people

Isolation involves physically separating people from the infection hazard. Examples include:

- placement strategies, such as cohorting or single rooms, for patients with infections transmitted by droplet or airborne transmission
- increasing the distance between beds
- physical barriers, such as privacy screens, for infections transmitted by the droplet route.

Reduce the risks through engineering controls

Engineering controls for infection hazards involve the use of a physical or mechanical process. Examples include:

- optimisation of ventilation and air quality including air exchange rates, air flow and air filtration systems, temperature, and ambient humidity
- redesign of work areas to limit the number of workers at workstations
- maintenance of airflow direction away from staff workstations and towards patient care areas where possible.

Reduce exposure to the hazard using administrative controls

Administrative controls are practices and policies that reduce or prevent exposure to hazards. Examples include:

- designation of an organisational lead who is responsible for implementing IPC strategies
- organisational compliance with the current version of the Australian Guidelines for the Prevention and Control of Infection[35]
- provision of training in IPC practices to all healthcare workers
- provision of a screening and immunisation program for risk-based workforce vaccine-preventable diseases, consistent with the current edition of the Australian Immunisation Handbook[39] and current jurisdictional requirements.

More information is provided in the Commission's document NSQHS Standards Workforce Immunisation Risk Matrix.[40]

[39] https://www.safetyandquality.gov.au/publications-and-resources/resource-library/australian-guidelines-prevention-and-control-infection-healthcare

[40] https://www.safetyandquality.gov.au/publications-and-resources/resource-library/nsqhs-standards-workforce-immunisation-risk-matrix

Use of PPE

In reducing the risk of infection, the effectiveness of PPE depends on access to appropriate PPE, correct use, complementary substitution, and administrative and engineering controls. Healthcare organisations should provide:

- access to a sufficient supply of a range of sizes and types of PPE relevant to the infection risks in the healthcare setting
- training programs about correct use of PPE, including how to put on, remove and dispose of PPE, and competency assessment
- fit-checking and fit-testing protocols for particulate filter respirators (for example, P2/N95).

Risk management in infection prevention and control programs

The NSQHS Preventing and Controlling Infections Standard[34] requires organisations to use evidence-based systems to mitigate the risk of infection. IPC programs are an important element of these systems to ensure:

- a safe environment for patients, visitors and healthcare workers
- good health outcomes for patients
- minimisation of the development of resistant organisms.

Each IPC program needs to address risk management in relation to:

- patients
- the clinical environment
- healthcare workers
- delivery of health care
- clinical equipment
- visitors and carers.

Each of these topics is expanded upon below.

Patients

Every patient that presents to a health service organisation should be considered as potentially at risk of acquiring an infection, and an infection risk to others. Opportunities for the transmission of infections occur because patients:

- are often located closely to one another
- are unwell, often with co-morbidities
- may undergo invasive procedures
- may have invasive medical devices inserted
- may receive antimicrobials and immunosuppressive therapies.

To assess infection risk in patients, consider the following questions:

- What is the patient's history, including underlying health conditions (for example, recent surgery, overseas travel, immunosuppression)?
- Does the patient have symptoms that suggest they may have an infection?
- Are other patients, healthcare workers or visitors at risk of infection (for example, immunosuppressed patients, pregnant women, young children, the elderly)?
- Is the patient likely to undergo an invasive procedure and where will this occur (operating theatre, interventional suite)?
- What are the processes for communicating relevant details of a patient's infectious status if care is transferred between clinicians or organisations, or with family and carers?

The clinical environment

The level of infection risk posed by the clinical environment varies according to the purpose for which it is used and the design and structure, which influences the ease with which the space can be cleaned. Other important factors are the volume of patient care activity and the type of equipment used for patient care.

To assess infection risk in the clinical environment, consider the following questions:

- What policies and guidelines are available to guide maintenance, repair and upgrade of building, equipment, furnishings, and fittings?
- What processes are in place to evaluate and respond to infection risks for new and existing equipment, devices, and products?
- Who is responsible for cleaning the environment?
- Are healthcare workers trained in environmental and equipment cleaning, use of PPE, and IPC?
- What environmental cleaning solutions are available?
- Are there local issues that might increase the risk of infection such as building renovations or outbreaks?

The Australasian Health Facility Guidelines[41] provide information to assist organisations to plan the design of health facilities.

The Commission has also developed environmental cleaning resources[42] that provide more information on risk management for the clinical environment.

See Module 4. Clean and safe healthcare environment and Module 10. Renovation, repairs and redevelopment risk management in this workbook for detailed information on risk management of the clinical environment.

Healthcare workers

Healthcare workers can become exposed to infectious agents in several ways, including through contact with an infectious patient or because of a sharps injury. They may also put patients at risk of infection if they have an infectious condition.

To assess infection risk to healthcare workers, consider the following questions:

- Does the organisation have a vaccine-preventable diseases screening and immunisation policy and program?
- Are healthcare workers assessed for their individual risk of exposure to vaccine-preventable diseases or other infections, during their work? (See the Commission's document NSQHS Standards Workforce Immunisation Risk Matrix.[40])
- Does the organisation have appropriate IPC training in place?
- Is a range of PPE available and easily accessible?
- Does the organisation provide suitable PPE for different tasks and different roles (for example, clinical care, cleaning, engineering)?

Healthcare workers living with a bloodborne virus (BBV), including hepatitis B, hepatitis C and human immunodeficiency virus (HIV), must be managed by the Australian National Guidelines for

[41] https://healthfacilityguidelines.com.au/aushfg-parts
[42] https://www.safetyandquality.gov.au/search?keys=cleaning

the Management of Health Care Workers Living with a Blood Borne Virus 2018.[43] and relevant state or territory policy.

Delivery of health care

While delivering care, healthcare workers should assess for risks and decide how activities can be performed safely. Some activities carry a higher risk of infection transmission than others.

The use of standard and transmission-based precautions will mitigate most infection risks. However, other factors should also be considered when assessing infection risk in the delivery of health care.

Figure 2.3. A healthcare worker wearing gloves to dress a patient's wound.

To assess infection risk in the delivery of health care, consider the following questions:

- What type of activity is being performed (for example, invasive procedure, wound dressing, personal care)?
- Where is the care being delivered (for example, clinical setting, patient's home)?
- Is the patient known to be colonised or infected with a particular microorganism?
- Are cognitive or behavioural factors present that may increase the risk of the patient transmitting an infection?
- What other activities are happening in the clinical area (for example, cleaning, emergency responses)?
- What resources are available for the activity (for example, appropriate PPE, condition of the equipment)?
- What actions can be taken to reduce the risk of infection transmission during the activity (for example, aseptic technique, patient placement, transmission-based precautions)?

Further information

The Commission has developed several resources to assist with risk assessment in the delivery of health care, including:

- Aseptic technique[44]
- NSQHS Standards workforce immunisation risk matrix[40]
- Ensuring appropriate patient placement[45]

[43] https://www1.health.gov.au/internet/main/publishing.nsf/Content/cda-cdna-bloodborne.htm
[44] http://www.safetyandquality.gov.au/publications-and-resources/resource-library/nsqhs-standards-aseptic-technique-risk-matrix
[45] https://www.safetyandquality.gov.au/our-work/infection-prevention-and-control/ensuring-appropriate-patient-placement

- Environmental cleaning.[46]

Clinical equipment

All new and existing equipment used for patient care and procedures should be routinely assessed for potential infection risks.

The variety of, and options for, equipment used in patient care is constantly evolving. New materials and technology used in equipment and medical devices can improve patient care and procedures, but also create new challenges.

Figure 2.4. Storeroom containing clinical equipment ready for use.

Cleaning solutions used within an organisation may not be appropriate for new devices. Some technologies require specialised servicing and maintenance, while others require staff to undergo specialised training and accreditation to use the device to perform a procedure.

Existing equipment and medical devices may become damaged over time or be difficult to clean. These factors can potentially increase the risk of infection transmission and must be planned for and managed.

To assess infection risk during use of clinical equipment, consider the following questions:

- Does the organisation have a process for assessing new products and equipment?
- Does the organisation have an equipment maintenance program for cleaning, servicing, repairing and replacement?
- Are reusable devices reprocessed on site or by an external contractor?
- Are staff trained to reprocess reusable medical devices and patient care equipment?
- How are equipment, stock and reusable medical devices stored?
- Do current reprocessing practices comply with AS/NZS 4187:2014[47] and AS/NZS 4815:2006[48] for reprocessing?

Visitors and carers

Visitors and carers can be at risk of infection as well as pose a potential infection risk to others. They may be involved in patient care and should be informed about basic IPC practices. Identifying and managing gaps in information and resources for visitors and carers will help to reduce the risk of infection, both in the organisation and at home.

[46] https://www.safetyandquality.gov.au/our-work/infection-prevention-and-control/environmental-cleaning-and-infection-prevention-and-control-resources
[47] https://store.standards.org.au/product/as-nzs-4187-2014
[48] https://store.standards.org.au/product/as-nzs-4815-2006

To assess infection risk to or from visitors and carers, consider the following questions:

- Is information available for visitors and carers about current infection risks or infectious diseases?
- Are restrictions on visiting clinical areas needed to reduce infection risks?
- If carers are involved in direct patient care, are they provided with information, training, and support to deliver that care safely?
- Is IPC-related information available in locally used languages, other than English?
- Are visitors and carers aware that they should not visit patients when they themselves are unwell?

Part 2: Risk management for specific infectious agents and diseases

Part 2 covers the following topics:

- **Introduction to risk management for specific infectious agents and diseases**
- **Common infectious agents and diseases and their risk management**

Introduction to risk management for specific infectious agents and diseases

This section provides guidance in relation to risk management, IPC, and patient placement for common infectious agents. Information for each agent is presented as a table describing the disease or infectious agent; symptoms, diagnosis, and treatment; means of transmission; IPC precautions; and other management strategies.

Patient placement is an important element of IPC, along with the use of dedicated equipment, appropriate PPE, and effective environmental cleaning. The Commission has developed the resource Ensuring appropriate patient placement[45] as a guide to support healthcare workers in the appropriate bed allocation, particularly in circumstances when IPC advice is not readily available.

The Commission's website also has Standardised infection control signage[49] (posters) that complements appropriate patient placement. The posters increase awareness by healthcare workers, patients and visitors of precautions that can minimise the transmission of infectious agents. Some states and territories have also developed signage which can be accessed by visiting the local health department website.

The content of the following tables has been sourced from:

- The Australian Guidelines for the Prevention and Control of Infection in Healthcare[50] (current edition)
- Australian Government Department of Health[51]
- Centers for Disease Control and Prevention.[52]

In addition, Communicable Diseases Network Australia (CDNA) has developed the Series of National Guidelines (SoNGs)[53]. These guidelines provide nationally consistent advice and guidance to public health units to help them respond to a notifiable disease event.

[49] https://www.safetyandquality.gov.au/our-work/infection-prevention-and-control/standard-and-transmission-based-precautions-and-signage
[50] https://www.safetyandquality.gov.au/publications-and-resources/resource-library/australian-guidelines-prevention-and-control-infection-healthcare
[51] https://www.health.gov.au/
[52] https://www.cdc.gov/
[53] https://www1.health.gov.au/internet/main/publishing.nsf/Content/cdnasongs.htm

Common infectious agents and diseases and their risk management

Risk management is described for the following common infectious agents and diseases:

- *Clostridioides difficile*
- Creutzfeldt-Jacob Disease (CJD)
- Gastroenteritis
- Group A beta-haemolytic streptococcus (GAS)
- Hepatitis A
- Hepatitis B
- Hepatitis C
- Impetigo
- Influenza (seasonal)
- Legionnaires' disease
- Measles (rubeola)
- Meningococcal disease
- Mumps
- Novel respiratory viruses
- Pertussis (whooping cough)
- Respiratory syncytial virus (RSV), parainfluenza and adenovirus
- Rubella (German measles)
- Tuberculosis (TB)
- Varicella (chickenpox)

Table 2.4. Clostridioides difficile

Disease or infectious agent	Clostridioides difficile
Description	*Clostridioides difficile* is a toxin and spore-forming bacteria that causes severe gastrointestinal infection and pseudomembranous colitis. About 20% of patients with an initial infection will have at least one recurrent episode of symptomatic infection, usually within 21 days of the initial episode. *Clostridioides difficile* infection (CDI) is commonly associated with prolonged and unnecessary use of broad-spectrum antimicrobials, hospitalisation, advanced age, and underlying morbidity. Infants can carry without having disease.
Symptoms	• Diarrhoea – two or more loose/watery stools more than what is normal for a patient in a 24-hour period. • Fever. • Ileus, toxic megacolon or pseudomembranous colitis (identified by colonoscopy).
Diagnosis	Faecal, rectal swab or intestinal contents testing.
Treatment	Appropriate antimicrobial therapy.
Means of transmission	• Direct contact with contaminated surfaces and equipment. • Transmitted in faeces.
Precautions on clinical suspicion	• Standard and contact precautions, including isolation in a single room with dedicated ensuite, where available. • Contact precautions for a minimum of 48 hours after the resolution of symptoms.
Other strategies	Transmission can be further reduced by: • using soap and water to perform hand hygiene, rather than alcohol-based hand rub • early testing of patients who have diarrhoea, and intervention to prevent outbreaks • regular cleaning of all equipment and environmental surfaces • an effective antimicrobial stewardship (AMS) program to ensure appropriate antimicrobial use, and potentially reduce the risk of patients developing CDI • routine surveillance • patient and carer education on how to reduce transmission.

Table 2.5. Creutzfeldt-Jacob Disease (CJD)

Disease or infectious agent	Creutzfeldt-Jacob Disease (CJD)
Description	Caused by protein-based, transmissible agents known as prions, that accumulate in brain and neural cells. Prions cannot be cultured and do not trigger an immune response. Causes rare chronic encephalopathy and associated dementia leading to death. Resistant to heat, chemicals, and irradiation. Long incubation period of many years. Once signs appear, deterioration is progressive and rapid.
Symptoms	• Personality changes • Memory loss • Impaired thinking • Blurred vision or blindness • Insomnia • Incoordination • Difficulty speaking • Dysphagia • Myoclonus
Diagnosis	• Medical and personal history • Neurological exam • Diagnostic tests such as cerebrospinal fluid (CSF) testing for protein markers • Brain biopsy
Treatment	None available – death usually occurs within one year of onset of symptoms.
Means of transmission	May develop as: • sporadic – occurs for no obvious cause • genetic or familial – inherited • medically acquired – from contaminated instruments used during brain or cornea surgery, from transplants of diseased human growth hormone or tissue, or from blood transfusions • variant – caused by eating meat from cattle that had mad cow disease (vCJD).
Precautions on clinical suspicion	Standard precautions.
Other strategies	Transmission can be further reduced by: • exclusive use of man-made human growth hormone, rather than the kind derived from human pituitary glands • destruction of surgical instruments used on the brain or nervous tissue of someone with known or suspected CJD • single-use kits for spinal taps (lumbar punctures) • risk assessment of all patients undergoing identified higher risk procedures.

Table 2.6. Gastroenteritis

Disease or infectious agent	Gastroenteritis
Description	**Gastroenteritis (viral):** rotavirus, norovirus, adenovirus. **Gastroenteritis (bacterial):** *Salmonella* spp., Campylobacter, Shigella, Cholera. **Gastroenteritis (protozoa):** *Giardia lamblia, Entamoeba histolytica, Cryptosporidium parvum*. Incubation period is usually 1–4 days but can be as short as several hours or as long as several weeks after exposure.
Symptoms	• Diarrhoea • Nausea and vomiting • Abdominal pain
Diagnosis	• Two or more loose/watery stools more than normal for a patient in a 24-hour period. • Two or more episodes of vomiting in a 24-hour period. • A stool positive for an infectious agent plus at least one symptom of either nausea, vomiting, abdominal pain, or diarrhoea.
Treatment	• Appropriate antimicrobial therapy for bacterial and protozoan infections. • No specific treatment for viral infections.
Means of transmission	• Faecal–oral route from contaminated food, fluid, or hands, and contaminated surfaces. • Aerosolisation of droplets of vomit or diarrhoea.
Precautions on clinical suspicion	Contact precautions for: • duration of illness in most infections • *Salmonella* spp., Campylobacter, Shigella, Cholera: until 24 hours after symptoms have ceased • norovirus: a minimum of 48 hours after the resolution of symptoms or to control institutional outbreaks. Droplet precautions are also required in some situations, such as during an outbreak.
Other strategies	Transmission can be further reduced by: • early diagnosis to reduce the risk of outbreaks • effective hand hygiene with soap and water • prioritising patients with vomiting and diarrhoea for a single room with a dedicated ensuite • patient and carer education on how to reduce transmission.

Table 2.7. Group A beta-haemolytic streptococcus (GAS)

Disease or infectious agent	Group A beta-haemolytic streptococcus (GAS)
Description	Group A beta-haemolytic *streptococcus* (GAS or group A strep) are bacteria that cause infections that range from minor to very severe, and include: • strep throat • skin infections, such as impetigo (school sores) • scarlet fever • cellulitis • toxic shock syndrome • rheumatic fever • necrotising fasciitis • post-streptococcal glomerulonephritis. Puerperal and neonatal infections require immediate antibiotic treatment. GAS can also lead to sepsis, which needs to be identified early and requires immediate treatment; sepsis is a medical emergency.
Symptoms	Symptoms vary depending on the site of infection but may include: • fever and chills • tender, swollen lymph nodes • sore throat, inflamed and exudative tonsils (strep throat) • rash on the torso (scarlet fever) • blisters on the face and/or limbs (impetigo).
Diagnosis	• Throat swab • Swab of fluid in blisters • Blood culture
Treatment	Appropriate antimicrobial therapy.
Means of transmission	Person-to-person by contact and droplet transmission (saliva and respiratory secretions).
Precautions on clinical suspicion	• Contact and droplet precautions until the first 24 hours of antimicrobial therapy is complete. • Standard precautions thereafter.
Other strategies	Transmission can be further reduced by: • covering affected wounds with appropriate occlusive dressings • patient and carer education on how to reduce transmission and the importance of taking the antimicrobial therapy as prescribed, to minimise the incidence of complications.

Table 2.8. Hepatitis A

Disease or infectious agent	Hepatitis A
Description	Hepatitis A virus is a non-enveloped ribonucleic acid (RNA) virus classified as a picornavirus. Hepatitis A: • is highly contagious and causes acute liver inflammation. • usually a short-term infection and does not become chronic. In rare cases, can cause liver failure and death. • occurs where there is incidence of the disease, combined with poor food handling or sanitation. • Is often associated with community outbreaks, for example, childcare centres, refugee camps. Infection is usually self-limiting, but can last for several weeks, and confers life-long immunity to further infection. Long incubation period (15–50 days) so determining the source of infection is often difficult.
Symptoms	May be asymptomatic. Symptoms may include: • jaundice and yellowing of the sclera • loss of appetite • abdominal pain • nausea and vomiting • fever • dark urine or pale stools • diarrhoea • joint pain • lethargy.
Diagnosis	• Medical history • Blood test
Treatment	• Rest • Adequate nutrition • Fluids
Means of transmission	Faecal-oral route, either by person-to-person contact or ingestion of contaminated food/water.
Precautions on clinical suspicion	• Standard precautions. • Addition of contact precautions for incontinent persons for the duration of illness.

Other strategies	Transmission can be further reduced by:
	• immunisation of high-risk individuals
	  ○ provision of hepatitis A vaccine or normal human immunoglobulin (NHIG) post exposure as recommended
	  ○ education on safe food handling and sanitation.
	• See Hepatitis A – CDNA National Guidelines for Public Health Units.[54]

[54] https://www1.health.gov.au/internet/main/publishing.nsf/Content/cdnasongs.htm

Table 2.9. Hepatitis B

Disease or infectious agent	Hepatitis B
Description	Hepatitis B virus is an enveloped deoxyribonucleic acid (DNA) virus belonging to the family Hepadnaviridae. Hepatitis B causes liver inflammation which can be acute or become chronic. Complications include cirrhosis of liver, hepatocellular carcinoma and death. Chronic hepatitis B infection is more common in some communities including: ○ Aboriginal and Torres Strait Islander communities ○ in people from parts of the world where hepatitis B is more common. Long incubation period (40–180 days) and is often insidious and asymptomatic in clinical presentation.
Symptoms	May be asymptomatic or cause with mild flu-like symptoms. Symptoms in more serious cases may include: • jaundice and yellowing of the sclera • loss of appetite • abdominal pain • nausea and vomiting • fever • dark urine or clay-coloured stools • joint pain • fatigue.
Diagnosis	• Medical history • Blood test
Treatment	• Rest • Adequate nutrition • Fluids • Antiviral medication in some instances
Means of transmission	Parenteral exposure to blood or body fluids of an infected person, or contaminated equipment. Occupational transmission can occur by percutaneous injures, or mucosal exposure to blood or body fluids from an infected person. Transmission can also occur perinatally. International reports of transmission via contaminated blood products or organ donation.
Precautions on clinical suspicion	Standard precautions.
Other strategies	Transmission can be further reduced by: • an effective occupational exposure protocol for BBV • regular review of activities that provide an infection risk • use of safety-engineered devices and equipment wherever possible • safe sharps management, handling and disposal • effective spills management protocols • cleaning, disinfection and sterilisation protocols for instrumentation and equipment that meet relevant national or jurisdictional requirements • patient and carer education on how to reduce transmission. See Hepatitis B – CDNA National Guidelines for Public Health Units.[55]

[55] https://www.health.gov.au/resources/publications/hepatitis-b-cdna-national-guidelines-for-public-health-units

Table 2.10. Hepatitis C

Disease or infectious agent	Hepatitis C
Description	Hepatitis C virus is a small, enveloped RNA virus belonging to the family Flaviviridae. Hepatitis C causes liver inflammation which can be acute or become chronic. Complications include cirrhosis of liver, hepatocellular carcinoma and death. Incubation period is 2–12 weeks (range: 2–26 weeks) and is often insidious and asymptomatic in clinical presentation. Around 30% of people who have been infected may clear the virus from their blood naturally, with no treatment, within 6 months.
Symptoms, diagnosis, and treatment	May be asymptomatic or cause with mild flu-like symptoms. Symptoms in more serious cases may include: • jaundice and yellowing of the sclera • loss of appetite • abdominal pain • nausea and vomiting • fever • dark urine or clay-coloured stools • joint pain • fatigue • skin rash.
Diagnosis	• Medical history • Blood test
Treatment	Appropriate antiviral therapy.
Means of transmission	Parenteral exposure to blood or body fluids of an infected person, or contaminated equipment. Occupational transmission can occur by percutaneous injury, or mucosal exposure to blood or body fluids of an infected person. Can occur perinatally. Can occur in people who have substantial or repeated percutaneous exposures to blood (for example, injecting drug users, persons with haemophilia). International reports of transmission via contaminated blood products.
Precautions on clinical suspicion	Standard precautions.

Disease or infectious agent	Hepatitis C
Other strategies	Transmission can be further reduced by: • screening and vaccination for healthcare workers and laboratory staff • an effective occupational exposure protocol for BBV • regular review of activities that provide an infection risk • use of safety-engineered devices and equipment • safe sharps management, handling and disposal • effective spills management protocols • cleaning, disinfection and sterilisation protocols for instrumentation and equipment • patient and carer education on how to reduce transmission. • risk assessment management of infected healthcare workers with regard to exposure-prone procedures (EPPs). See Hepatitis C – CDNA National Guidelines for Public Health Units.[56]

Table 2.11. Impetigo

Disease or infectious agent	Impetigo
Description	Highly infectious bacterial skin infection caused by *Staphylococcus* or *Streptococcus* bacteria. Common in school-aged children.
Symptoms, diagnosis, and treatment	Symptoms include: • red, itchy patches of skin that form blisters, particularly around the nose and mouth • blisters burst and weep yellow, sticky fluid • an area that develops a raised, wet-looking crust. If large areas of the skin are affected, symptoms may also include: • fever • swollen lymph glands • malaise.
Diagnosis	• Clinical appearance. • Culture of fluid in blisters.
Treatment	Appropriate antimicrobial therapy.
Means of transmission	Direct contact with the fluid from the blisters or sores.
Precautions on clinical suspicion	• Contact precautions are required until the first 24 hours of antimicrobial therapy is completed. • Standard precautions are required thereafter.

[56] https://www.health.gov.au/resources/publications/hepatitis-c-cdna-national-guidelines-for-public-health-units?language=en

Disease or infectious agent	Impetigo
Other strategies	Transmission can be further reduced by: • covering the blisters or sores with an occlusive dressing • excluding children with impetigo from school or day care until 24 hours of antimicrobial therapy is complete • performing hand hygiene with soap and water • good personal hygiene • avoiding the sharing of personal items such as towels and face washers • patient and carer education on how to reduce transmission.

Table 2.12. Influenza (seasonal)

Disease or infectious agent	Influenza (seasonal)
Description	Respiratory tract infection caused by single-stranded RNA orthomyxoviruses, classified as types A, B, C or D. Generally, only influenza A and B cause severe disease in humans. Novel and pandemic strains require outbreak and disaster risk-planning. Refer to national, state or territory guidelines for more information. Incubation period 1–4 days with symptomatic disease lasting 2–5 days. Virus changes antigenic makeup frequently (often annually). Complications include: • pneumonia • otitis media • encephalitis • death.
Symptoms	• Fever • Malaise • Headache • Cough • Sore throat • Myalgia • Vomiting and diarrhoea in children
Diagnosis	Nose and/or throat swab
Treatment	Anti-viral medications should be considered for treatment if identified early.
Means of transmission	Direct and indirect contact and droplet transmission.
Precautions on clinical suspicion	• Contact and droplet precautions until after 72 hours of receiving anti-influenza medication or 5 days have elapsed since the onset of respiratory symptoms (may be longer for young children, immunosuppressed people, or patients in intensive care). • Standard precautions thereafter.

Disease or infectious agent	Influenza (seasonal)
Other strategies	Transmission can be further reduced by: • early diagnosis and treatment to reduce the risk of outbreak • minimising aerosol-generating procedures • annual vaccination in line with national, state or territory requirements • patient and carer education on how to reduce transmission. See Seasonal Influenza Infection – CDNA National Guidelines for Public Health Units.[57]

Table 2.13. Legionnaires' disease

Disease or infectious agent	Legionnaires' disease)
Description	Severe bacterial lung infection caused by either *Legionella pneumophila* or *Legionella longbeachae.* *Legionella pneumophila* most often associated with water from water supply systems (hot, warm or cold) or from cooling towers for air-conditioning units. *Legionella longbeachae* most often associated with potting mixes or soil.
Symptoms, diagnosis, and treatment	• Headache (often severe) • Fever • Myalgia • Dry cough and shortness of breath In some cases, other systems in the body are affected causing: • diarrhoea • mental confusion • renal failure.
Diagnosis	• History of possible exposure. • Culture of blood, urine and/or sputum.
Treatment	Appropriate antimicrobial therapy.
Means of transmission	• Not transmitted from person-to-person. • Infection caused by inhaling bacteria from soil or water.
Precautions on clinical suspicion	Standard precautions for the duration of admission.
Other strategies	Transmission can be further reduced by: • developing a *Legionella* risk management plan based on risk assessment • investigating potential outbreaks associated with the organisation, to identify and test the possible source of infection and likely reservoirs for contamination • reviewing preventive maintenance procedures and monitoring programs for cooling towers, water systems, birthing and hydrotherapy pools, and thermal mixing valves • avoiding the use of tap water in respiratory therapy devices, such as nebulisers. See Legionellosis – CDNA National Guidelines for Public Health Units.[58]

[57] https://www1.health.gov.au/internet/main/publishing.nsf/Content/cdnasongs.htm
[58] https://www.health.gov.au/resources/publications/legionellosis-cdna-national-guidelines-for-public-health-units?language=en

Table 2.14. Measles (rubeola)

Disease or infectious agent	Measles (rubeola)
Description	Measles is caused by an enveloped, single-stranded RNA virus called paramyxovirus from the genus *Morbillivirus*. Highly transmissible; non-immune individuals are at high risk of contracting if exposed. Usually presents as a mild disease. However, complications include otitis media, pneumonia and encephalitis. Rarely, subacute sclerosing panencephalitis (SSPE)[59] can occur and can lead to death.
Symptoms, diagnosis, and treatment	• Prodrome of malaise, cough, coryza, and conjunctivitis. • Maculopapular rash that spreads from the head to the trunk, to the lower extremities. • Fever.
Diagnosis	• Clinical symptomology • Throat swab • Urine test • Blood test
Treatment	• Rest • Adequate nutrition • Fluids • Appropriate antimicrobial therapy may be required if otitis media or bacterial pneumonia develop
Means of transmission	Airborne transmission (saliva and respiratory secretions).
Precautions on clinical suspicion	• Airborne precautions, including placement in a negative pressure room if available, for 4 days after rash appears, and for the duration of illness in immunocompromised patients. • Standard precautions thereafter.
Other strategies	Transmission can be further reduced by: • preventing susceptible healthcare workers from caring for patients • screening and vaccination in line with national, state or territory requirements • post-exposure prophylaxis for susceptible healthcare workers • minimising aerosol-generating procedures • patient and carer education on how to reduce transmission. See Measles – CDNA National guidelines for Public Health Units.[60]

[59] https://www.ninds.nih.gov/Disorders/All-Disorders/Subacute-Sclerosing-Panencephalitis-Information-Page
[60] https://www.health.gov.au/resources/publications/measles-cdna-national-guidelines-for-public-health-units?language=en

Table 2.15. Meningococcal disease

Disease or infectious agent	Meningococcal disease)
Description	Rare but significant disease caused by a bacterium known as *Neisseria meningitides*. Can cause inflammation of the brain and spinal cord, and septicaemia. Often difficult to diagnose and can cause significant morbidity and mortality if not identified and managed early. Occurs throughout the year, although most significant in Australia during autumn and winter. Can be carried asymptomatically in the throat of healthy individuals and be transmitted to others. Can also cause: • bacteraemia • septic arthritis (especially weight bearing joints) • conjunctivitis.
Symptoms	Symptoms include: • sudden onset of fever • altered state of consciousness • neck stiffness • headache • haemorrhagic, non-blanching rash. Young children may have fewer specific symptoms. Which may include: • irritability • difficulty waking • high-pitched crying • refusal to eat. Absence of a rash should not delay treatment if meningococcal disease is suspected.
Diagnosis	• Clinical symptomology • Culturing of blood or cerebral spinal fluid
Treatment	Urgent appropriate antimicrobial therapy.
Means of transmission	Droplet transmission (saliva and respiratory secretions).
Precautions on clinical suspicion	• Droplet precautions until the first 24 hours of antimicrobial therapy is complete. • Standard precautions thereafter.

Disease or infectious agent	Meningococcal disease)
Other strategies	Transmission can be further reduced by: • healthcare worker education about the identification of disease • vaccination • contact tracing and prophylaxis for close contacts • patient and carer education. Immunisation considered with some healthcare worker groups for example, laboratory staff. More commonly used during outbreaks. Immunisation does not cover all possible serotypes. Post-exposure prophylaxis for staff who have had significant contact with patient's naso/oropharyngeal secretions before droplet precautions being implemented. Colonised individuals usually not treated with antibiotics. See Invasive Meningococcal Disease – CDNA National Guidelines for Public Health Units.[61]

[61] https://www.health.gov.au/resources/collections/cdna-series-of-national-guidelines-songs?utm_source=health.gov.au&utm_medium=callout-auto-custom&utm_campaign=digital_transformation#i

Table 2.16. Mumps

Disease or infectious agent	Mumps
Description	Acute viral infection caused by an enveloped virus which is a member of the *Paramyxovirus* family. Incubation period is usually 12–25 days. Generally mild and self-limiting in children, but may lead to severe complications, such as: • encephalitis • meningitis • myocarditis. Complications in post-pubertal individuals include: epididymoorchitis (males) mastitis and/or oophoritis (females) miscarriage in first 3 months of pregnancy. Rare in Australia due to vaccination; non-immunised people have the highest risk.
Symptoms, diagnosis, and treatment	• Fever • Swelling of the parotid glands (usually unilateral) • Headache • Fatigue • Myalgia • Loss of appetite • Pain on chewing or swallowing
Diagnosis	• Clinical symptomology • Throat swab • Urine test • Blood test
Treatment	• Rest • Adequate nutrition • Fluids
Means of transmission	Contact and droplet (respiratory secretions).
Precautions on clinical suspicion	• Standard and droplet precautions until 5 days after onset of parotid gland swelling. • Exposed non-immune people should be considered infectious from days 12–25 after exposure, with or without symptoms.
Other strategies	Transmission can be further reduced by: • preventing susceptible healthcare workers from caring for patients • screening and vaccination in line with national, state or territory requirements • patient and carer education on how to reduce transmission.

Table 2.17. Novel respiratory viruses

Disease or infectious agent	Novel respiratory viruses
Description	Novel respiratory viruses are new virus subtypes that emerge when an animal virus begins to spread among humans. Include: • novel influenza viruses • coronaviruses, such as Middle East respiratory syndrome Coronavirus (MERS-CoV), severe acute respiratory syndrome (SARS) and severe acute respiratory syndrome Coronavirus 2 (SARS-CoV-2/COVID-19). Often have pandemic potential.
Symptoms, diagnosis, and treatment	• Apnoea in infants • Low-grade fever (generally minimal throughout the course of the disease) • Mild, occasional cough • Runny nose
Diagnosis	• Clinical symptomology • Physical examination • Throat swab culture • Blood test
Treatment	• Antiviral treatment • Symptom support/ hydration, respiratory support
Means of transmission	Contact, droplet and airborne transmission.
Precautions on clinical suspicion	Combined contact and airborne precautions, noting that these precautions in combination provide adequate protection against droplet transmission.
Other strategies	Transmission can be further reduced by: • early diagnosis to reduce the risk of outbreaks • preventing non-immune healthcare workers from caring for patients (in the case of SARS-CoV-2/COVID-19) • screening and vaccination of healthcare workers in line with national, state or territory requirements (in the case of SARS-CoV-2/COVID-19) • minimising aerosol-generating procedures • patient and carer education on how to reduce transmission, including vaccination (in the case of SARS-CoV-2/COVID-19). See Coronavirus Disease 2019 (COVID-19) – CDNA National Guidelines for Public Health Units.[62]

[62] https://www.health.gov.au/resources/publications/coronavirus-covid-19-cdna-national-guidelines-for-public-health-units?language=en

Table 2.18. Pertussis (whooping cough)

Disease or infectious agent	Pertussis (whooping cough)
Description	Highly infectious respiratory tract infection caused by the bacterium *Bordetella pertussis.* Most at risk population is infants under 6 months of age who are not fully vaccinated. In this population, death can result from pertussis or its complications. Any age group can contract this infection and transmit it to others if exposed to a case and not protected by vaccination, or if immunity has waned.
Symptoms	Early symptoms include: • runny nose • low-grade fever (generally minimal throughout the course of the disease) • mild, occasional cough • apnoea in infants. As the disease progresses, symptoms may include: • paroxysmal coughing, followed by a high-pitched “whoop” sound • vomiting during or after coughing fits • exhaustion following coughing paroxysms.
Diagnosis	• Clinical symptomology • Physical examination • Throat swab culture • Blood test
Treatment	Appropriate antimicrobial therapy.
Means of transmission	Droplet transmission (saliva and respiratory secretions).
Precautions on clinical suspicion	• Droplet precautions until at least 5 days after starting appropriate antimicrobial therapy, or for 21 days after the onset of symptoms if not receiving antimicrobial treatment, or for 14 days after the onset of paroxysmal cough (if the onset is known). • Standard precautions thereafter.
Other strategies	Transmission can be further reduced by: • preventing susceptible healthcare workers from caring for patients • early diagnosis and treatment to reduce the risk of outbreaks • identification and follow up of high-risk contacts (children under 5 years of age and pregnant women) • minimising aerosol-generating procedures • pertussis booster/vaccination and post-exposure prophylaxis for healthcare workers in late pregnancy and high-risk areas • patient and carer education on how to reduce transmission. See Pertussis – CDNA National Guidelines for Public Health Units.[63]

[63] https://www.health.gov.au/resources/publications/pertussis-whooping-cough-cdna-national-guidelines-for-public-health-units?language=en

Table 2.19. Respiratory syncytial virus (RSV), parainfluenza and adenovirus

Disease or infectious agent	Respiratory syncytial virus (RSV), parainfluenza and adenovirus
Description	Respiratory syncytial virus (RSV), parainfluenza and adenoviruses are a group of respiratory viruses that are common among children and can also affect adults. Highly infectious and can cause acute respiratory distress. Often associated with seasonal outbreaks which can impact upon healthcare services with an influx of admissions. Complications include: • pneumonia • bronchiolitis • conjunctivitis • croup.
Symptoms	• Runny nose • Fever • Decreased appetite • Cough • Sneezing • Wheezing • Dyspnoea
Diagnosis	Nasal aspirate.
Treatment	• Rest • Adequate nutrition • Fluids
Means of transmission	Direct and indirect contact and droplet transmission.
Precautions on clinical suspicion	Contact and droplet precautions, including placement in a single room if available for the duration of illness.
Other strategies	Transmission can be further reduced by: • early diagnosis to reduce the risk of outbreaks • minimising aerosol-generating procedures • patient and carer education on how to reduce transmission.

Table 2.20. Rubella (German measles)

Disease or infectious agent	Rubella (German measles)
Description	Rubella is caused by an enveloped, positive-stranded RNA classified as a *Rubivirus* in the *Matonaviridae* family. Usually mild, self-limiting, and may be subclinical. Average incubation period of rubella virus is 17 days, with a range of 12 to 23 days. Complications include: • arthralgia or arthritis • thrombocytopenic purpura • encephalitis. Can cause significant birth defects in foetus if contracted during early pregnancy.
Symptoms	• Lymphadenopathy • Maculopapular rash that spreads from the head to the trunk, to the lower extremities • Fever
Diagnosis	• Clinical symptomology • Throat swab • Urine test • Blood test
Treatment	• Rest • Adequate nutrition • Fluids
Means of transmission	Contact and droplet transmission (saliva and respiratory secretions).
Precautions on clinical suspicion	• Contact and droplet precautions for the duration of illness in immunocompromised patients. • Standard precautions thereafter.
Other strategies	Transmission can be further reduced by: • preventing susceptible healthcare workers (for example, pregnant women) from caring for patients • screening and vaccination in line with national, state or territory requirements • patient and carer education on how to reduce transmission.

Table 2.21. Tuberculosis (TB)

Disease or infectious agent	Tuberculosis (TB)
Description	Bacterial infection caused by an acid-fast bacillus (AFB) known as *Mycobacterium tuberculosis*. Most commonly affects the lungs, causing pulmonary TB, but can also affect parts of the body (such as the brain, kidneys or bone) and is known as extra-pulmonary TB. Most people infected with TB do not have any symptoms (latent TB). Latent TB can develop into active TB disease.
Symptoms, diagnosis, and treatment	Symptoms depend on which part of the body is affected. Symptoms of active pulmonary TB include: • persistent cough • haemoptysis • lethargy • weight loss • fever • night sweats. Latent TB infection is asymptomatic and is not transmissible to others.
Diagnosis	• Medical history and potential risk of exposure • Chest x-ray for evidence of pulmonary infection • Blood and sputum cultures
Treatment	Combined multi-drug therapy, usually a combination of 4 agents administered con over a prolonged period (usually at least 6 months).
Means of transmission	• Active pulmonary TB can spread from person to person through airborne transmission (respiratory secretions). • Latent and extra-pulmonary TB is not spread easily from person to person.
Precautions on clinical suspicion	• Airborne precautions until diagnosis confirmed for all cases of active pulmonary TB and during all aerosol generating procedures (such as induced sputum collection). • Standard precautions for all cases of latent and extra-pulmonary TB.
Other strategies	Transmission can be further reduced by • patient education about the disease and the application of airborne precautions for themselves and others. See Tuberculosis – CDNA National Guidelines for Public Health Units.[64]

[64] https://www.health.gov.au/resources/publications/tuberculosis-cdna-national-guidelines-for-public-health-units?language=en

Table 2.22. Varicella (chickenpox)

Disease or infectious agent	Varicella (chickenpox)
Description	Highly contagious infection caused by an enveloped virus known as varicella-zoster virus (VZV), which is a member of the herpes virus family. Can cause severe disease in adults, particularly in pregnant women and those who are immunocompromised. Average incubation period is 14–16 days after exposure, with a range of 10–21 days. Complications include: • cerebellar ataxia • encephalitis • viral pneumonia • haemorrhagic conditions • septicaemia • toxic shock syndrome • necrotising fasciitis • osteomyelitis • bacterial pneumonia • septic arthritis. Shingles can occur in some individuals who have had previous infection with VZV.
Symptoms, diagnosis, and treatment	• Fever • Headache • Malaise • Vesicular rash
Diagnosis	• Clinical symptomology • Blood test • Culture of fluid from lesion
Treatment	• Antiviral therapy in some cases • Rest • Adequate nutrition • Fluids
Means of transmission	Airborne transmission, as well as via direct contact with fluid from lesions and nasopharyngeal secretions.
Precautions on clinical suspicion	• Airborne and contact precautions, including placement in a negative pressure room if available, until all lesions are dry and crusted. • Standard precautions thereafter.
Other strategies	Transmission can be further reduced by: • preventing susceptible healthcare workers from caring for patients • pre-employment screening and vaccination of healthcare workers in line with national, state or territory requirements • post-exposure prophylaxis for susceptible healthcare workers • minimising aerosol-generating procedures • patient and carer education on how to reduce transmission.

Australian Guidelines for the Prevention and Control of Infection

Module 3. Basic microbiology and multidrug-resistant organisms

Contents

Overview of Module 3

Module 3 contains two parts:

- **Part 1: Basic microbiology and microorganisms**
- **Part 2: Multidrug-resistant organisms**

This module will provide you with an understanding of basic microbiology and the key multidrug-resistant organisms (MROs) that may be present in acute and non-acute health service organisations and the community. Your local state or territory health department may also have more specific MRO guidance available. Information on the management of MROs can also be found in the Australian Guidelines for the Prevention and Control of Infection in Healthcare.[65]

After completing this module, you should be able to:

- describe normal flora and where it is found
- show an understanding of environmental microorganisms
- show an understanding of different types of microorganisms
- show knowledge of multidrug-resistant organisms
- show an understanding of antimicrobial resistance.

Organisations that are required to be assessed against the National Safety and Quality Health Service (NSQHS) Standards (second edition) should refer to the Preventing and Controlling Infections Standard,[66] which sets the framework for infection prevention and control in health service organisations.

[65] https://www.safetyandquality.gov.au/publications-and-resources/resource-library/australian-guidelines-prevention-and-control-infection-healthcare
[66] https://www.safetyandquality.gov.au/standards/nsqhs-standards/preventing-and-controlling-infections-standard

Part 1: Basic microbiology and microorganisms

Part 1 covers the following topics:

- **Basic microbiology**
- **Types of microorganisms**
- **Viruses**
- **Fungi**
- **Prions**

Basic microbiology

In the context of human health, microbiology is the study of microorganisms that make up normal flora and transient flora, as well as infectious agents, and how these microorganisms impact on the health and safety of humans.

As part of their role in producing comprehensive and integrated care, it is important for organisations to develop and maintain formal links with pathology providers, microbiologists, laboratories, and infectious disease specialists who can:

- identify microorganisms
- detect resistance patterns
- support management or treatment of patients.

Normal flora

Normal flora (also known as commensal flora) refers to a collection of microorganisms that do not usually cause any harm and are found in all individuals. These microorganisms are acquired soon after birth and change continuously throughout life.

Normal flora is primarily made up of colonising species that are beneficial to the host. Different parts of the body have different normal flora (see Figure 3.1 Normal flora and the human body).

Under certain conditions, normal flora may become opportunistic pathogens. An opportunistic pathogen is a microorganism that usually does not harm its host, but can cause infection when:

- the host's resistance is low (such as in the elderly, pregnant women, neonates, or those with weakened immune systems)
- a protective barrier (such as the skin or mucous membranes) is damaged or penetrated.

For example, opportunistic pathogens are a common cause of infections acquired from surgical procedures. *Clostridioides difficile* infection, and infections caused by *Candida* species (spp.) may also be opportunistic, as they may occur due to disruption of the normal flora in the body caused by antimicrobial therapy.

People can also be infected by transient flora that briefly colonise the body, or from microorganisms directly acquired from an external source, such as other people, medical devices, equipment, or the environment.

Environmental microorganisms

Our environment is filled with microorganisms. Microorganisms can be found in or on:

- water
- soil
- animals
- buildings and air-conditioning units
- vegetation
- food
- equipment and other hard surfaces.

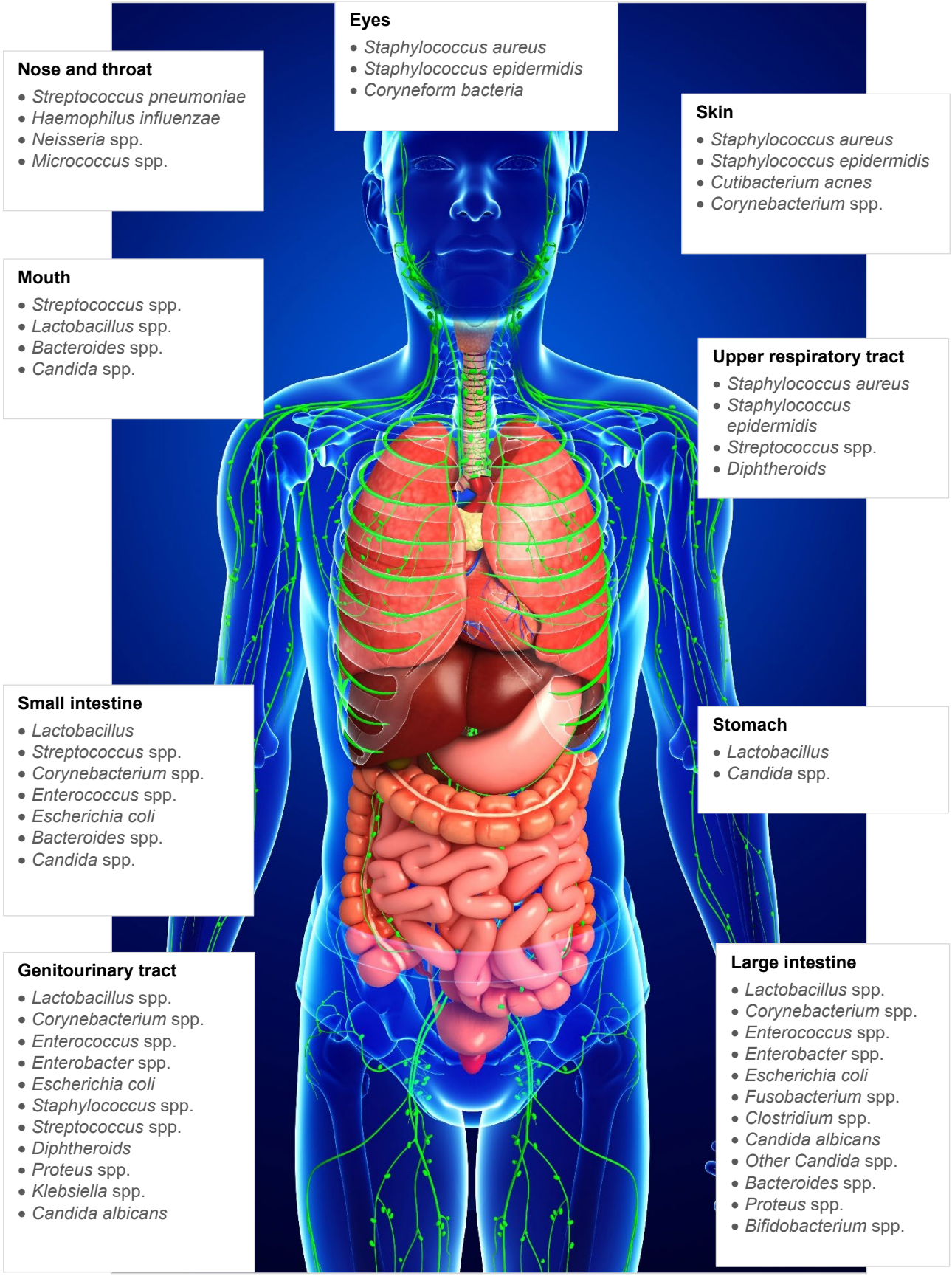
Areas in a health service organisation where there is a risk of contamination by environmental microorganisms include:

- food preparation areas
- air handling systems
- water and plumbing systems
- inanimate surfaces and objects, such as curtains, shelving, or storage units
- equipment, such as ventilators and humidicribs
- wet areas.

Examples of common environmental microorganisms that can become pathogens include *Pseudomonas aeruginosa, Legionella longbeachae, Legionella pneumophilia, Listeria monocytogenes*, and *Aspergillus fumigatus*.

Humans also shed their normal flora into their immediate environment. If an individual's normal flora has potential to cause disease in other people, the environment can act as a reservoir for these microorganisms to multiply and be transmitted, directly or indirectly. Examples of normal flora that can contaminate the environment and be transmitted to others include *Staphylococcus aureus* and *Enterococcus* spp.

Figure 3.1 Normal flora and the human body



Types of microorganisms

Bacteria

Bacteria are single-celled microorganisms. Their cell structure is simpler than that of other organisms, as there is no nucleus or membrane-bound organelles. Instead, their genetic information is contained in a single loop of deoxyribonucleic acid (DNA).

When conditions are favourable (correct temperature and available nutrients), bacteria can multiply rapidly. This can occur inside a host, or on culture media in a laboratory.

Bacteria cause many of the infections that are associated with health care and are therefore the primary focus of infection prevention and control (IPC) programs and surveillance activities.

Nomenclature

Bacterial names consist of two words written in italics. The genus is the first word, and the species is the second word, often abbreviated to “spp.” For example, *Escherichia* spp. The genus is written with an initial capital letter; the species is all lower case.

Identifying bacteria

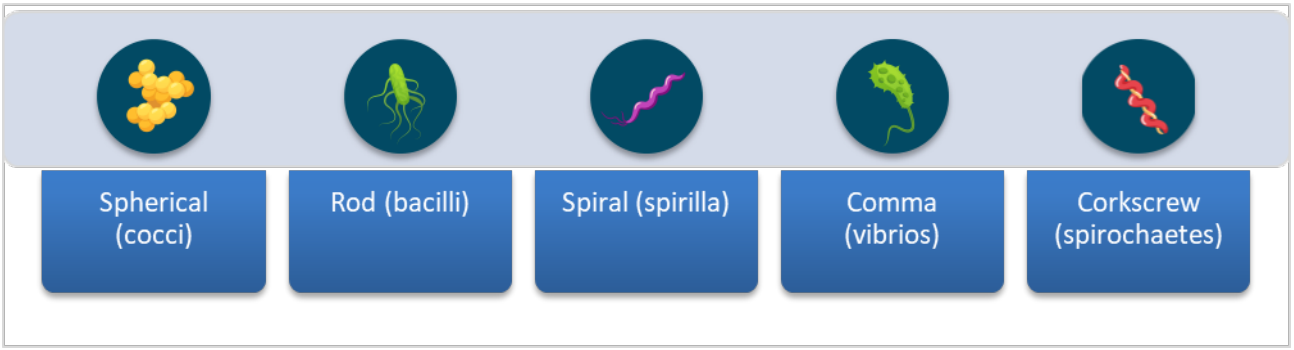
Tools for identification of bacteria include:

- microscopy
- gram staining
- culture
- biochemical, molecular, or proteomic methods, such as immunoassay, polymerase chain reaction (PCR), or matrix-assisted laser desorption ionisation-time of flight (MALDI-TOF) mass spectrometry.

Microscopy

Bacteria can be seen under a microscope and classified into five groups according to their basic shapes (see Figure 3.2). Bacteria can exist as single cells, in pairs, chains or clusters.

Figure 3.2. Classification of bacteria by shape



Gram staining

Gram staining is a common technique used to differentiate two large groups of bacteria by the chemical and physical properties of their cell walls. A slide, containing a heat-fixed smear of bacterial cells, is treated with crystal-violet stain (a basic dye), during which the cells turn blue. The slide is then flushed with an iodine solution, followed by an organic solvent (such as alcohol or acetone). In the final step, a counterstain, such as safranin, is added and stains the gram-negative cells red.

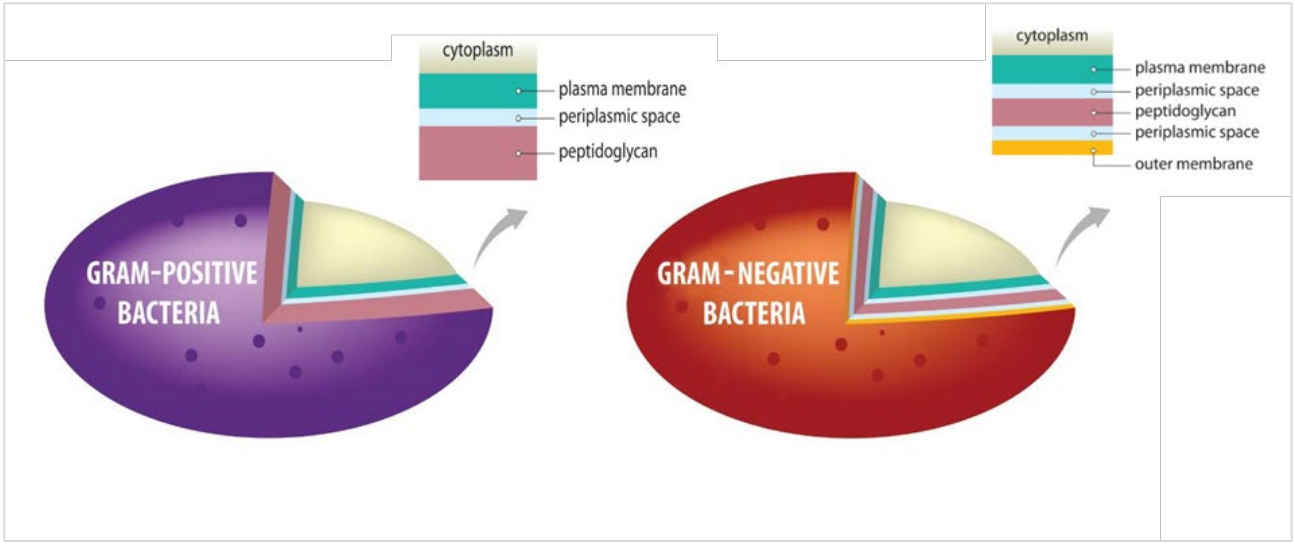
Gram staining divides bacterial species into two large groups:

- gram-positive bacteria
- gram-negative bacteria (see Figure 3.3).

Gram-positive bacteria are characterised by having a thick cell wall made of peptidoglycan (a substance consisting of sugars and amino acids) which retains the blue stain when challenged with the Gram stain technique. Examples of gram-positive bacteria include *Staphylococcus aureus, Staphylococcus epidermidis, Enterococcus* spp.*, Streptococcus pyogenes, Streptococcus pneumoniae, Clostridioides difficile, Lactobacillus* spp. and *Listeria* spp.

Gram-negative bacteria have a thinner peptidoglycan layer and an additional outer layer made up of lipids (fats) and polysaccharides (sugars). As a result, the second red stain is retained, and the blue stain is not. Examples of gram-negative organisms include *Neisseria meningitidis, Neisseria gonorrhoeae, Escherichia coli, Klebsiella pneumoniae, Pseudomonas aeruginosa, Acinetobacter* spp.*, Serratia* spp*. and Bacteroides* spp.

Figure 3.3 Characteristics of gram-positive and gram-negative bacteria



The benefit of Gram staining is that it provides rapid preliminary guidance as to the type of bacteria causing infection. This means that appropriate antimicrobial therapy can be started while waiting for other test results, which can be used to refine the treatment regimen.

Other stains used for microorganism identification

Mycobacterium tuberculosis, which is the causative agent for pulmonary and extra-pulmonary tuberculosis (TB), is an important human pathogen for IPC programs. Due to a complex waxy component in the cell wall, mycobacteria do not take up Gram staining. Instead, a special stain called a Ziehl-Neelsen (ZN) is used, which stains the bacilli red. It is often preferable to use this staining technique to identify mycobacteria as mycobacteria grow relatively slowly and it can take several days to weeks before results of cultures are available.

Because of their resistance to acid-alcohol decolouration (that is, Gram staining), mycobacteria are sometimes referred to as acid-fast bacilli (AFB).

Culture

An artificial nutrient-based culture medium is often used to grow bacterial and fungal cells for further testing. Different types of culture medium are designed to either inhibit or stimulate microorganism growth. Microorganism cells are applied to the culture medium and allowed to grow (incubate). Incubation can take days to weeks depending on the particular species of

microorganism. Once colonies of cells are visible on the culture medium, these colonies are used for further pathological testing such as microscopy, Gram staining, antimicrobial sensitivity testing, and biochemical testing.

Biochemical methods

Biochemical testing is used to identify different bacteria based on their biochemical behaviours in the presence of other chemicals. For example, the ability of a bacteria to metabolise carbohydrates. Antigen testing via immunoassay is a type of biochemical testing method, which detects the presence of proteins (antigens) that are produced as a result of the body's reaction to the presence of infection.

Other molecular testing

Molecular testing is used to detect the presence of DNA. A polymerase chain reaction (PCR) is an example of molecular testing, where a high number of copies of the bacterial cell's DNA are produced and used to identify the bacteria and/or specific genes in the bacteria. This method is often used to identify bacteria that are difficult to culture (for example, those that are nutritionally fastidious or require extreme growing conditions).

Proteomic methods

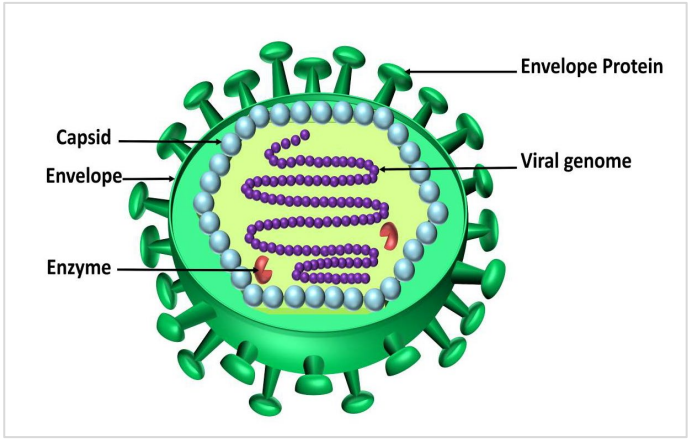
The MALDI-TOF mass spectrometry is an example of a proteomic method that is used to identify and classify bacteria. A sample of microbes is added to a solution called a matrix, which is then dried. The sample is placed into the mass spectrometer and a laser is used to ionise the sample, with individual proteins producing a unique signal. Different bacteria are comprised of different proteins, so the time taken for the reaction (ionisation) to occur is unique to each bacterium and can be used to identify them. This method of testing is fast, sensitive and economical.

Viruses

Viruses are small microorganisms that are seen using an electron microscope and are usually detected by viral culture or molecular methods, such as PCR.

Viruses consist of a core of genetic material of either DNA or ribonucleic acid (RNA), and an outer protein coat called a capsid. Around the capsid, there may be a spikey covering known as an envelope (See Figure 3.4). These spikes are proteins that enable viruses to bind to and enter host cells.

Figure 3.4. Structure of a virus



Unlike bacteria, viruses have no ability to live independently. Instead, viruses require a living host cell in which to grow and multiply. These may be the cells of bacteria, fungi, plants, and animals.

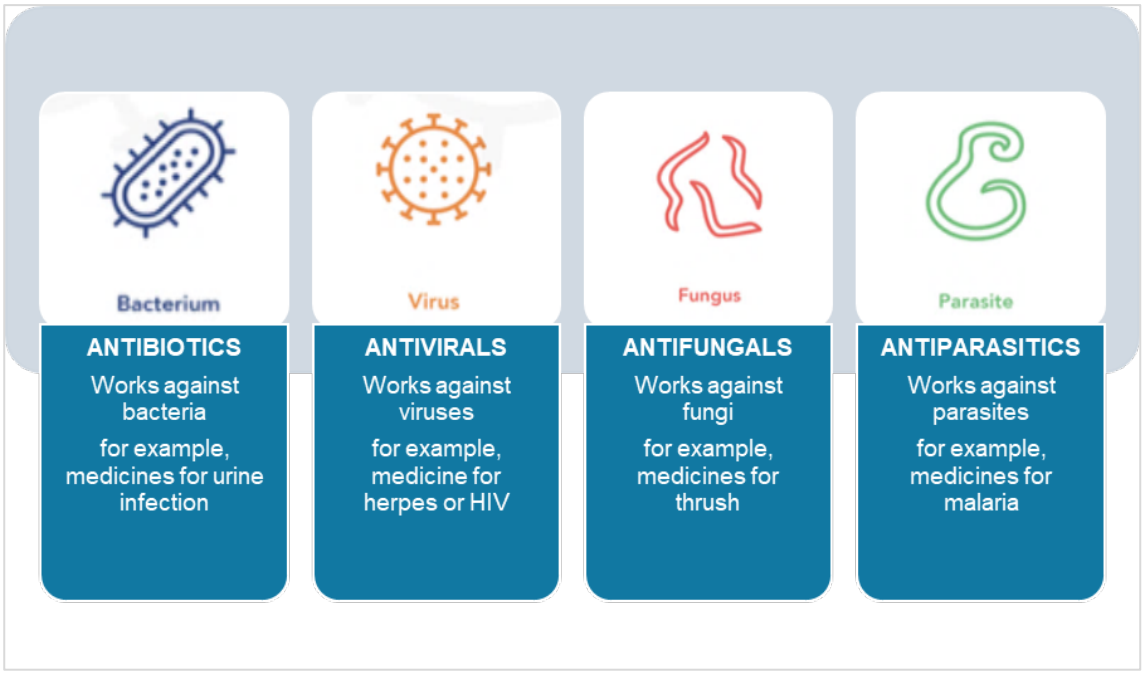
After entering a host cell, a virus hijacks the host cell and uses the host's cellular machinery to make many copies of itself.

Examples of viruses include:

- respiratory viruses, such as respiratory syncytial virus (RSV) and influenza
- systemic viruses, such as measles, rubella, herpes, and varicella-zoster
- gastrointestinal viruses, such as rotavirus and norovirus
- bloodborne viruses (BBV), such as hepatitis and human immunodeficiency virus (HIV).

Viral infections cannot be treated with antibacterial antimicrobials (that is, antibiotics). Figure 3.5 shows the appropriate antimicrobial treatments for each different type of microorganism.

Figure 3.5. The spectrum of antimicrobials



Fungi

Fungi are single-celled or multicellular organisms. Most fungi are microscopic and consist of a thread-like branching structures named hyphae. These branching structures grow into a root-like structure called a mycelium, which absorbs nutrients from the environment. A wide variety of nutrient sources are used by fungi, from soil and water to decaying matter and other living organisms.

Parasitic fungi use specialised hyphal structures that allow them to penetrate host cells. The cell wall of fungi is composed largely of chitin, the same molecule used in the exoskeleton of crustaceans and insects.

Fungi are mostly found in the environment. Yeast, mildew, and mould are types of fungi. Fungi commonly produce spores when they reproduce. Yeast, such as *Candida* spp. (see Figure 3.6), are classified as fungi. Yeasts, however, may be normal flora in certain parts of the body; they can also be invasive opportunistic pathogens.

Figure 3.6. Candida fungi

Aspergillus is a common environmental fungus, which is not usually part of the normal flora of humans. Most strains of this fungus are harmless, but a few can cause serious illness when people with weakened immune systems, underlying lung disease, or asthma inhale *Aspergillus* spores. For this reason, dust from construction and renovation work near or around susceptible hospitalised patients needs to be contained and monitored.

Prions

Prions are abnormal proteins that replicate in host cells. Prions are not microorganisms but are of significant concern for human and animal health as they are transmissible and can cause disease that is rapidly progressive, invariably incurable, and fatal. Prions induce abnormal folding of specific normal cellular proteins (called prion proteins or PrPC), found most abundantly in the brain.

This leads to brain damage, chronic encephalopathy, and associated dementia.

The abnormal proteins of prions are mostly transmitted in healthcare settings via contaminated instruments used during neurosurgery, or other procedures involving contact with neural tissue, such as dentistry.

Prions have a long incubation period and are resistant to heat, chemicals, and irradiation. They cannot be cultured and do not trigger an immune response. Human prion diseases are classified as transmissible spongiform encephalopathies (TSEs) and include:

- classic Creutzfeldt-Jakob Disease (CJD)
- variant Creutzfeldt-Jakob Disease (vCJD) (mad cow disease).

Other prions are also known to affect animals. There are a number of rare TSEs which have been found in sheep, goats, cows, deer, cats and some zoo animals. These diseases are not directly transmissible from animal to animal or from human to animal. Bovine spongiform encephalopathy (BSE) is a fatal neurological disorder which affects cattle and is linked to vCJD in humans. In cattle, BSE is spread through the ingestion of feed stock contaminated with infected meat and bone meal (such as brain and spinal cord). People who have eaten beef or beef products from BSE-infected cattle are at risk of developing vCJD. In Australia, there are no cases of cattle infected with BSE.

The Communicable Diseases Network Australia (CDNA) has developed infection prevention and control guidance on CJD.[67]

[67] https://www.health.gov.au/diseases/creutzfeldt-jakob-disease-cjd?utm_source=health.gov.au&utm_medium=callout-auto-custom&utm_campaign=digital_transformation

Part 2: Multidrug-resistant organisms

Part 2 covers the following topics:

- **Introduction to multidrug-resistant organisms**
- **Multidrug-resistant gram-positive organisms**
- **Multidrug-resistant gram-negative organisms**
- **Antimicrobial resistance and stewardship**

Introduction to multidrug-resistant organisms

Multidrug-resistant organisms (MROs) are microorganisms that have developed resistance to the action of multiple antimicrobials. Table 3.1 describes different types of resistance mechanisms. All resistance mechanisms are encoded by resistance genes. These can develop because of mutations, or through acquiring plasmids and other mobile genetic elements. Mobile genetic elements, such as plasmids, are small pieces of DNA that carry genetic instructions from one bacterium to another.

Table 3.1. Resistance mechanisms of multidrug-resistant organisms

Resistance mechanism (Defence strategy)	Description
Restrict access of the antimicrobial	Restrict access by changing the entryways or limiting the number of entryways. Example: gram-negative bacteria have an outer layer (membrane) that protects them from their environment. These bacteria can use this membrane to selectively keep some antimicrobials from entering into the bacterial cell.
Removal of the antimicrobial	Uses pumps (called efflux pumps) in their cell walls to remove antimicrobials that have entered the cell. Example: some *Pseudomonas aeruginosa* bacteria can produce pumps to get rid of several different antimicrobials, including fluoroquinolones, beta-lactams, chloramphenicol, and trimethoprim.
Change or destroy the antimicrobial	Change or destroy the antimicrobial with enzymes or proteins that break it down. Example: *Klebsiella pneumoniae* produce enzymes called carbapenemases which break down carbapenem and most other beta-lactams.
Bypass the effects of the antimicrobial	Develop new cell processes that avoid using the antimicrobial's target. Example: methicillin-resistant *Staphylococcus aureus* bacteria can bypass the effects of beta-lactams by acquiring a gene that codes for a protein that is not affected by the antimicrobial agent.
Change the targets for the antimicrobial	Many antimicrobials are designed to single out and destroy specific parts (or targets) of bacteria. The bacteria may have genes that change the target so the antimicrobial can no longer fit and do its job. Example: *Escherichia coli* bacteria with the mcr-1 gene can add a compound to the outside of the cell wall so that the antimicrobial colistin cannot latch onto it.

Adapted from: https://www.cdc.gov/drugresistance/about/how-resistance-happens.html[68]

[68] https://www.cdc.gov/drugresistance/about/how-resistance-happens.html

Risk factors and treatment

Risk factors for acquiring an infection caused by an MRO include:

- hospitalisation or recent health care, especially if the patient received antimicrobials
- living in residential aged care and other communal environments
- having a developing, waning or compromised immunity (for example, neonates, the elderly, neutropenic patients, those undergoing organ transplant).

The risk of infection is increased by:

- the presence of indwelling devices
- long-term antimicrobial use
- surgical procedures
- prolonged hospitalisation
- haemodialysis.

The treatment of an infection caused by an MRO is dependent on the resistance and susceptibility patterns of the microorganism. Often, complex treatment or treatment with greater side effects is required if an infection is caused by an MRO.

Clinical management should involve consultation with an infectious diseases physician, a microbiologist, the IPC team, and the antimicrobial stewardship team (depending on availability of all these specialists). These specialists will be aware of local antibiograms[69], which are reports that display the organisms present in clinical specimens and their susceptibility to various antimicrobials.

The Commission has developed a Specification for a Hospital Cumulative Antibiogram[70], which provides a guide for organisations to develop local cumulative antibiograms. The use of cumulative antibiograms is intended to aid antimicrobial stewardship (AMS) programs in the development of local antimicrobial prescribing guidelines and formulary management.

The Commission's Australian Passive AMR Surveillance (APAS)[71] system collects, analyses and reports on AMR data from hospitals and private pathology services across Australia. Participation in APAS also allows laboratories to produce their own local cumulative antibiogram. Where local resistance data are not available, national surveillance data provide a broader picture of AMR in Australia.

Infection prevention and control interventions

To prevent and control the spread of infections, including those caused by MROs, it is critical to understand the means of transmission of an infectious agent and how and when to apply the basic principles of IPC.

Standard precautions are healthcare practices that provide a first-line approach to IPC in the healthcare environment. They should be adopted by all healthcare workers when caring for all patients, regardless of suspected or confirmed infection status. Standard precautions are used to reduce or prevent the transmission of infectious agents and to render and maintain objects and healthcare settings as free as possible from infectious agents.

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[69] https://www.safetyandquality.gov.au/our-work/antimicrobial-resistance/antimicrobial-use-and-resistance-australia-surveillance-system-aura/hospital-antimicrobial-resistance/antibiograms

[70] https://www.safetyandquality.gov.au/publications-and-resources/resource-library/specification-hospital-cumulative-antibiogram-2019

[71] https://www.safetyandquality.gov.au/our-work/antimicrobial-resistance/antimicrobial-use-and-resistance-australia-surveillance-system-aura/community-antimicrobial-resistance/australian-passive-amr-surveillance-apas

Standard precautions include:

- hand hygiene, consistent with the 5 Moments for Hand Hygiene[72]
- the use of appropriate personal protective equipment (PPE)
- the safe use and disposal of sharps
- environmental cleaning
- respiratory hygiene and cough etiquette
- aseptic technique
- reprocessing of reusable medical equipment and instruments
- waste management
- appropriate handling of linen.

Transmission-based precautions are precautions used in addition to standard precautions. Transmission-based precautions interrupt the specific means of transmission of a particular infectious agent. Understanding the means of transmission of an infectious agent is important for deciding the most appropriate transmission-based precautions to use.

There are three categories of transmission-based precautions:

- **Contact** precautions: used when there is a known or suspected risk of transmission of infectious agents by direct or indirect contact
- **Droplet** precautions: used when there is a known or suspected risk of transmission of infectious agents by respiratory droplets
- **Airborne** precautions: used when there is a known or suspected risk of transmission of infectious agents by the airborne route.

For some infectious agents, a combination of precautions may be required. For example, seasonal influenza requires both contact and droplet precautions.

Multidrug-resistant gram-positive organisms

Any organism has the potential to develop resistance to common antimicrobial treatments. However, in the healthcare setting there are several commonly recognised MROs. These include:

- *Staphylococcus aureus*
- healthcare-associated methicillin-resistant *staphylococcus aureus* (HA-MRSA)
- community-associated methicillin-resistant *staphylococcus aureus* (CA-MRSA)
- vancomycin-resistant *enterococcus* (VRE)
- *Clostridioides difficile*.

Staphylococcus aureus

Staphylococcus aureus is a gram-positive coccus that is found readily on the skin and in the upper respiratory tract of healthy humans. At any point in time, one-third of humans carry *S. aureus* in their normal flora.

S. aureus is also able to survive in dry conditions in the healthcare environment, such as on bench tops, linen, or bed rails. Transmission is usually person-to-person by direct contact with contaminated hands, or indirectly by contact with contaminated equipment or the environment.

S. aureus can cause a wide range of localised or systemic infections, such as:

- boils
- cellulitis

[72] https://www.safetyandquality.gov.au/our-work/infection-prevention-and-control/national-hand-hygiene-initiative/what-hand-hygiene/5-moments-hand-hygiene

- endocarditis
- pneumonia
- severe sepsis
- post-operative, catheter-associated, and bloodstream infections.

S. aureus has developed many resistance mechanisms, including enzyme production, cell structure changes, and production of toxins such as haemolysin and exotoxins. The preferred agent for 'susceptible' strains is flucloxacillin (or dicloxacillin), which can be replaced with first-generation cephalosporins such as cefazolin or cefalexin in penicillin-allergic patients. Treatment depends on the susceptibility pattern of the microorganism to antimicrobial treatment.

The Commission's website has more information on Staphylococcus aureus bloodstream infection (SABSI) prevention resources.[73]

Healthcare-associated methicillin-resistant *S. aureus*

Transmission of HA-MRSA is usually person-to-person by direct contact with contaminated hands, or indirectly by contact with contaminated equipment or the environment.

HA-MRSA strains are resistant to beta-lactam antibiotics such as penicillin, amoxicillin, flucloxacillin and cephalosporins. HA-MRSA strains are often also resistant to erythromycin, clindamycin, aminoglycosides, and fluoroquinolones. When needed, vancomycin is the usual treatment.

Community-associated methicillin-resistant *S. aureus*

CA-MRSA strains are found in people in both healthcare and community environments. Transmission is usually person-to-person by direct contact, or indirectly from contact with the environment.

CA-MRSA strains are resistant to methicillin but remain susceptible to many other commonly used antimicrobials, as well as vancomycin.

Vancomycin-intermediate/resistant *S. aureus*

Vancomycin-intermediate/resistant *S. aureus* (VISA/VRSA) is sometimes referred to as glycopeptide-intermediate *S. aureus* (GISA).

VISA/VRSA is usually found in hospitalised patients who have had serious MRSA infections (such as bacteraemia) and required long-term treatment before development of resistance.

Vancomycin-resistant *Enterococcus* species

Enterococcus spp. are gram-positive cocci found in normal bowel flora. *Enterococcus* spp. are opportunistic pathogens that cause a variety of infections in vulnerable people such as the very elderly, the immunosuppressed, and those whose physical barriers are compromised through surgery or invasive devices.

These infections include:

- urinary tract infections
- endocarditis
- bacteraemia
- wound infections
- intra-abdominal infections.

[73] https://www.safetyandquality.gov.au/our-work/infection-prevention-and-control/staphylococcus-aureus-bloodstream-infection-sabsi-prevention-resources

Enterococci are naturally resistant to several common antimicrobial classes, including anti-staphylococcal penicillins, cephalosporins, macrolides and lincosamides. More serious infections require treatment with intravenous ampicillin or amoxicillin. Vancomycin is used instead of ampicillin/amoxicillin for serious infections in patients who are allergic to penicillins.

Ampicillin resistance has emerged worldwide which has led to increased use of vancomycin. More recently, vancomycin-resistant enterococci (VRE) have also emerged, most notably in *Enterococcus faecium*, and to a lesser extent in *Enterococcus faecalis.*

There are two main gene complexes that contribute to vancomycin resistance and are transferable to other bacteria:

- *vanA,* which causes resistance to both vancomycin and teicoplanin
- *vanB,* which causes low-level resistance to vancomycin but is susceptible to teicoplanin.

Colonisation with VRE is common. People who are colonised will often show no signs of infection but can transmit the organism to others. Transmission is usually person-to-person by direct contact with contaminated hands, or indirectly by contact with contaminated equipment or the environment.

VRE are often implicated in healthcare-associated outbreaks in intensive care units, transplant units, and renal therapy units.

The Commission's website has more information about our work on Vancomycin-resistant enterococci.[74]

Clostridioides difficile

Clostridioides difficile is an anaerobic, spore-forming, gram-positive bacillus often found as part of the normal flora, especially in children younger than two years old. In adults, it can be the cause of *C. difficile* infection (CDI), which is a severe, antibiotic-associated gastrointestinal disease.

The bacterium is ubiquitous in its spore form in natural and built environments. *C. difficile* spores can survive for long periods in the environment and are resistant to heat, desiccation, and chemicals.

C. difficile is not an MRO. However, due to the tough structure of its cell wall, *C. difficile* is known to be naturally resistant to cephalosporins, acquires clindamycin resistance readily and, more recently, has developed resistance to fluoroquinolones. As such, contact precautions in addition to standard precautions are often used to manage a hospital patient who has a CDI to prevent cross-infection.

Transmission of *C. difficile* occurs by ingestion of spores through person-to-person contact, animal-to-person contact or environment-to-person contact.

> ➢ The transmission of *C. difficile* can be further reduced by using soap and water to perform hand hygiene, rather than alcohol-based hand rub.

C. difficile multiplies after the normal gut flora are inhibited due to exposure to medications or procedures that disrupt the normal flora of a person's gastrointestinal system (for example, certain antimicrobials or protein pump inhibitors, gastrointestinal surgery, endoscopy, or the presence of enteral feeding tubes).

[74] https://www.safetyandquality.gov.au/our-work/infection-prevention-and-control/australian-infection-prevention-and-control-guidelines/vancomycin-resistant-enterococci-vre

The bacteria damage the gut wall using two main exotoxins:

- Toxin A – an enterotoxin that acts on intestinal mucosa
- Toxin B – a cytotoxin which kills cells.

Clinical manifestations associated with CDI include diarrhoea and pseudomembranous colitis. However, these presentations are generally only observed in individuals infected with toxin-producing strains of *C. difficile*. Non-toxigenic strains of *C. difficile* are sometimes associated with extra-intestinal illness.

Epidemics in Canada, the United States and the United Kingdom have involved outbreaks of hyper-virulent strains of *C. difficile* that are resistant to fluoroquinolones and capable of excessive toxin production.

The Commission's website has more information on our work on monitoring *Clostridioides difficile* infection (CDI) in Australia.[75]

Multidrug-resistant gram-negative organisms

In this section, we'll look at some multidrug-resistant gram-negative organisms, including:

- aminoglycoside-resistant gram-negative bacteria (ARGN)
- extended-spectrum beta-lactamases (ESBLs)
- carbapenemase-producing *Enterobacterales* (CPE).

Aminoglycoside-resistant gram-negative bacteria

ARGN are resistant to aminoglycoside antimicrobials, such as gentamicin, tobramycin, and amikacin. The gene for aminoglycoside resistance can be passed from one bacterium to another via mobile genetic elements.

Some of these bacteria are part of normal flora, and some are widespread in moist areas of the environment. Infection by an ARGN is usually caused by an internal (endogenous) source or by contact transmission.

Examples of ARGNs include:

- *Acinetobacter* spp.
- *Escherichia coli*
- *Proteus mirabilis*
- *Klebsiella* spp.
- *Serratia* spp.
- *Enterobacter* spp.
- *Burkholderia* spp.

The most common ARGN is *Pseudomonas aeruginosa*, which is an opportunistic pathogen that primarily affects hospitalised or immunocompromised patients. *P. aeruginosa* is commonly found in moist environments, and is naturally resistant to many chemicals, including most common antimicrobials and some antiseptics. As a result, *P. aeruginosa* frequently causes infections in patients who are receiving antimicrobial treatments for other purposes.

[75] https://www.safetyandquality.gov.au/our-work/infection-prevention-and-control/clostridioides-difficile-infection-monitoring-australia

P. aeruginosa can cause urinary tract infection in patients with catheters or structural abnormalities of the urinary tract. It is commonly associated with burn and other wound infections and has a strong propensity to cause chronic persistent airway infection in patients with cystic fibrosis. *P. aeruginosa* also causes septicaemia, especially in neutropenic patients.

Extended-spectrum beta-lactamase producing bacteria

Beta-lactamases are enzymes produced by gram-negative bacteria that destroy certain beta-lactam antimicrobials (Table 3.2). Some beta-lactamases, such as plasmids, are encoded on mobile genetic elements, while others are encoded on chromosomes. The genes encoding these enzymes are widespread in hospitals and the community. Extended-spectrum refers to the enzyme's ability to break down the newer third generation cephalosporins, as well as penicillins and earlier generations of cephalosporins.

Table 3.2. Beta-lactam antimicrobials

Beta lactam groups	Examples
Penicillins	• *Penicillinase* sensitive: penicillin G (procaine benzylpenicillin), penicillin • *Penicillinase* resistant: methicillin, flucloxacillin, dicloxacillin • Ampicillin, amoxicillin • Ticarcillin • Piperacillin
Cephalosporins	• First generation: cefazolin, cefalothin, cefalexin • Second generation: cefaclor, cefotetan, cefoxitin • Third generation: cefotaxime, ceftriaxone, ceftazidime • Fourth generation: cefepime • Fifth generation: ceftaroline
Carbapenems	• Imipenem, meropenem, ertapenem
Monobactams	• Aztreonam

Examples of ESBL-producing bacteria include:

- *E. coli*
- *E. cloacae*
- *K. pneumoniae.*

These microorganisms have great capacity to become multidrug-resistant. Few antimicrobials are available for treatment of highly multidrug-resistant strains, and all are more toxic than the beta-lactamases. When treatment is required, a carbapenem is often used.

ESBLs cause a variety of infections in the healthcare setting and are often associated with poor outcomes. Infection is usually caused by an endogenous source or acquired by contact transmission. Patients colonised with an ESBL can serve as a reservoir for further transmission.

Carbapenemase-producing *Enterobacterales*

Enterobacterales are the largest family of gram-negative bacteria causing human infection. This family includes common pathogens such as:

- *E. coli*
- *K. pneumoniae*
- *Enterobacter cloacae*
- *Proteus* spp.

Enterobacterales colonise the normal human gastrointestinal tract, generally without causing disease. However, they can also cause common infections, including urinary tract infection, abdominal infection, and bloodstream infection. *Enterobacterales* are important human pathogens and vehicles for the dissemination of AMR because:

- some are normal flora of the gastrointestinal tract
- most have the potential to colonise people and are highly transmissible (that is, they are easily spread between individuals)
- antimicrobial resistance genes can easily spread between different species and strains within the *Enterobacterales* family
- they are the most common gram-negative bacteria to cause human infections in the community and in healthcare settings.

Carbapenemase-producing *Enterobacterales* (CPE) are members of the *Enterobacterales* that are resistant to carbapenems. Carbapenems are the 'last resort' beta-lactam antimicrobials for treating serious infections, and include imipenem, meropenem and ertapenem. The most common way that *Enterobacterales* become resistant to carbapenems is by producing enzymes called a carbapenemase.

CPE are an ongoing threat to public health. Vulnerable patients with comorbidities are at increased risk of developing an infection and consequently dying.

A number of strategies have been shown to reduce transmission of CPE. These include the use of standard and transmission-based precautions (including hand hygiene, appropriate patient placement and use of PPE), increased patient screening, and environmental cleaning and disinfection.

Environmental controls, including facility redesign where possible, also minimise the risks associated with environmental reservoirs of CPE.

See the Commission's website for More information on our work on Carbapenemase-producing Enterobacterales.[76]

Carbapenemase-producing *Enterobacterales* are one of the critical antimicrobial resistances (CARs) monitored and reported on via the Commission's National Alert System for Critical Antimicrobial Resistances (CARAlert).[77]

Antimicrobial resistance and stewardship

Antimicrobial resistance

Antimicrobial resistance (AMR) is recognised as a significant global health priority. Resistance to antimicrobials is commonly found in Australian hospitals and some resistances are increasing in the community.

AMR can have a significant impact on:

- morbidity
- mortality
- treatment costs.

[76] https://www.safetyandquality.gov.au/our-work/infection-prevention-and-control/carbapenemase-producing-enterobacterales

[77] https://www.safetyandquality.gov.au/our-work/antimicrobial-resistance/antimicrobial-use-and-resistance-australia-surveillance-system/national-alert-system-critical-antimicrobial-resistances-caralert

The personal and financial costs of AMR include:

- the psychosocial and clinical impact associated with the isolation of patients with MROs
- the need for complex treatments that have a risk of serious side effects
- the need for additional resources such as PPE, special accommodation, and dedicated care equipment to provide care to the patient and protects the broader patient population and workforce.

A significant contributor to AMR is the unnecessary or inappropriate use of antimicrobials. Around one-third of all antimicrobial use in health care is unnecessary or inappropriately prescribed, as shown by the National Antimicrobial Prescribing Survey.[78]

The Commission's Antimicrobial Use and Resistance in Australia (AURA) Surveillance System[79] captures data on antimicrobial use and AMR in human health. This provides a valuable data source to inform clinical practice change and support policy development for prevention and control of AMR.

Antimicrobial stewardship

Antimicrobial stewardship (AMS) is a suite of coordinated activities which together promote the appropriate prescribing and use of antimicrobials. Antimicrobial stewardship is important at all levels of the healthcare system to improve the safety and appropriateness of antimicrobial use.

The intention of AMS is to:

- maximise the benefit of antimicrobials
- reduce patient harm
- prevent and contain AMR.

Actions 3.18 and 3.19 (Antimicrobial stewardship) of the NSQHS Preventing and Controlling Infections Standard[80] describe the elements necessary to support an effective AMS program, and require all health service organisations to have systems in place for the safe and appropriate prescribing and use of antimicrobials.

In addition, this standard requires organisations to act on the results of antimicrobial use and appropriateness audits to promote continuous quality improvement.

The Commission's AMS webpage[81] and Antimicrobial Stewardship in Australian Health Care[82] (the AMS Book) provides more information on AMS in different healthcare settings.

[78] https://www.safetyandquality.gov.au/our-work/antimicrobial-resistance/antimicrobial-use-and-resistance-australia-surveillance-system/aura-surveillance-system-data-sources/appropriateness-antimicrobial-use
[79] https://www.safetyandquality.gov.au/our-work/antimicrobial-resistance/antimicrobial-use-and-resistance-australia-surveillance-system
[80] https://www.safetyandquality.gov.au/publications-and-resources/resource-library/national-safety-and-quality-health-service-standards-second-edition
[81] https://www.safetyandquality.gov.au/our-work/antimicrobial-stewardship
[82] https://www.safetyandquality.gov.au/our-work/antimicrobial-stewardship/antimicrobial-stewardship-australian-health-care-ams-book

Module 4. Clean and safe healthcare environment

Contents

Overview of Module 4

Module 4 contains two parts:

Part 1: Environmental cleaning

Part 2: Risk assessment, cleaning schedules and programs

This module has been developed to provide you with an understanding of the basic principles for maintaining a clean and safe healthcare environment. You should refer to your local state or territory guidelines for any local environmental cleaning requirements.

After completing this module, you will understand:

- the role of environmental cleaning in reducing the transmission of infectious agents
- the role of risk assessment in environmental cleaning
- environmental cleaning processes and product selection
- safe linen and waste management
- cleaning programs and cleaning schedules
- the role of auditing in environmental cleaning.

Part 1: Environmental cleaning

- **Introduction to environmental cleaning**
- **National Safety and Quality Health Services Standards**
- **Environmental cleaning in the healthcare environment**
- **Cleaning patient care equipment**
- **Managing biological spills**
- **Managing chemical and other spills**
- **Linen management**
- **Waste** management
- **Environmental sustainability and recycling**

Introduction to environmental cleaning

Environmental cleaning is the cleaning of the physical environment and patient care equipment to remove dirt and microorganisms from surfaces. This ensures the environment and equipment is clean and hygienic for both healthcare consumers and healthcare workers.

Environmental cleaning is a fundamental element of standard and transmission-based precautions. It should be incorporated in the infection prevention and control (IPC) program of every health service organisation.

A safe and clean healthcare environment can be influenced by factors such as:

- air and water quality
- intact and cleanable surfaces
- cleaning programs and the provision of cleaning equipment
- waste and linen management programs
- cleaning, storage, and maintenance of shared patient care equipment
- provision of personal protective equipment (PPE)
- provision of hand hygiene products and hand-washing sinks
- general decluttering of workspaces.

Every member of the health workforce has a responsibility to maintain a clean and safe environment.

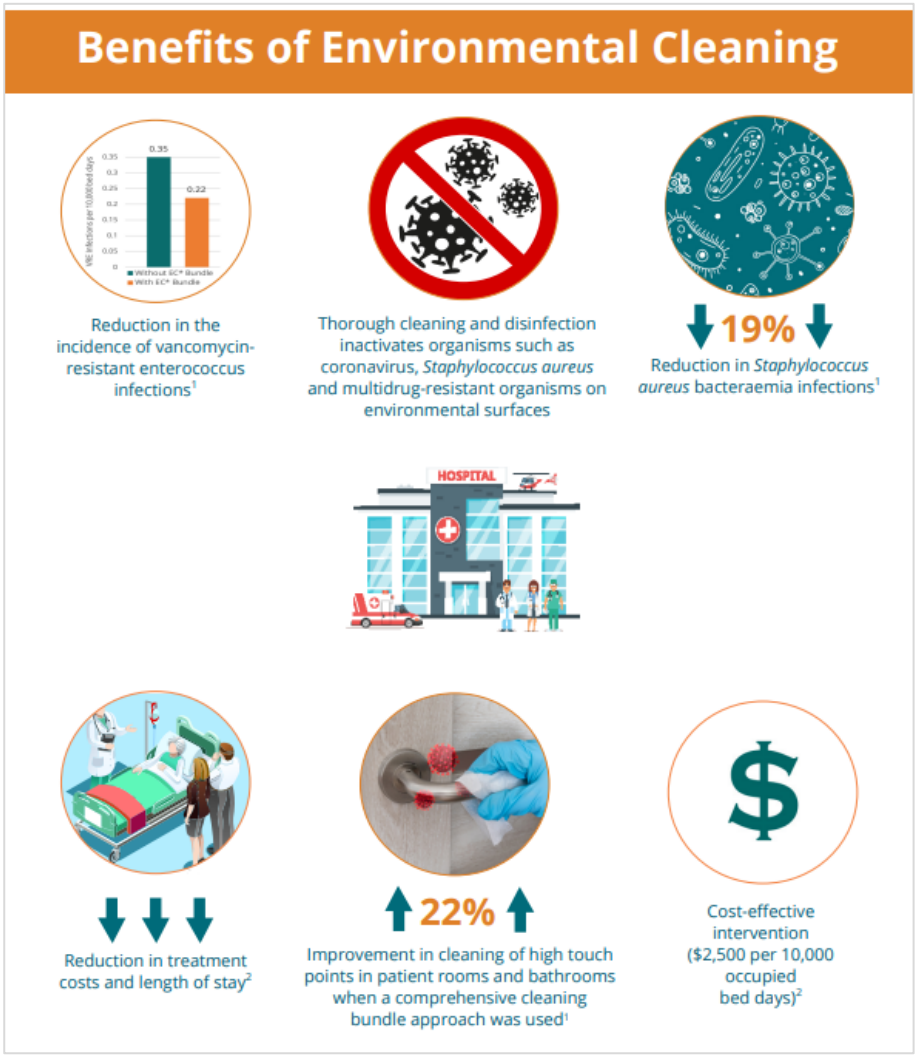
- Clinical staff (for example, medical, allied health, nursing, and midwifery staff) should know how to clean shared patient care equipment and how to respond to biological spills.
- Cleaning staff have a dedicated role in ensuring that the healthcare environment is clean and safe.
- Other members of the health workforce may be required to clean their own work environment (for example, desks, work benches, computers, and phones).

The benefits of a clean and safe healthcare environment include:

- a reduction in infections and transmission of communicable diseases
- a reduction in the financial and personal costs associated with the treatment of infections and length of stay for patients
- improved patient and healthcare worker safety.

The benefits of environmental cleaning are highlighted in Figure 4.1.

Figure 4.1.Benefits of environmental cleaning



Source: https://www.safetyandquality.gov.au/publications-and-resources/resource-library/benefits-environmental-cleaning-infographic[83]

National Safety and Quality Health Services Standards

Action 3.13 (Clean and safe environment) of the NSQHS Preventing and Controlling Infections Standard[84] requires organisations to have processes in place to maintain a clean and hygienic environment, in line with the current edition of the Australian Guidelines for the Prevention and Control of the Infection in Healthcare,[85] and jurisdictional requirements that:

a. respond to environmental risks, including novel infections
b. require cleaning and disinfection using products listed on the Australian Register of Therapeutic Goods[86] (ARTG) consistent with manufacturers' instructions for use and recommended frequencies
c. provide access to training on cleaning processes for routine and outbreak situations, and novel infections

[83] https://www.safetyandquality.gov.au/publications-and-resources/resource-library/benefits-environmental-cleaning-infographic
[84] https://www.safetyandquality.gov.au/standards/nsqhs-standards/preventing-and-controlling-infections-standard
[85] https://www.safetyandquality.gov.au/publications-and-resources/resource-library/australian-guidelines-prevention-and-control-infection-healthcare
[86] https://www.tga.gov.au/australian-register-therapeutic-goods

d. audit the effectiveness of cleaning practice and compliance with its environmental cleaning policy
e. use the results of audits to improve environmental cleaning processes and compliance with policy.

In addition, Action 3.14 (Clean and safe environment) of the NSQHS Preventing and Controlling Infections Standard[84] requires organisations to have processes to evaluate and respond to infection risks for:

a. new and existing equipment, devices and products used in the organisation
b. clinical and non-clinical areas, and workplace amenity areas
c. maintenance, repair and upgrade of buildings, equipment, furnishings, and fittings
d. handling, transporting, and storing linen
e. novel infections and risks identified as part of a public health response or pandemic planning.

Environmental cleaning in the healthcare environment

The healthcare environment

The environment in a healthcare setting includes:

- floors, walls, and ceiling
- furnishings, such as curtains, bedside lockers, beds, and chairs
- fittings, such as taps, sinks, light switches, and door handles
- patient care equipment; for example, shower chairs, walkers, wheelchairs.

Organisations should refer to refer to the Australasian Healthcare Facility Guidelines[87] for guidance on facility design, including furnishings and fittings. These guidelines provide information on the recommended elements for facility design that are consistent with IPC requirements.

Importance of environmental cleaning

There are two main reasons why environmental cleaning is important for all organisations.

The first reason is that it is one of the most effective ways to interrupt the transmission of infectious agents and prevent infection and outbreaks of infectious diseases. We know that microorganisms can be transferred from environmental surfaces and equipment on the hands of healthcare workers. These microorganisms can be transmitted to a patient or another individual or may contaminate other surfaces touched by the healthcare worker, causing subsequent infection.

Many microorganisms will survive on environmental surfaces for long periods of time if left undisturbed. For example:

- Viruses, such as Hepatitis B and C, are known to survive in dried blood on environmental surfaces and equipment surfaces; and influenza can be transmitted by contact with contaminated surfaces.
- Bacteria, such as methicillin-resistant *Staphylococcus aureus* (MRSA) and *Clostridioides difficile* spores, can be present in dirt and dust that has settled on surfaces.
- Fungi, such as candida and aspergillus, occur naturally in the environment in soil and vegetation, but can also be present on indoor environmental surfaces and in wet areas, such as bathrooms and kitchens. Renovations and construction work can also release fungal spores into the air.

[87] https://healthfacilityguidelines.com.au/

Contaminated environmental surfaces and equipment have been linked to outbreaks of infectious diseases in healthcare settings.

For more information on the risk of transmission of specific microorganisms and infectious agents, refer to workbook Module 2. Risk management for infectious agents and diseases.

The second reason why environmental cleaning is important is that health service organisations are expected to provide facilities that are clean and hygienic. A visually clean and hygienic environment that is well maintained and free of clutter supports a consumer's right to access safe and high-quality care in an environment that makes them feel safe.

Frequency of environmental cleaning

A risk assessment should be carried out for each department of an organisation to identify infection risks. This determines the frequency of cleaning to minimise the infection risks to patients, visitors, and all members of the health workforce. The principles of risk assessment for environmental cleaning are discussed in Module 2. Risk management for infectious agents and diseases.

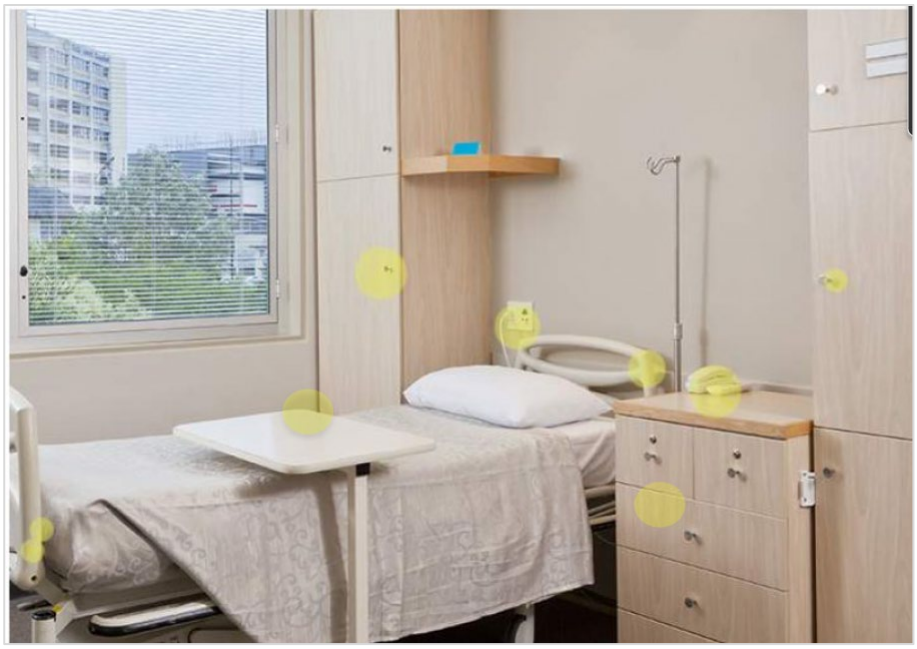
Organisations should refer to their local health network or jurisdiction for guidance on how frequently to clean different functional areas within a facility. Areas identified as a high risk for infection will need more frequent cleaning, such as twice daily or more often. Areas with a low risk for infection may need less frequent cleaning, such as daily or less often. Risk ratings for different areas will be discussed in detail later in this module.

The frequency for cleaning environmental surfaces and equipment is usually determined by how often an area or item of equipment is used, and the types of patients or services that use the area or item of equipment. Environmental and equipment cleaning can be prioritised as follows:

1. Environmental surfaces and equipment must always be cleaned if they are visibly dirty.
2. Surfaces that are soiled with blood or body fluids must always be cleaned and disinfected immediately to avoid blood and body fluid exposure to members of the health workforce and patients.
3. Shared patient equipment and patient rooms must always be cleaned between patient use (for example, before and after patient use, before returning equipment to storage and after a patient is discharged).
4. Frequently touched surfaces (such as light switches, handrails, door handles), high-traffic zones (such as corridors, ambulance bays, waiting rooms), clinical departments or wards, procedural units, bathrooms, and toilets should be cleaned at least daily or more frequently.
5. Other surfaces (such as minimally touched surfaces like floors, walls, ceilings, windows, and blinds) and environments such as non-clinical areas may require less frequent cleaning.
6. Workstations on wheels and shared computer stations should be cleaned between use by different operators.
7. Reception desks and write-up areas should be kept free of clutter to facilitate daily cleaning.

Figure 4.2 highlights the frequently touched areas in a patient zone. These areas are usually heavily contaminated with microorganisms and require more attention when cleaning.

Figure 4.2. The patient zone with frequently touched surfaces highlighted in yellow



Other factors that influence how frequently an area may need to be cleaned include:

- the type of activity that occurs in an area and the potential for contamination with blood, body fluids, dust, or dirt
- the number of people who use the area
- the type of environmental surfaces and equipment in an area, particularly the ability of these surfaces to support the growth of infectious agents (for example, porous material, fluid-repellent surfaces)
- moisture, temperature, and light levels, which can influence the growth and survival of infectious agents on environmental surfaces.

Cleaning techniques and cleaning frequency may need to be adjusted depending on these factors.

Each organisation should develop a cleaning schedule and program based on the local level of infection risk. The cleaning schedule and program will provide guidance on the type of cleaning required, and the frequency of cleaning in each area of the organisation. Cleaning programs and schedules will be covered in more detail later in this module.

Cleaning methods

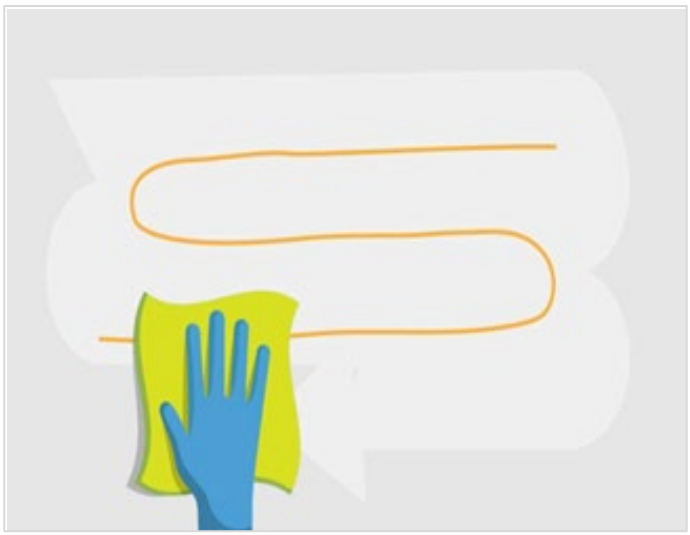
Cleaning of environmental surfaces and patient care equipment involves the physical removal of dirt and microorganisms from all surfaces. This ensures the environment and equipment is clean and hygienic for both consumers and workers. Cleaning is done by wiping over surfaces with a cloth, using a neutral detergent and water, and an S-shaped motion.

➢ Using an S-shaped motion stops dirt and infectious agents from being spread back over the area that has just been cleaned.

Steps used for cleaning surfaces and equipment:

1. Wipe the surface with a neutral detergent solution, using an S-shaped motion (Figure 4.3).
2. Allow the neutral detergent to remain on the environmental surface for the recommended contact time advised by the detergent manufacturer.
3. Allow the surface to completely dry.

Figure 4.3 Demonstration of an S-motion in cleaning



Disinfection may be required if the environmental surface and or shared patient care equipment is contaminated with blood or body fluid, a resistant infectious agent, or to manage an outbreak of an infectious agent.

There are two processes that are commonly used for cleaning with a disinfectant in the healthcare setting: a two-step process or a two-in-one process.

Two-step process

Step 1: All environmental surfaces are cleaned first with a neutral detergent and water to remove dirt, dust, and organic matter (such as blood and body fluids). The neutral detergent is to remain on the environmental surface for the recommended contact time advised by the detergent manufacturer and then allowed to completely dry.

Step 2: If the environmental surface has been contaminated with blood, body fluids or an infectious agent, a disinfectant solution is applied to the surface after initial cleaning with a neutral detergent. The disinfectant is to remain on the environmental surface for the recommended contact time advised by the disinfectant manufacturer to kill or inactivate infectious agents. The surface is then allowed to completely dry.

Two-in-one–step process

A cleaning solution that contains both a neutral detergent and a disinfectant is used to clean and disinfect environmental surfaces. The solution is to remain on the environmental surface for the recommended contact time advised by the product manufacturer. The surface is then allowed to completely dry.

Cleaning products and equipment

It is essential that the cleaning products and equipment selected for use in an organisation are specifically labelled and intended for the purpose of cleaning. Action 3.13 (Clean and safe environment) of the NSQHS Preventing and Controlling Infections Standard[84] requires health service organisations to use products listed on the Australian Register of Therapeutic Goods (ARTG)[86] for disinfection and sanitisation of environmental surfaces in organisations.

Neutral detergents, unless used for the cleaning of medical devices, are not regulated by the Therapeutic Goods Administration[88] (TGA).

Disinfectants used for the environmental cleaning of hard surfaces in healthcare settings are regulated by ARTG.

Using ARTG-listed disinfectants ensures that organisations are using safe and effective products that meet local needs. ARTG testing methods ensure that listed products meet the manufacturer's claims for antimicrobial action against infectious agents.

There are two main types of products used for environmental cleaning in the healthcare setting: neutral detergents and disinfectants.

Neutral detergents

A neutral detergent is a solution that contains a surfactant. A surfactant is a chemical that facilitates the removal of dirt and organic matter. Most hard surfaces can be adequately cleaned with warm water and a neutral detergent as per the manufacturer's instructions.

Disinfectants

A disinfectant is a chemical agent that rapidly kills or inactivates most infectious agents. Disinfectants must not be used instead of detergents. Disinfectants should only be used if required, and only after cleaning with a neutral detergent, or in a combination cleaning agent (detergent/disinfectant).

When assessing and selecting a disinfectant in the healthcare setting, product factors such as kill claims, wet contact time, compatibility, safety, ease of use and value for money should be considered. Table 4.1 provides a list of factors and considerations when selecting a disinfectant for cleaning in a healthcare facility.

Table 4.1. Questions to ask when selecting disinfectants for healthcare facilities

Factor	Product considerations
Kill claims	Is the product listed on the Australian Register of Therapeutic Goods (ARTG)? Does the product: • kill pathogens that cause most HAIs and outbreaks, that are a major issue in our facility? • have sustained activity once used on a surface? • work in the presence of organic matter (blood, sputum, faeces)? • testing match real-life scenarios? • kill pathogens quickly?
Wet-contact times	• Is it fast-acting? • Does it keep surfaces wet for enough time to kill pathogens? • How long before the disinfectant evaporates? • Is the product inactivated by organic material?
Compatibility	• Is it compatible with the surfaces in our facility? • Is it compatible with other products in use? • Is it compatible with medical equipment?
Safety	• What is the toxicity rating? (Consider exposure of staff, visitors and patients) • Is it approved by a relevant regulatory body? • What PPE will be required?

[88] https://www.tga.gov.au/resources/resource/guidance/disinfectants-sterilants-and-sanitary-products

Factor	Product considerations
Ease of use	• Does it come in the forms that our facility needs (wipes, sprays, liquids)? • Are the instructions clear? • Does it need dilution, or is it a ready-made solution? • Is it a two-step or a one-step product? • How much training will be required, and who will provide this training? • Can the product help you to standardise practices in your facility?
Value for money	Is it the most cost-effective option? (Consider product capabilities, efficiencies through improvements in cleaning compliance/standardisation and potential transmission avoided.)

Source: Fact sheet – Principles of environmental cleaning product selection[89]

Cleaning with a disinfectant is only necessary when:

- cleaning surfaces (including floors) suspected or known to have been contaminated by a multidrug-resistant organism (MRO), an outbreak of an infectious agent, or other potentially infectious material, including blood and body fluids
- cleaning in high- or extremely/very high-risk settings, according to local risk assessment
- undertaking discharge cleaning for a patient with an infection or a colonisation caused by an MRO or another infectious agent which requires transmission-based precautions.

For a disinfectant to work effectively (that is, kill the infectious agents on a surface), the disinfectant must:

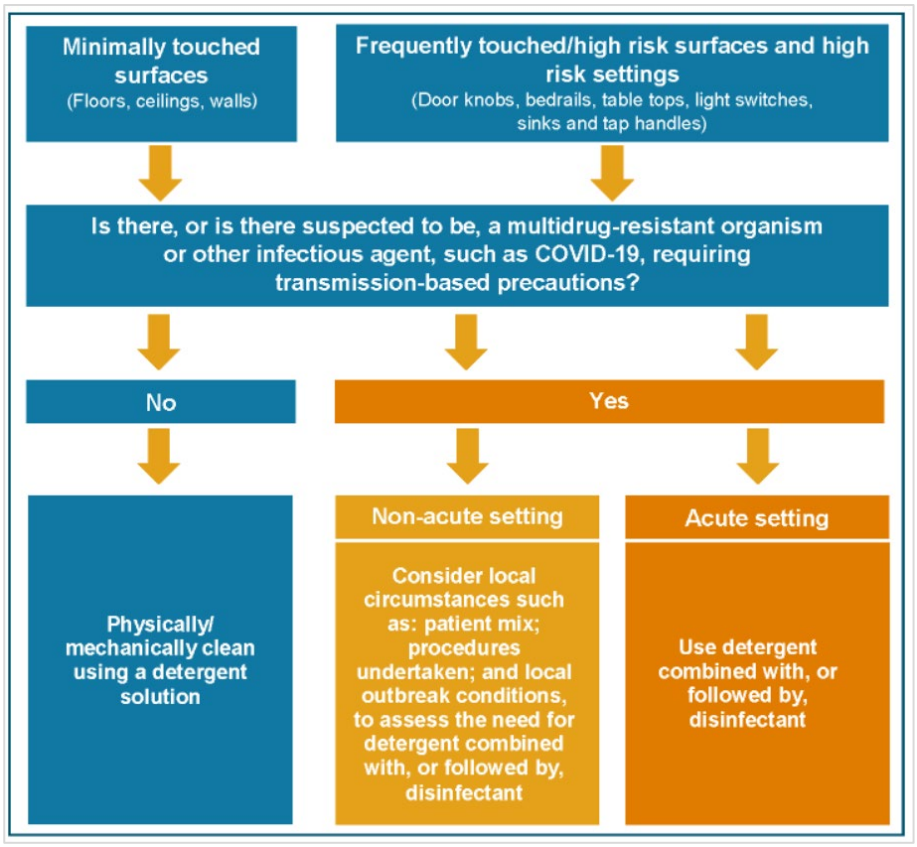
- have enough contact time with the surface to kill the infectious agent
- be used at the correct concentration
- be applied to a clean, dry surface
- be effective against the specific infectious agent.

All cleaning products should be prepared as needed and replaced with fresh solution frequently or upon contamination. Once a solution has been prepared, it should be dated and discarded after 24 hours. Figure 4.4 provides guidance on when to use a disinfectant in addition to a neutral detergent for environmental cleaning.

➢ If using contact precautions, in addition to standard precautions, when caring for a particular patient, you will likely need to clean the patient zone and equipment using both a detergent and a disinfectant.

[89] https://www.safetyandquality.gov.au/publications-and-resources/resource-library/fact-sheet-principles-environmental-cleaning-product-selection

Figure 4.4. When to use a disinfectant in routine cleaning



Source: Flowchart – The process and product selection for routine environmental cleaning[90]

Equipment for cleaning

It is essential that cleaning products and equipment selected for use in a health service organisation are intended for the purpose of cleaning and are specifically labelled. Staff should only use cleaning products and equipment that are in good condition and working order and supplied and approved by the organisation. This includes mops, buckets, appropriate PPE, cleaning cloths, and cleaning solutions. These products should be used as per the manufacturers' instructions.

Staff who undertake environmental cleaning should have access to an appropriate water supply, sink or floor drainage, and suitable facilities for equipment and chemical storage.

All cleaning equipment should be cleaned and dried between uses. Mop heads should be laundered daily after use on a patient's environment and after contamination with an infectious agent. If a cleaning cart is used, there should be separation between clean and soiled items and the cart should be thoroughly cleaned at the end of the day. Reusable cleaning equipment can be colour-coded to restrict the use of specific items, such as mops and cloths, to designated areas, such as bathrooms, kitchens, or isolation rooms.

Cleaning equipment that is designated for single use should be appropriately disposed of immediately after use. In the interest of environmental sustainability, reusable items should be used in preference to single-use items wherever it is safe to do so.

[90] https://www.safetyandquality.gov.au/publications-and-resources/resource-library/flowchart-process-and-product-selection-routine-environmental-cleaning

Cleaning patient care equipment

Equipment used for patient care should be cleaned frequently, and before and after each use. Patient care equipment includes medication trolleys, mobile workstations, IV poles, pumps, physiotherapy equipment, wheelchairs, or beds. Shared patient care equipment can act as a reservoir for microorganisms and enable microorganisms to be transferred between patients.

Most patient care equipment can be cleaned with a neutral detergent. It is important to refer to the manufacturer's instructions for how to clean each piece of equipment and which cleaning products are suitable to use. Some items may require special servicing to clean them.

Organisations should develop processes for the cleaning of patient care equipment which includes instructions on the use of suitable cleaning products, the removal of stains, sticky marks and dust from surfaces, and appropriate storage of cleaned patient care equipment.

- Only use cleaning solutions recommended by the equipment's manufacturer. Some cleaning solutions may not be compatible with all materials used in the manufacturing of patient equipment and may degrade or damage these materials over time. Damaged equipment may become an infection control and patient safety risk.
- The manufacturer's warranty may be void if the manufacturer's instructions for use are not followed.

The TGA regularly publishes information on products that may not be compatible or suitable for use in the healthcare setting. This information can be found at the Australian Register of Therapeutic Goods website.[86]

Managing biological spills

Biological spills are spillages of blood and body fluids, such as urine, faeces, vomit, and sputum. The prompt removal of all spots and spills of blood and body fluids ensures a safe and hygienic environment, and meets IPC, and work health and safety requirements. All clinical staff should be provided with training on how to manage a biological spill. Signage should be used to indicate where spill kits are stored and how to use them.

Table 4.2 provides details on the process for managing biological spills in the healthcare environment.

Table 4.2. Management of biological spills

Volume of spill	Process
Spot cleaning	• Select and put on appropriate PPE. • Wipe the spot immediately with a damp cloth, tissue, or paper towel. • Discard contaminated materials into an appropriate waste bin. • Remove PPE in the correct sequence and perform hand hygiene.
Small spills (up to 10cm diameter)	• Select and put on appropriate PPE. • Wipe spill immediately with absorbent material. • Place contaminated absorbent material into an impervious container or plastic bag for disposal – discard into an appropriate waste bin. • Clean the area with warm detergent solution, using a disposable cloth or sponge. • Remove PPE in the correct sequence and perform hand hygiene.
Large spills (greater than 10cm diameter)	• Select and put on appropriate PPE. • Cover the area of the spill with an absorbent clumping agent and allow to absorb. • Use a disposable scraper and pan to scrape up absorbent material and any unabsorbed blood or body fluid. • Place all contaminated items into an impervious container or plastic bag for disposal. • Discard contaminated materials into an appropriate waste bin. • Mop the area with a neutral detergent solution. • Wipe the area with disinfectant and allow to dry. • Remove PPE in the correct sequence and perform hand hygiene.

Source: Table 6, Section 3.1.Australian Guidelines for the Prevention and Control of Infection in Healthcare[91]

Each clinical area in an organisation should have a basic spill kit to manage biological spills. A spill kit should include the following equipment:

- a list of equipment and instructions for use
- a scoop and scraper
- single-use PPE including gloves, protective apron, surgical mask, and protective eyewear
- absorbent agent to absorb liquids
- clinical waste bags and ties.

Detergent and disinfectant should be supplied by the organisation.

Managing chemical and other spills

Some organisations may have specialised spill kits to manage spills of hazardous chemicals and materials such as cytotoxic or radiological material, or other hazardous chemicals used for medical treatments. Many hazardous chemicals and materials also carry a risk of fire, explosion, injury, poison or damage to person or property and may be incompatible with other chemicals (such as cleaning solutions).

SafeWork Australia provides recommendations for the safe handling and storage of hazardous chemical and materials.[92] The organisation should provide staff with instruction, training, and

[91] https://www.safetyandquality.gov.au/publications-and-resources/resource-library/australian-guidelines-prevention-and-control-infection-healthcare
[92] https://www.safeworkaustralia.gov.au/safety-topic/hazards/chemicals/storing-hazardous-chemicals

equipment for storing, handling, and managing hazardous chemicals and materials. Signage should be used to indicate where chemical spill kits are stored and how to use them.

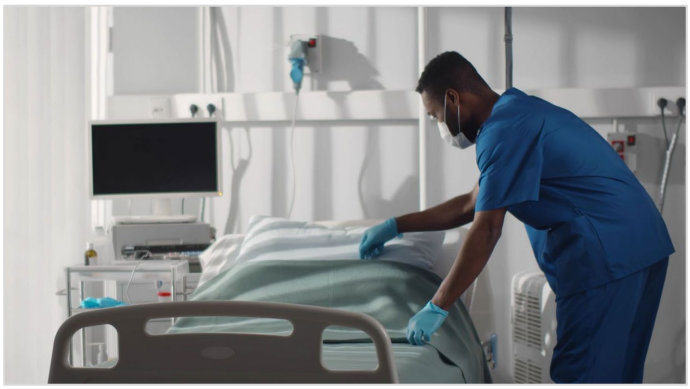
> ➢ Managing hazardous chemical and material spills requires specialised training and equipment and is not covered by this workbook.

Linen management

Clean linen used in the organisation should be stored in a dedicated space for clean linen only. This space should be separate to storage spaces for dirty or used linen and should be designed to protect the clean linen from contamination by aerosols, dust, moisture, and vermin. Clean linen can be stored on trolleys, covered with clean covers or stored in clean cupboards with the doors closed to protect it from contamination.

Used linen should be stored in a separate area, away from clean linen and the clinical area. Staff should always use standard precautions when handling used linen. For example, hand hygiene must be performed after all contact with used linen, regardless of whether the linen is visibly soiled. In some circumstances, staff may need to use transmission-based precautions in addition to standard precautions if there is a risk that the linen is contaminated with a highly infectious agent (see Figure 4.5).

Figure 4.5. Demonstration of linen management



When changing used linen, staff should take a linen bag to where they are working to avoid carrying the used linen through the clinical area. This reduces the risk of exposure to infectious agents to healthcare workers and the clinical area. If the used linen is soiled with a body fluid, it should be placed into a leakproof bag and sealed to prevent spills. Clean linen that has been removed from a clean linen stock trolley and decanted to a small trolley (for bed-making) must not be returned to the stock of clean linen, but should be discarded into a linen bag to prevent contamination of the clean stock of linen for that department.

Linen bags should not be more than three-quarters full. This helps prevent injury to the person handling the linen bag, and spillage of the contents. Trolleys used to transport linen to and from clinical areas should be cleaned after use. Separate transport trolleys should be used for clean linen and dirty linen.

Organisations should refer to AS/NZS 4146:2000 – Laundry practice[93] for guidance on the storage, handling and laundering of linen used in a healthcare facility.

[93] https://store.standards.org.au/product/as-nzs-4146-2000

Waste management

Waste generated in a clinical area must be handled with care. Staff should be trained on how to segregate waste and to always use standard precautions when handling waste. For example, staff should wear PPE, such as gloves and an apron, to protect themselves from contamination with infectious agents. Staff must perform hand hygiene after contact with all waste. Staff may need to use transmission-based precautions in addition to standard precautions if there is a risk of exposure to highly infectious material in the waste.

Waste should be disposed of at the point of generation, if practical, into an appropriate receptacle to prevent contamination of the broader healthcare environment. Waste bins should be leak-proof and have lids that close to prevent spillage.

All waste must be stored and transported safely. Large transport waste bins should have lids to prevent spillage. Waste storge areas should have lockable doors, and be located away from public spaces, clinical areas, and food preparation areas. Ideally, processes should be in place to transport waste in a manner that avoids transport through an organisation's patient and public areas, clean clinical spaces, and food preparation areas. This may involve the use of dedicated lifts or corridors for waste transportation. Organisations should also have processes in place, including the engagement of licensed services, for the regular removal of all types of waste.

Waste should be disposed of according to local waste management plans and jurisdictional requirements. Organisations should refer to Standard AS 3816:2018 – Management of clinical and related wastes,[94] resources produced by the Waste Management and Resource Recovery Association of Australia,[95] and the Industry Code of Practice: Managing Biohazardous Waste (Including Clinical and Related Wastes).[96]

Table 4.3 describes different categories of waste that are generated by health service organisations.

Table 4.3. Waste categories in the healthcare setting

Waste category	Description
General	The most frequently generated waste, and includes most items used in the clinical and non-clinical setting.
Clinical	Any waste that can potentially cause injury, infection, or offence. Examples include: • anatomical waste • clinical waste/pathology waste • radioactive waste • cytotoxic waste • pharmaceutical waste.

[94] https://store.standards.org.au/product/as-3816-2018
[95] https://wmrr.asn.au/Web/Home/Web/Default.aspx?hkey=b66f7d1f-370c-4fb4-9592-9192c68054f5
[96] https://wmrr.asn.au/Web/About_WMRR/WMRR_Structure/Biohazard_Waste_Industry.aspx

Waste category	Description
Clinical sharps	Any items such as hollow bore needles or catheters, and non-hollow bore items including glass vials, dental probes, scalpel blades, suture needles, retractors, skin or bone hooks, wires, electrosurgical tips. Sharps containers should be clearly labelled, puncture- and leak-proof, and conform to Standard AS 23907:2023[97] or relevant international standard for example, ISO 23907-1:2019.[98] Containers used for sharps waste should be located at the point of use; if this is not possible, then as close as practical to the area of use. Reusable sharps containers requiring transport to a reprocessing area must be placed in a puncture-resistant lidded container. Broken glass or other items which can cause cuts or puncture wounds can be disposed on in sharps bins to prevent injury.
Food	Including organic food material, oils, liquids, and food packaging. Like other forms of waste, the different waste material should be segregated and stored appropriately. Organic food waste must be stored in a manner to prevent attracting vermin and insects, and away from food storage and preparation areas.

Environmental sustainability and recycling

Action 3.03 (Applying quality improvement systems) of the NSQHS Preventing and Controlling Infections Standard[84] requires health service organisations to apply quality improvement systems that support and monitor the safe and sustainable use of IPC resources.

Health services use immense amounts of resources and generate vast amounts of waste in delivering care to their patients. Improving the environmental sustainability of health services is an opportunity to improve the safety and quality of care, reduce low-value care, eliminate unwarranted variation in care, and reduce waste.

To effectively mitigate and adapt to future sustainability, health services need to plan for the foreseeable effects of climatic events and take opportunities to deliver sustainable health care. This includes consideration of:

- the hazards that climatic change and environmental destabilisation pose to the delivery of future health services and the population's health
- the effect that organisations pose to the climate and environment through emissions, waste production, and supply chains when delivering care or using low-value models of care.

The environmental impact of the daily operations of an organisation should not be underestimated. Services such as environmental cleaning and waste management should assess and implement strategies that deliver environmentally sustainable and adaptable services across all sectors of an organisation. Factors to consider include:

- minimising the organisation's carbon footprint
- water management, including minimising water utilisation and wastage, and identifying opportunities for water conservation
- minimising the use of toxic cleaning products
- options for reprocessing equipment.

[97] https://store.standards.org.au/product/as-23907-2023
[98] https://www.iso.org/standard/71506.html

Wastewater management

Organisations must consider strategies for managing and reducing wastewater. In the healthcare setting, wastewater contamination can occur from procedures such as dialysis, pharmaceutical compounding and disposal processes, and chemicals used for cleaning and disinfection. For example:

- Renal dialysis produces large volumes of wastewater. Reverse-osmosis reject water is generated before patient dialysis and is essentially clean water. Spent dialysis effluent is the wastewater produced during dialysis and contains blood cells. Both reverse-osmosis reject water and spent dialysis effluent are commonly discarded into the sewer system.
- The disposal of antimicrobial and other clinical waste, such as faecal matter, into wastewater may contribute to the proliferation of environmental MRO reservoirs such as carbapenemase-producing Enterobacterales in the healthcare settings. See AURA 2021[99] and the 2021 Recommendations for the control of carbapenemase-producing Enterobacterales (2021 CPE Guide)[100] for more information.
- Cleaning chemicals and pharmaceuticals can contain toxins that may be harmful to animals and the environment when discarded into sewage systems.

Action 4.14 (Safe and secure storage and distribution of medicines) of the NSQHS Preventing and Controlling Infections Standard[84] recommends that health service organisations comply with manufacturers' directions, legislation, and jurisdictional requirements for the disposal of unused, unwanted, or expired medicines. States and territories, as well as peak pharmaceutical advisory bodies, can provide guidance on the safe disposal of pharmaceuticals.

Organisations should educate staff on the safe handling and disposal of pharmaceuticals and chemicals. Organisations should also consider alternative uses for wastewater, alternative means of disposal of chemicals and options to recycle clean wastewater, such as reverse osmosis reject water, to reduce the environmental impact.

In some regions of Australia there is a risk of water shortages. Organisations should be aware of options for reducing water wastage and implementing water re-use strategies in relation to storm water, grey water, and treated sewage, where feasible. For more information on safe water reuse, see the Australian guidelines for water recycling.[101]

Waste generation and management should include consideration of environmental sustainability. Actions to consider for sustainability include:

- minimising waste by selecting products with less packaging
- using reusable items where safe and clinically appropriate to do so
- only using equipment if clinically indicated, such as reviewing if a patient really needs an intravenous line or urinary catheter
- avoid overstocking linen trolleys to minimise amount of unused linen that needs to be re-laundered
- minimising the use of toxic cleaning products
- the environmental sustainability of emerging cleaning technologies, such as micro-fibre cloths or steam cleaning technology
- disposal of waste in appropriate containers and waste streams for disposal.

[99] https://www.safetyandquality.gov.au/our-work/antimicrobial-resistance/antimicrobial-use-and-resistance-australia-surveillance-system/aura-2021
[100] https://www.safetyandquality.gov.au/publications-and-resources/resource-library/2021-recommendations-control-carbapenemase-producing-enterobacterales-2021-cpe-guide
[101] https://www.waterquality.gov.au/guidelines/recycled-water#managing-health-and-environmental-risks-phase-1

Recycling

Organisations can consider recycling programs to minimise waste and reduce the environmental impact of the waste production. General waste can be streamed into paper, glass, metals, and hard and soft plastics (such as peripheral venous catheter intravenous fluid bags and packaging) for recycling. Another option for recycling is retaining expired stock for education and training purposes. As with all other receptacles used to store waste, receptacles used to collect recycling should also be made of materials that can be cleaned.

Part 2: Risk assessment, cleaning schedules and programs

- **Risk assessment in environmental cleaning**
- **Cleaning programs and schedules**
- **Staff training and safety for environmental cleaning**
- **Environmental cleaning audits**

Risk assessment in environmental cleaning

Risk assessment for environmental cleaning is an important element of the organisation's wider risk management program. Risk management is an ongoing and proactive activity, which involves systems and processes to identify hazards and assess and control the risks for patients, visitors, and members of the workforce, so far as is reasonably practicable.

Risk management is a four-step process. The steps are:

1. Identify the hazards – what are the real or potential hazards that could cause harm in the organisation?
2. Assess risks – what are the risks if someone is exposed to these hazards, and how likely is it that someone could be exposed to a hazard in the organisation?
3. Control risks – what actions can be taken to control the risk?
4. Review the control measures – how effective are the controls that are in place, and how can they be modified as required, to ensure the ongoing safety of everyone?

More information on risk management is available at workbook Module 2. Risk Management for infectious agents and diseases.

In the context of environmental cleaning, unhygienic and poorly maintained healthcare environments and equipment may result in injury or illness, outbreaks of infectious agents, and damage to environmental surfaces and equipment, such as corrosion or rust. To mitigate these risks, a risk assessment is used to determine and allocate the level of risk. Factors which may affect the level of risk include:

- the treatments and services provided in the healthcare setting
- whether the healthcare setting is a clinical or non-clinical environment
- whether there are frequently touched/high touch surfaces or minimally touched/low touch surfaces
- local infection risks, including outbreaks of infectious disease or a high burden of MROs, such as MRSA, vancomycin-resistant enterococcus (VRE) and carbapenemase-producing Enterobacterales (CPE)
- whether standard and/or transmission-based precautions are in use.

The information from the risk assessment is then used to determine the type and frequency of cleaning required in a particular healthcare setting. This protects patients, visitors and healthcare workers from risks associated with the specific hazards unique to that environment.

Table 4.4 provides examples of risk levels assigned to specific healthcare settings based on the outcomes of a risk assessment. For example, an operating theatre complex is assigned an infection risk level of extreme/very high because of the high risk of infection to patients during surgery, and the high risk of equipment and environmental contamination with blood and body fluids. In comparison, the risk level in an administration area is low as there are no clinical activities performed in that setting.

Table 4.4. Examples of infection risk levels for healthcare settings

Risk level	Examples (includes connecting areas such as bathrooms, corridors, storerooms)
Extreme/very high	• Operating theatre complex • Intensive care units • Emergency departments • Labour and delivery wards • Clinical areas with immunosuppressed patients
High	• General wards • Outpatient clinics with treatment/procedure rooms • Emergency ambulances and other rescue vehicles
Medium	• Outpatient clinics including consulting rooms and ambulatory care • Residential accommodation • Offices in patient and clinical areas • Kitchenettes, pantry, and other food preparation and storage areas
Low	• Office/ administration areas

Source: Adapted from Fact sheet – Principles of Environmental Cleaning Auditing[102]

Environmental cleaning risk assessment should be a continual process. It should be undertaken by staff who perform cleaning duties and used to inform the type and frequency of cleaning required in different functional areas. Cleaning frequencies may need to increase in response to emerging evidence, outbreaks of an infectious disease (for example, gastroenteritis or COVID-19) or in response to internal building works (for example, causing the generation of dust or fungal spores).

Cleaning programs and schedules

The information from a risk assessment should be used to inform the development of a department- or organisation-wide cleaning schedule.

Cleaning schedules describe the frequency of cleaning and the type of cleaning required to reduce risks and maintain a hygienic and safe healthcare environment. Cleaning schedules will differ, depending on the type of healthcare setting, the current risk level and the types of risk that have been identified. Cleaning schedules should include information on:

- the infection risk level, for example, which areas have a high or low risk of infection (see Table 4.4)
- the frequency of cleaning in different areas, based on the infection risk level
- which cleaning products and techniques should be used in different settings and on different equipment
- staffing training requirements for equipment, cleaning products, and PPE use.

[102] https://www.safetyandquality.gov.au/publications-and-resources/resource-library/fact-sheet-principles-environmental-cleaning-auditing

Cleaning schedules should be available to all members of the workforce who are responsible for environmental cleaning. Table 4.5 provides an example of a cleaning schedule for a day procedure unit. This cleaning schedule includes the following information:

- infection risk level for each area of the unit
- the type of cleaning required and the recommended cleaning product
- the frequency of cleaning in each different area of the unit.

Table 4.5. Sample cleaning schedule for day only endoscopy unit

Area / Type of activity	Infection risk level	Frequency of cleaning	Cleaning solution
Sterilisation area	Extreme/very high risk	Daily or more often	Neutral detergent, disinfectant for blood, body fluid and MROs
Treatment/ procedure areas	High risk	Daily or more often (for example, between patient use)	Neutral detergent, disinfectant for blood, body fluid and MROs
Bathrooms	High risk	Daily or more often	Neutral detergent, disinfectant for blood, body fluid and MROs
Administration areas	Low risk	Daily or weekly	Neutral detergent
Reception and patient waiting area	Low risk, but may increase if patient present with infectious conditions (for example, MROs, COVID)	Daily or more often	Neutral detergent
Patient recovery area	High risk	Daily or more often	Neutral detergent, disinfectant for blood, body fluid and MROs
Staff room	Medium risk	Daily	Neutral detergent

Source: Environmental cleaning practices for small health service organisations[103]

Staff training and safety for environmental cleaning

Organisations need to provide training and safe work practices to support members of the health workforce perform their roles. In relation to environmental cleaning and IPC, staff should be provided with:

- education on basic IPC, specifically the use of standard precautions and transmission-based precautions and safe work practices that minimise the transmission of infectious agents
- safe processes and systems of work, including manual handling techniques, safe handling and storage of chemicals and equipment, access to material safety data sheets and PPE use
- education on how to clean biological and or chemical spills as appropriate to their role
- workplaces that are functional and designed to minimise the transmission of infectious agents, for example designated areas for waste storage and disposal that is separate to other workspaces
- access to reporting systems for compliance and identifying breaches of IPC protocols
- training on cleaning processes and techniques
- training on how to clean, use and maintain cleaning equipment.

[103] https://www.safetyandquality.gov.au/publications-and-resources/resource-library/environmental-cleaning-practices-small-health-service-organisations

Safe processes and systems of work

Developing safe processes and systems of work involves identifying all the factors that are involved with a task and designing interventions that protect workers undertaking that task. This is a complex process that should involve managers, supervisors and staff.

Developing safe processes and systems of work includes identifying:

- how work tasks are performed (the steps involved)
- the complexity of the task
- how frequently the task is performed
- the worker's ability to perform the task (training, skill level, limitations)
- the context/environment in which the task is performed
- the resources that are available to perform the task.

For more information on safe systems and processes of work, refer to Safe Work Australia: Principles of good work design* handbook.

**https://www.safeworkaustralia.gov.au/system/files/documents/1702/good-work-design-handbook.pdf*

Manual handling techniques

Environmental cleaning involves lifting, pushing, pulling, carrying, potential exposure to hazardous chemicals, and sometimes operating heavy equipment. Manual handling techniques are one intervention that can help reduce the risk of physical injury to staff in the course of their work.

It is important to identify hazardous tasks and the associated risk for physical injury and introduce interventions to mitigate those risks. For example, hanging cloth curtains using a ladder or moving heavy furniture to clean around can present risks. Manual handling techniques should be included as part of staff training for environmental cleaning. Specific training should be provided to staff who operate heavy equipment, such as floor polishers, or handle hazardous chemicals.

For more information on manual handling, see Safe Work Australia: Model Code of Practice: Hazardous manual tasks.*

**https://www.safeworkaustralia.gov.au/doc/model-codes-practice/model-code-practice-hazardous-manual-tasks*

Safe handling and storage of chemicals

All chemicals used for environmental cleaning have the potential to cause harm, illness or injury and must be stored and handled safely. Chemicals used in environmental cleaning can cause skin and respiratory sensitivity or reactions, and some chemicals may be carcinogenic or poisonous. Staff should be provided with:

- training for handling and storing chemicals
- appropriate PPE for handling and mixing cleaning chemicals
- a well-ventilated environment to mix and store chemicals
- access to hazardous material spill kits
- access to chemical safety data sheets for information on each chemical they use in the course of their work.

For more information on the chemical safety data sheets or specific chemicals used for environmental cleaning, see: Safety data sheets | Safe Work Australia.*

https://www.safeworkaustralia.gov.au/safety-topic/hazards/chemicals/safety-data-sheets

PPE for cleaning

PPE should always be made available for all members of the workforce who undertake environmental and equipment cleaning. Staff need access to protective eyewear, face masks, face shields, aprons, gowns, and gloves (single-use or utility gloves) to protect against exposure to infectious agents and chemical used in environmental and equipment cleaning. Table 4.6 lists types of PPE and recommended usage.

Table 4.6. Types of personal protective equipment and their uses

Equipment	Use
Protective eyewear and face shields	Use when handling or mixing chemicals for cleaning. Protective eyewear is required to protect against potential splashes from chemicals to the eyes and face.
Face masks	Protect staff from inhaling vapours from cleaning chemicals.
Aprons or protective gowns	Protects a person's clothing from contact with chemicals or infectious agents that may be present on environmental surfaces and equipment during cleaning.
Gloves	Protects the staff member's skin from exposure to cleaning chemical and infectious agents that may be present on environmental surfaces and equipment during cleaning. Staff may either use single use gloves, which are disposed of after each use, or reusable utility gloves which can be decontaminated for re-use.

For more information on the use of PPE in relation to standard and transmission-based precautions, see workbook Module 1. Principles of infection prevention and control.

For more information on the use of PPE for environmental cleaning, visit Safe Work Australia.*

https://covid19.swa.gov.au/

Environmental cleaning audits

An environmental cleaning audit is a way to check that environmental cleaning is performed to a high standard. This prevents the onset of HAIs, ensures patient safety, and minimises the risk of adverse patient outcomes. Audit outcomes should be reported back to cleaning staff for discussion, and strategies can be developed to improve cleaning practices as required.

Table 4.7 lists some considerations when undertaking an environment cleaning audit.

Table 4.7. Environmental cleaning audit considerations

Consider	Description
Who will be undertaking the audit?	This should be someone who has knowledge about environmental cleaning processes, is familiar with the organisation, and is trained in environmental cleaning auditing.
When to audit?	Consider different times of the day to capture different cleaning activities. For example, in patient areas audit early in the morning to observe routine cleaning or later in the day to capture discharge cleaning.
Where to audit	A variety of areas should be sampled in each audit to provide a cross-section of the cleaning process across an organisation. Each audit should include different locations, such as clinical and non-clinical staff and patient areas. However, if monitoring cleaning performance in a specific location, then that location should be included in each audit.
Frequency of audits	The frequency or timing of environmental cleaning auditing should be based on the frequency of cleaning, as well as: • local risks (for example, higher infection risk areas may require more frequent auditing in response to identified gaps in cleaning processes) • the commissioning of new cleaning processes or staff • outbreak management • special project cleaning.
What should be included in environmental cleaning audits	Consider the different requirements and services provided by a health service organisation. Besides auditing cleaning processes of the different areas in a facility, audits may also include: • compliance with linen storage and handling policies • compliance with waste segregation, storage, and handling policies • cleaning and storage of shared patient care equipment.

How to undertake environmental cleaning audits

Visual inspections measure the visual cleanliness that is apparent to patients and visitors and help to identify maintenance issues (for example, surface degradation) that require rectification.

Objective methods, such as fluorescent gel markers and adenosine triphosphate (ATP) bioluminescence detection systems, can be used to measure the amount of organic material on a surface and the effectiveness of individual cleaning techniques.

Selecting surfaces to audit. A random sample of different surfaces and equipment in the organisation should be included in each environmental cleaning audit. For example, a mix of frequently and minimally touched surfaces such as light switches and handrails, bathrooms, patient equipment, kitchens, floors. If comparing audit results for an individual surface over time (for example, the same tap handle in the same room in the same ward), it is important to record what specific sites have been audited at each audit.

What to do with audit results

Findings from audits should be fed back to all staff who are involved in environmental and equipment cleaning (clinical staff, non-clinical staff, support staff and managers). This information can then be used to:

- modify cleaning processes as required
- assess compliance with environmental policies, procedures and protocols
- identify and repair damaged equipment and surfaces
- improve stock and equipment storage systems.

Auditing environmental cleaning as part of an organisation's quality improvement program can be used to identify, and set priorities for, organisational strategies to prevent and control healthcare-associated infections and manage the risks.

For more information on auditing environmental cleaning, see the Commission's suite of environmental cleaning resources:

- Principles of environmental cleaning factsheet*
- Environmental cleaning practices for small health service organisations†
- Environmental cleaning: information for cleaners±
- Environmental cleaning: Emerging environmental cleaning technologies§
- Principles of environmental cleaning: product selection¶

**https://www.safetyandquality.gov.au/publications-and-resources/resource-library/principles-environmental-cleaning-auditing-august-2020-fact-sheet*
†https://www.safetyandquality.gov.au/publications-and-resources/resource-library/environmental-cleaning-practices-small-health-service-organisations
±https://www.safetyandquality.gov.au/publications-and-resources/resource-library/environment-cleaning-information-cleaners
§https://www.safetyandquality.gov.au/publications-and-resources/resource-library/environmental-cleaning-emerging-environmental-cleaning-technologies
¶https://www.safetyandquality.gov.au/publications-and-resources/resource-library/principles-environmental-cleaning-product-selection-october-2020-fact-sheet

Module 5. Basics of surveillance and quality improvement

Contents

Overview of Module 5

Module 5 contains two parts:

Part 1: Surveillance

Part 2. Using infection surveillance for quality improvement

This module provides an understanding of the basic principles of surveillance and quality improvement to use as part of an organisation's infection prevention and control program. By completing this module, you will understand:

- the importance of surveillance in infection prevention and control
- the essential components of an infection surveillance program
- the importance of data quality in infection surveillance
- the national systems for infection surveillance
- the purpose of quality improvement
- the elements of successful quality improvement systems
- the main components of a quality improvement system for infection prevention and control.

Part 1: Surveillance

Part 1 covers the following topics:

- **The importance of surveillance**
- **The essential components of an infection surveillance program**
- **Data quality in infection surveillance**
- **National infection surveillance systems**

The importance of surveillance

Action 3.05 (Surveillance) of the NSQHS Preventing and Controlling Infections Standard[104] requires health service organisations to have a surveillance strategy for infections, infection risk, and antimicrobial prescribing and use.

The surveillance strategy should:

a. incorporate national and jurisdictional information in a timely manner
b. collect data on healthcare-associated and other infections relevant to the size and scope of the organisation
c. monitor, assess, and use surveillance data to reduce the risks associated with infections
d. report surveillance data on infections to the workforce, the governing body, consumers and other relevant groups
e. collect data on the volume and appropriateness of antimicrobial use relevant to the size and scope of the organisation
f. monitor, assess, and use surveillance data to support appropriate antimicrobial prescribing
g. monitor responsiveness to risks identified through surveillance
h. report surveillance data on the volume and appropriateness of antimicrobial use to the workforce, the governing body, consumers, and other relevant groups.

Staff responsible for the implementation of an organisation's infection prevention and control (IPC) program should know:

- the different types of surveillance methods that can be used to monitor the risk or incidence of infection
- the basic statistical methods to interpret surveillance data
- how to report surveillance data
- how to use surveillance data with a quality improvement approach to respond to changes in the risk or incidence of infection.

What is surveillance and why is it important?

Surveillance for IPC is an epidemiological practice where the spread of disease or infection is monitored to establish patterns of progression. Surveillance of the risk or incidence of infection can inform strategies to reduce healthcare-associated infection (HAI) and the morbidity and mortality associated with these infections. The scope of infection surveillance can be very broad. While this module focuses on the use of surveillance in the context of monitoring and responding to HAIs, there are other forms of surveillance that support IPC programs. These include environmental cleaning auditing, hand hygiene compliance auditing, or monitoring compliance with correct and appropriate use of personal protective equipment (PPE).

The surveillance of antimicrobial use as part of an organisation's antimicrobial stewardship (AMS) program is also relevant to IPC, particularly in the management of multidrug-resistant organisms

[104] https://www.safetyandquality.gov.au/standards/nsqhs-standards/preventing-and-controlling-infections-standard

(MROs). This is not covered in this module, however, the Commission's website has information on AMS and the surveillance of antimicrobial use.[105]

The main purpose of infection surveillance is to improve the quality of care provided to patients to optimise clinical outcomes and improve patient experience. Surveillance data can be used to model, observe, and minimise the harm caused by infection. It can also be used to evaluate current IPC strategies and inform quality improvement actions to prevent further transmission and disease.

Surveillance provides information on:

- whether there is an infection problem
- the magnitude of the problem
- the factors that contribute to the onset of infection
- the impact of existing IPC strategies
- where to target interventions to improve and minimise the risk of infection.

Organisations can use this information to minimise the risk of infection and improve patient safety. Timely feedback and reporting of surveillance data to stakeholders is critical to support effective change.

The essential components of an infection surveillance program

What are the features of an infection surveillance program?

Infection surveillance data should accurately reflect the clinical outcome or process of interest. The user should be able to compare the data with historical data or data from other organisations. Infection surveillance data should also be provided to relevant audiences including organisational clinicians, executives, healthcare consumers, and carers. Data should be presented in a format that is easy to understand.

These goals can be achieved by using the most appropriate:

- surveillance designs
- data collection processes
- statistical methods to analyse the data
- methods to provide feedback and report findings.

What is surveillance design?

Surveillance design is the approach that is used to collect information about a particular disease or infection. When deciding which surveillance design is most suitable, the following points should be considered:

- the purpose of the surveillance
- the duration of surveillance
- the target of the surveillance
- at what point data collection is required
- the resources available for surveillance in the short- and long-term
- the size, service complexity, and role delineation of the organisation
- the patient population and its risk factors for infection.

[105] https://www.safetyandquality.gov.au/our-work/antimicrobial-stewardship/antimicrobial-stewardship-ams-resources-and-links

There are a number of different surveillance methods. Some methods address the duration of surveillance (for example, continuous surveillance). Other methods may address the target of surveillance (for example, process or outcome surveillance) or focus on the timing of data collection (for example, prospective or retrospective surveillance). It is important to understand that certain surveillance methods can be used together in a complementary way in a surveillance design (for example, continuous and process surveillance) because they address different and unrelated aspects of data collection.

Methods that address the same aspect cannot be used together in a surveillance design. For example, it is not possible to use both a retrospective and prospective surveillance design. Table 5.1 provides a brief introduction to the different methods that are commonly used in infection surveillance.

Table 5.1. Surveillance methods used in infection surveillance

Surveillance method	Purpose	Advantages	Disadvantages
Continuous	Ongoing surveillance. Examples include daily review of microbiology results.	Provides a historical and real-time baseline rate which contemporary data can be compared against to identify changes in the spread of an infection. For example, the emergence of a local cluster or outbreak.	Can be resource-intensive. Produces a large amount of information.
Targeted	Surveillance of specific processes or outcome. For example, specific infections, aspects of clinical care, populations, or locations within a health service.	Can be used for a short duration of time. Provides very specific information. Can be initiated in response to a change in infection rates or in response to an intervention.	Information is limited to the specific process, outcome or setting that is under surveillance.
Process	Observe and measure compliance with a process in real time. For example, compliance with guidelines, policies and/or procedures, including hand hygiene, aseptic technique, or PPE use. Uses methods such as documentation review or observational auditing.	Easy to use; can use auditing tools to monitor practices. Findings can be benchmarked against clinical indicators. Provides evidence of whether a process is occurring sub-optimally. Can be used to monitor practical activities, such as hand hygiene, PPE use, compliance with aseptic technique. Can be done alongside outcome surveillance.	Can be resource-intensive. Cannot discriminate if a sub-optimal process has resulted in an infection.

Surveillance method	Purpose	Advantages	Disadvantages
Outcome	Identifies if an infection has occurred. Involves reviewing multiply datasets. Can be used to record the burden of disease in a population. For example, cases of Legionnaire's disease.	Can be used to establish changes in disease epidemiology.	Can only collect data after the clinical outcome has occurred. Does not identify the clinical processes that may have contributed to the infection. Relies on accuracy of data collected at the time.
Passive	Uses existing laboratory data that is collected as part of routine clinical investigation.	Less labour-intensive than other forms of surveillance as information may be easily accessible from existing data sources. For example, daily line lists or automated notifications, such as alerts on patient healthcare records.	May not capture all cases of infection as data collection is limited to what is captured by existing systems.
Active (screening)	Involves collecting information about colonisation and infection for the whole at-risk population. For example, admission/ pre-operative screening, COVID screening questions on admission.	Can provide information about the number of people in a population who: • have symptomatic disease • are asymptomatic carriers of infection • are not infected.	Is resource-intensive and time-consuming.
Signal (sentinel)	Is a specific type of outcome surveillance. Useful for monitoring of low numbers of infections that are not sufficient for statistical analysis but may be a signal for further investigation of procedures or practices. Can be used to identify surgical site infections or catheter-associated urinary tract infections.	Does not require the collection of large amounts of information. Can be used as an early warning indicator of broader patient safety issues. Can be used for small organisations or where low numbers of infections are common.	Only provides information after the event has happened. Not useful for infections that occur in large numbers or have outbreak potential.

Surveillance method	Purpose	Advantages	Disadvantages
Prospective	Requires data to be collected when the clinical outcome or clinical process occurs. Examples include daily review of microbiology results.	Provides real-time information and enables timely reporting of surveillance results. Identifies potential issues/ cases as they emerge. Allows for immediate interventions. Information can be verified against direct patient observation or clinical interview.	Is resource-intensive and time-consuming.
Retrospective	Data is collected after the clinical outcome has occurred or after the clinical process has been completed.	Data can be validated against documented evidence of infection, such as the patient healthcare record.	Surveillance can only be undertaken after the process or clinical outcome has occurred. May be difficult to provide timely feedback to individuals who were involved in the original event. For example, staff move onto other roles, long time lag between the event occurring and identifying the infection during the surveillance. May not be able to verify data against clinical observation or interview in real time. Heavily reliant on accurate record keeping.

Data collection processes for infection surveillance

Case finding

A standardised surveillance definition is used to identify the cases of interest to be included in data collection. This process needs to be done thoroughly to enhance the reliability of surveillance data.

Examples of case finding methods include:

- direct patient observation
- clinical interviews
- reviews of surgical lists
- examination of laboratory results
- review of pharmacy dispensing records
- interrogation of the patient's observation chart, healthcare records and or clinical care plans
- checking if the patient has been referred to other clinical services, such as infectious diseases clinics or wound clinics
- review of infection flags/alerts on electronic patient healthcare records.

Organisations should aim to use multiple case finding methods to increase the robustness and reliability of data collection. Standardised surveillance definitions often require complementary use of multiple case finding methods, such as both laboratory results and clinical observations.

Case definition

A surveillance definition describes the criteria used to determine whether a clinical outcome or process can be attributed as an infection or infection risk. Surveillance definitions are specific to the clinical outcome or clinical process that is under surveillance.

A surveillance definition is made of two parts. The first part describes the parameters of the numerator. In simple terms, the numerator represents the number of infections that have occurred, taking into consideration:

- **Patient-specific risk factors** such as the patient's age (for example, paediatric or adult) and co-morbidities (for example, diabetes/morbidly obese/anaesthesia risks/current infections).
- **The type of intervention/procedure** as there are different risks associated with different interventions/procedures (for example, length of surgery/complexity of procedure).
- **The inclusion period** refers to the period of time in which the onset of infection must have occurred for it to be related to the intervention/procedure and/or the at-risk period.
- **The acceptable markers of infection** describes the clinical signs, symptoms and other observations which are indicative of infection.

Other factors which may influence the risk for infection may also be included in the case definition. For example, admission to intensive care units, the presence of indwelling devices, or specific procedures, such as surgery.

The second part of the definition describes the parameters of the denominator. The denominator represents the total number of patients who are potentially at risk of infection during the surveillance period. The denominator will also usually define the setting that is under surveillance and for what period.

Many infection surveillance programs around the world have adopted definitions from the United States Centres for Diseases Control National Healthcare Safety Network (NHSN).[106] Using standardised definitions such as these allows for robust comparison of local data with data from other health services and organisations. The Commission has produced national standardised surveillance definitions for use in the Australian health system:

- Staphylococcus aureus bloodstream infection[107]
- Clostridioides difficile infection[108]
- Central line-associated bloodstream infection.[109]

Statistical methods

Staff who are responsible for infection surveillance should know how to calculate an infection rate, apply risk stratification, make statistically valid comparisons and be able to provide feedback and report on infection rates.

[106] https://www.cdc.gov/nhsn/index.html
[107] https://www.safetyandquality.gov.au/our-work/infection-prevention-and-control/hai-surveillance/surveillance-staphylococcus-aureus-bloodstream-infection-sabsi
[108] https://www.safetyandquality.gov.au/our-work/infection-prevention-and-control/hai-surveillance/surveillance-central-line-associated-bloodstream-infection
[109] https://www.safetyandquality.gov.au/our-work/infection-prevention-and-control/hai-surveillance/surveillance-clostridioides-difficile-infection-implementation-guide

Calculating infection rates

The amount of infection in a population is usually reported as the **incidence** or **prevalence** of infection.

- **Incidence**: Only new cases of infection in a population
- **Prevalence**: All cases (new and old) of an infection in a population

Infection rates are calculated using the following information:

- The **numerator** represents the number of infections that occurred, as described by the surveillance definition.
- The **denominator** represents the number of individuals at risk of getting an infection (that is, the at-risk population). The surveillance definition will inform who is included in the denominator. For example, the denominator may include all overnight admissions within an organisation (for example, patient days) or the total population for a community.
- The **constant** is a multiple of 10, usually 100, which is used to obtain a percentage. The constant makes the resulting rate meaningful, as it is often difficult to understand the practical impact of an infection rate that is less than 1.

- The formula for calculating the rate of infection is: (Numerator ÷ Denominator) × Constant = Infection rate.

CASE STUDY

Hospital A has a 200-bed capacity. Five patients were identified with *S. aureus* bloodstream infections from hospital A in a 30-day period. Hospital A had another 135 patients coming in and out of the hospital during these 30 days with a total of 12,000 patient days of bed occupation. What is the infection rate?

Use the formula:

(Numerator/ Denominator) x Constant = Infection rate

The numerator is the 5 cases of *S. aureus* bloodstream infection

The denominator is the total 12,000 patient days of occupation in the hospital

The constant is 10,000. Using this multiplier will result in a value greater than 1.

The calculation is: = (5 ÷ 12,000) × 10,000

= (0.0004) × 10,000

= 4 infections

Therefore, the *S. aureus* infection rate is 4 per 10,000 patient days.

➢ Information on patient-days of bed occupation is usually available from the health service organisation administration services.

CASE STUDY

Ward A is an obstetric surgical ward. Each month they care for 150 women who have undergone a Caesarean section. In April, 5 patients are readmitted with a wound infection. They had their surgery in March. What is the infection rate for this ward?

Use the formula:

(Numerator/ Denominator) × Constant = Infection rate

The numerator is the 5 cases surgical site wound infection.

The denominator is the total 150 procedures.

The constant is 100. Using this multiplier will result in a value greater than 1.

The calculation is: = (5 ÷ 150) × 100

= (0.033) × 100

= 3.3 infections

Therefore, the infection rate is 3.3 per 100 procedures.

Calculating infection rate using a standardised statistical method ensures that infection rates can be compared between similar wards and hospitals, and before and after the implementation of infection control strategies.

Risk stratification

Risk stratification is not used for all surveillance. For example, *Staphylococcus aureus* bloodstream infection (SABSI) surveillance. However, where risk stratification is applied, infection rates can be adjusted according to the level of infection risk for the at-risk population.

Risk stratification uses standardised criteria and recognises that the level of infection risk can vary within the population. For example, people who have a long length of surgery or a higher ASA* physical status score may be at a higher risk of infection. Similarly, people who are immunocompromised may be more likely to acquire an infection than someone who is immunocompetent.

***ASA physical status score**: American Society of Anaesthesiology physical status score is used to assess a person's tolerance/risk for anaesthesia and surgery.

It is important to account for varying levels of infection risk within a population when analysing surveillance data. Failure to do so may result in missed opportunities to improve patient safety for high-risk patient groups and clinical settings. It may also incur avoidable costs associated with deploying unnecessary interventions in areas where the risk of infection is low.

It is also important to consider the impact of variations, such as infection risk, if a health service organisation wishes to benchmark their performance with others. The level of infection risk and the comparability of infection surveillance data can be affected by the differences between:

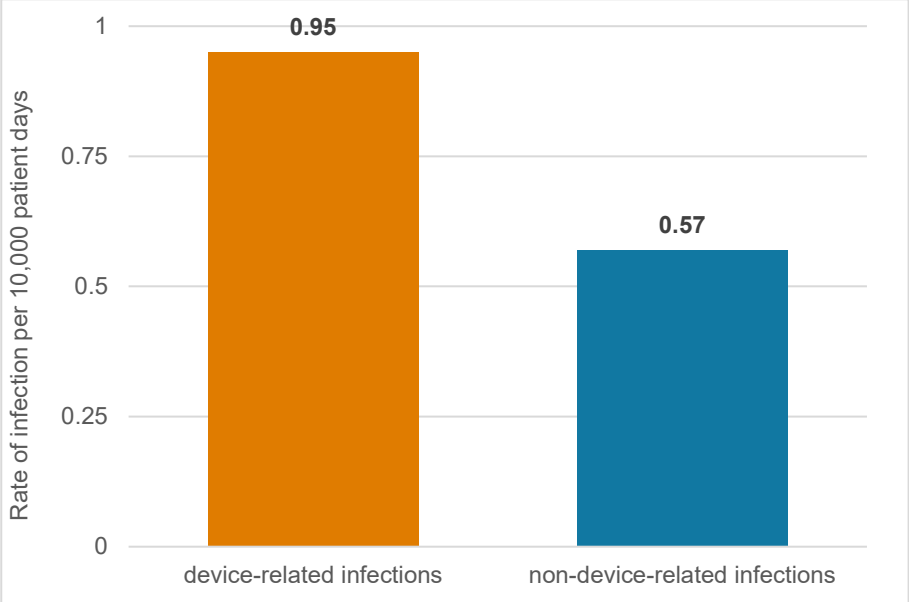
- procedure type
- facility type
- patient case mix
- role delineation (complexity of care).

Some simple ways to risk adjust infection surveillance data include:

- comparing similarly aged patient populations (for example, analyse healthcare-associated bloodstream infections in children separately to healthcare-associated bloodstream infections in adults)
- analysing infections in high-risk patients and high-risk clinical settings separately to other patient groups and settings (for example, analyse infections occurring in intensive care units or among haematology or oncology patients separately to infections presenting in general medical or surgical wards).

An example of risk stratification is comparing rates of infection between patients with invasive devices and patients without invasive devices within the same department, such as in intensive care units (ICU) – see Figure 5.1.

Figure 5.1. Example of rates of device-related infections in ICU



Another example of risk stratification is wound classification (see Table 5.2). Wound classification is used in surgical site infection (SSI) surveillance to identify which patients may have had a higher risk for SSI. Wound classification considers the degree of contamination of a surgical wound at the time of surgery. Stratifying SSIs by wound class ensures that surgical procedures with a high infection risk are not directly compared with surgical procedures where there is a much lower risk of infection.

Table 5.2. Wound classification

Wound Class	Description
Clean	An uninfected operative wound where no inflammation is encountered and the respiratory, alimentary, genital, or uninfected urinary tracts are not entered. In addition, clean wounds are primarily closed and, if necessary, drained with closed drainage. Operative incisional wounds that follow non-penetrating (blunt) trauma should be included in this category if they meet the criteria.
Clean-contaminated	Operative wounds in which the respiratory, alimentary, genital, or urinary tracts are entered under controlled conditions and without unusual contamination. Specifically, operations involving the biliary tract, appendix, vagina, and oropharynx are included in this category, provided no evidence of infection or major break in technique is encountered.
Contaminated	Open, fresh, accidental wounds. In addition, operations with major breaks in sterile technique (for example, open cardiac massage), or gross spillage from the gastrointestinal tract, and incisions in which acute, non-purulent inflammation is encountered, including necrotic tissue without evidence of purulent drainage (for example, dry gangrene) are included in this category.
Dirty/infected	Includes old traumatic wounds with retained devitalised tissue and those that involve existing clinical infection or perforated viscera. This definition suggests that the organisms causing post-operative infection were present in the operative field before the operation.

Source: Approaches to surgical site infection surveillance (2017)[110]

Risk stratification improves comparability of different datasets collected in different sites or at different times and ensures that the findings are meaningful and relatable to the clinical context.

Comparisons

Besides risk stratification, valid data comparison relies on the use of consistent surveillance definitions and data collection methods. This consistent approach controls for variations due to differences in patient numbers, patient demographics, hospitals or locations, role delineations and times periods.

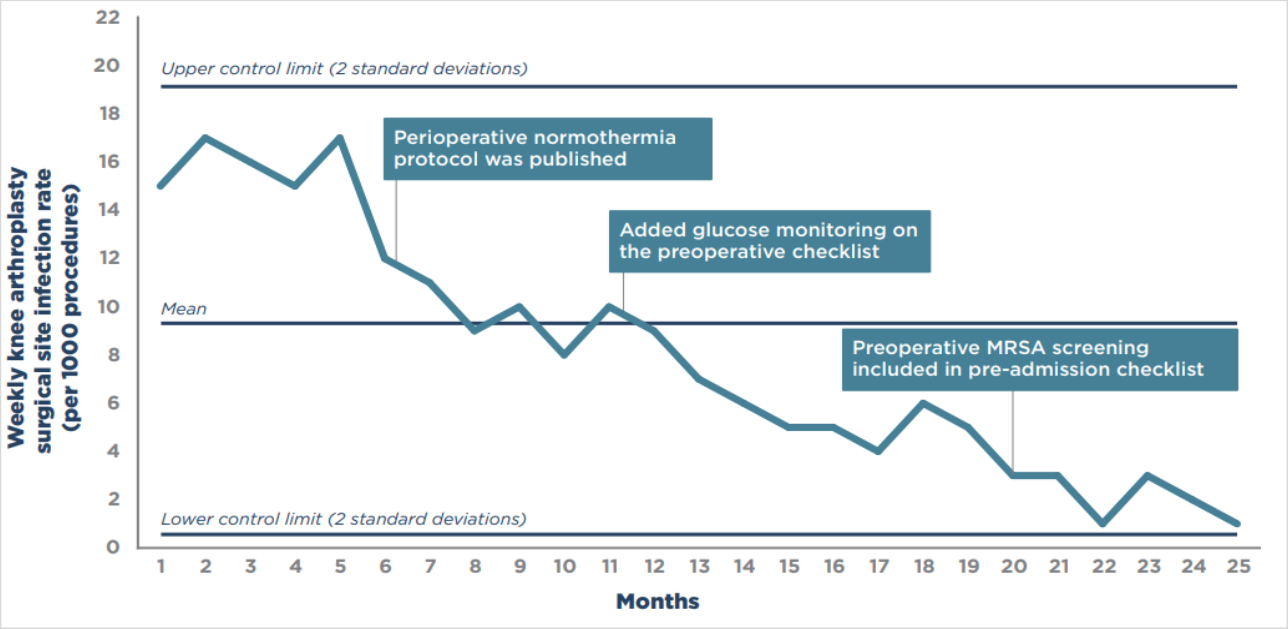
To improve the comparability of infection surveillance data, findings are generally presented as one of the following:

- **Ratio** – compares the number of individuals at risk of an infection or with an infection with the number of individuals who do not have the infection.
- **Proportion** – describes the number of individuals at risk of an infection or with an infection as a percentage or a fraction of the total at-risk population.
- **Rate** – describes the frequency at which infection occurs within a population within a particular setting.

Changes in rates over a period can be visualised by plotting rates on a statistical process control chart, also known as a run chart (see Figure 5.2). Data should be plotted at a regular frequency (such as daily, weekly, monthly) and changes in practice should be annotated on the chart alongside the time points when the change occurred. The run chart should include an upper and a lower control limit – often control limits of two or three standard deviations are used.

[110] https://www.safetyandquality.gov.au/sites/default/files/2019-06/approaches-to-surgical-site-infection-surveillance.pdf

Figure 5.2. Example of a statistical process control chart for surgical site infection rates associated with total knee arthroplasty



Source: Australian Commission on Safety and Quality in Health Care. Approaches to Surgical Site Infection Surveillance. Sydney: ACSQHC; 2017[111]

Tasks required for infection surveillance

Comparing infection surveillance data helps to identify trends in the data, such as increases or decreases in infection rates over time. This can be used to inform strategies to improve clinical practice and patient safety and outcomes. For example:

- Comparing a hospital's infection rate to that of a hospital of similar size and complexity can provide an understanding of how a hospital is performing in relation to others. Successful strategies and interventions can be shared and implemented across groups of similar hospitals to promote changes in practice.
- Comparing current infection rates to previous reporting periods provides a basis for investigating reasons for increased rates, and for evaluating the effectiveness of interventions. Higher than average rates should prompt local action, such as staff training and education, policy compliance assessment, and review of policy and procedure, to improve clinical practice. Conversely, if the average rate is decreasing, any recent interventions and practice improvements can be identified, shared, and further embedded into routine clinical care.
- Examining infection rates by clinical setting can help to identify if there is a greater risk, or incidence, of infection in certain clinical areas, and allows for the implementation of specific strategies to address these risks. For example, an increased rate of healthcare-associated *S. aureus* bloodstream infection in a perioperative unit may prompt a hospital to consider reviewing its pre-surgical admission process for *S. aureus* screening, decolonisation and surgical antimicrobial prophylaxis. If infections are repeatedly related to one type of surgery, an outbreak investigation may also be required.

[111] https://www.safetyandquality.gov.au/publications-and-resources/resource-library/approaches-surgical-site-infection-surveillance

Data quality in infection surveillance

Data quality refers to data that is accurate, fit for purpose, and fulfils the requirements of the relevant data dimensions.

Data dimensions are the different elements of data that require assessment to establish the quality of the data. There are a number of different data dimensions that influence data quality, and one dimension can impact another. Table 5.3 describes the relevant data dimensions for IPC and infection surveillance. High-quality data is achieved when there is a high level of confidence in a combination of these dimensions.

Table 5.3. A summary of the data dimensions in infection surveillance data

Data dimension	Definition
Completeness	A measure of how well the data contains the most important information required, without duplication and not missing information, according to the defined collection, data field and dataset criteria. This can usually be measured by checking against reference data.
Accuracy	The measure of how correct the data is at representing, estimating, or describing the purpose it was collected for. Accuracy can be checked internally by using expectations of relationships between data variables, for example date and time values, or externally by using reference data.
Consistency	The measure of how consistent and logical the data is when it is viewed in its entirety within the dataset (internal consistency), as well as with other datasets (external consistency).
Plausibility	The measure of the credibility of the data field, in light of another data field or knowledge about the data that is being measured. Plausibility can be determined by using expectations of relationships between variables.
Timeliness	Reflects the length of time between the events or phenomena described and the data becoming available. It is important data is recorded as close to an event as possible. This dimension of data is contextual and will differ depending on what data is being collected.
Relevance	The relatedness of the source of the data and how appropriate the data is for a data field or dataset. The timeliness of data can also impact the relevance of the data.

A critical part of infection surveillance is to ensure that collected data accurately reflects the true risk of infection in a specific setting or population. This is important because surveillance information is used to inform IPC policies and practices to improve both patient and healthcare worker safety and clinical outcomes.

Data validation

Data validation is a process that ensures collected data are accurate, classified correctly, fit for purpose and that there is minimal risk of bias. Robust data validation is an essential step in the analysis process to ensure high-quality data. Data validation identifies errors and anomalies in data. If data are not validated, IPC interventions based on the data will be misinformed. This may mean that inappropriate or less effective strategies are used; there may be misallocation of finite resources; and there may be increased patient or healthcare worker safety risk.

Data validation involves checking that all the information collected for infection surveillance is accurate and complete. As a minimum, this process should include checking:

- that all the required data entry fields have been completed
- there are no duplicate data entries

- there are no errors from cutting and pasting practices
- data fields are within the expected or acceptable value ranges
- consistent use of surveillance definitions
- any other events that may affect validation in the findings. For example, outbreaks of infectious agents, or introduction of new equipment, processes or procedures.

Feedback and reporting

Providing timely and relevant feedback to clinicians on clinical practice has a positive effect on improving infection rates. Feedback will increase clinician:

- awareness of IPC strategies
- recognition of risk factors for infection
- understanding of policy and organisational expectations to improve patient safety outcomes.

Feedback and reporting should facilitate opportunities to discuss the effectiveness of existing practices and quality improvement initiatives.

Feedback can be provided either informally at an individual level, or formally at a departmental or team meeting, at an executive level, or via internal or public reporting systems. Reporting infection surveillance data to peak governance committees is important for raising awareness and accountability for IPC and seeking additional program resources. An organisation's peak governance committee will usually include representatives of services such as:

- nursing and medical administration
- clinical specialties
- IPC
- antimicrobial stewardship
- clinical governance and quality assurance.

Organisations also should ensure that the outcomes of infection surveillance are also reported to consumers, whose input can be used to inform quality improvement activities to reduce the risk of infection.

National infection surveillance systems

Organisations should consider using existing national infection surveillance systems where available. These systems have standardised surveillance definitions and data collection methods, and often have a national dataset to use for making comparisons.

Examples of national surveillance systems and supports available in Australia for IPC are shown in Figure 5.3 and include:

- The National Hand Hygiene Initiative,[112] which includes process monitoring of hand hygiene compliance in organisations using a defined direct observation audit methodology
- The Antimicrobial Use and Resistance in Australia (AURA) Surveillance System,[113] which includes data from targeted and passive surveillance programs for antimicrobial use and antimicrobial resistance in hospital and community settings

[112] https://www.safetyandquality.gov.au/our-work/infection-prevention-and-control/national-hand-hygiene-initiative/national-hand-hygiene-initiative-nhhi-learning-management-system-lms/hand-hygiene-online-learning-modules
[113] hthttps://www.safetyandquality.gov.au/publications-and-resources/resource-library/implementation-guide-surveillance-staphylococcus-aureus-bloodstream-infectiontps

- Nationally standardised definitions for Staphylococcus aureus bloodstream infection,[114] Clostridioides difficile infection[115] and central line-associated bloodstream infection,[116] produced by the Commission to support surveillance of the incidence of these infections
- The Australian and New Zealand Intensive Care Unit Society central line-associated bloodstream infections (CLABSI-ICU) registry,[117] which supports the surveillance of the incidence of CLABSI in Australian intensive care units
- The Communicable Diseases Network Australia[118] co-ordinates national surveillance programs for communicable diseases in Australia.

Figure 5.3. National surveillance resources (cover images)

[114] https://www.safetyandquality.gov.au/publications-and-resources/resource-library/implementation-guide-surveillance-staphylococcus-aureus-bloodstream-infection
[115] https://www.safetyandquality.gov.au/publications-and-resources/resource-library/cdi-implementation-guide
[116] https://www.safetyandquality.gov.au/publications-and-resources/resource-library/implementation-guide-surveillance-central-line-associated-bloodstream-infection-2019
[117] https://www.anzics.com.au/clabsi/
[118] https://www1.health.gov.au/internet/main/publishing.nsf/Content/cda-cdna-index.htm

Part 2. Using infection surveillance for quality improvement

Part 2 covers the following topics:

- **The purpose of quality improvement**
- **Quality improvement systems**

The purpose of quality improvement

What is quality improvement?

Quality improvement refers to the combined efforts of the workforce and others (for example, consumers, patients and their families, researchers, planners and educators) to make changes that will lead to improvements in:

- patient safety
- patient outcomes, such as better health
- system performance, such as better care
- clinical practice.

Quality improvement is often centred on interventions to mitigate the risk of infection associated with clinical care. Interventions may be targeted at reducing the risk of infection associated with specific clinical settings, procedures, or patient groups.

Interventions aimed at reducing infections within an organisation have the potential to improve patient outcomes through reducing mortality and morbidity, improving the overall patient safety culture and protecting members of the health workforce from harm. There is also the potential to reduce long-term financial costs, improve the use of resources, and support the organisation to meet the requirements of the NSQHS Standards.

What are the requirements of the NSQHS Standards for quality improvement systems?

Action 1.08 (Measurement and quality improvement of the NSQHS Patient safety and quality systems standard[119] require health service organisations to use organisation-wide quality improvement systems. These systems should be used to:

- identify safety and quality measures, and monitor and report performance and outcomes
- identify areas for improvement in safety and quality
- implement and monitor safety and quality improvement strategies
- involve consumers and the workforce in the review of safety and quality performance and systems.

Action 3.03 (Applying quality improvement systems) of the NSQHS Preventing and Controlling Infections Standard[104] also requires health service organisations to use quality improvement systems to:

- monitor the performance of IPC systems
- implement strategies to improve IPC systems
- report to the governance body, the workforce, patients, and other relevant groups on the performance of IPC systems.

[119] https://www.safetyandquality.gov.au/standards/nsqhs-standards/clinical-governance-standard/patient-safety-and-quality-systems

Quality improvement systems

The elements of a successful quality improvement system

The elements of a successful quality improvement system include:

- a description of high quality that is reflected through the organisation's vision, mission, and values
- a definition of the organisation's stakeholders
- clearly defined and aligned organisational and clinical quality objectives
- clearly defined processes and responsibilities that are required to meet clinical quality objectives
- training in safety and quality for the organisation's workforce
- processes to verify that the quality improvement system is operating effectively
- safety and quality indicators to monitor the quality of care, consumer satisfaction and changes in clinical practice
- a supportive governance system that promotes continual quality improvement.

Identifying safety and quality indicators

When planning a quality improvement program, data is required to identify if a problem exists, and to measure the outcome of any interventions. Organisations collect a wide variety of different data, including safety and quality indicators, such as:

- infection surveillance data
- incident management data
- complaints data
- safety and quality audit reports
- hospital-acquired complications[120] data
- reviews of clinical practice.

Examples of quality and safety indicators which are specific to IPC include:

- infection rates related to a particular infectious agent; for example, *S. aureus* bloodstream infections (SABSI)
- infection rates related to a particular clinical procedure; for example, catheter-associated urinary tract infections, ventilator-associated pneumonia
- infection rates among high-risk patient populations; for example, renal dialysis patients, elective surgery patients, haematology, and transplant patients
- compliance with processes known to minimise the risk of infection; for example, compliance with hand hygiene, PPE use or aseptic technique.

[120] https://www.safetyandquality.gov.au/our-work/indicators/hospital-acquired-complications

CASE STUDY

How SABSI and hand hygiene surveillance can support infection control practice and quality improvement

At a national level, hand hygiene compliance and the rate of bloodstream infections caused by *S. aureus* are considered to be robust indicators of the effectiveness of an organisation's IPC program.

Surveillance of SABSI has been well established in Australia since 2009, when the national SABSI case definition and mandatory reporting was endorsed and implemented by all states and territories. The former Australian Health Ministers' Advisory Council endorsed a revised national benchmark for healthcare-associated SABSI for the purpose of national reporting of public hospitals. The revised benchmark of 1.0 per 10,000 patient days was implemented on 1 July 2020.

Hand hygiene is an essential element of IPC practice. Hand hygiene compliance is assessed against a national benchmark set by the former Australian Health Ministers' Advisory Council. The current national benchmark is 80%.

Monitoring SABSI rates and hand hygiene compliance data can provide organisations with an indication of their overall IPC culture and practices. For example, low rates of SABSI may reflect widespread uptake of aseptic technique during line insertion and good management of peripheral intravenous catheters. Whereas poor hand hygiene compliance may reflect poor compliance with other IPC practices, such as PPE use and aseptic technique.

What does a successful quality improvement system consist of?

A quality improvement system should have clearly defined objectives and has five key components:

1. Data collection
2. Data analysis
3. Reporting and reviewing of surveillance or project outcomes
4. Initiating practice change
5. Testing the effectiveness of practice change.

Ongoing monitoring through infection surveillance enables organisations to identify aspects of clinical care that may contribute to the occurrence of preventable HAIs.

Once these aspects are identified, the organisation will be better informed to develop targeted interventions to reduce the incidence of these infections occurring in the future.

Reporting and reviewing

Once infection surveillance data have been analysed, it is important to report the outcomes to the relevant stakeholders to determine whether further action is required to address any changes in infection risk.

The relevant stakeholders for a health service organisation may include:

- **The infection prevention and control committee:** Surveillance data should be provided to this multidisciplinary group to consider the validity of the surveillance findings and whether surveillance outcomes are 'usual' or indicate real changes in infection trends.
- **Clinicians:** Providing timely and relevant feedback to clinicians increases their awareness of preventive measures and helps them recognise and address risk factors for infection. Regular feedback also reinforces policy and organisational expectations to improve patient safety outcomes. Reporting infection surveillance data at formal and informal clinician and departmental meetings provides opportunities for feedback on existing quality improvement initiatives and highlights best practice outcomes.
- **Executive and governance committees:** Reporting infection surveillance data to the health service executive and peak governance committees is important for raising awareness and accountability for infection prevention and seeking additional resourcing to support IPC programs. Peak governance committees usually include representation from clinical or medical services, IPC, antimicrobial stewardship, drug and therapeutics, clinical governance, and quality assurance.
- **Consumers and the community:** Consumers provide a valuable perspective on how well care is delivered and what aspects of care are most valued. Consumer input can be obtained from the different types of partnerships with patients and consumers that exist within the healthcare system. These partnerships may occur at the individual level when providing direct care to a patient, at the department or program level when a consumer is directly involved in the design or delivery of a program, or at the organisation level when consumers are involved in the overall governance, policy, and planning. Consumers and consumer representatives may also be members of an organisation's peak governance committees for patient safety, facility design, quality improvement and patient or family education.

There are some key questions that the stakeholders should consider when infection surveillance outcomes are provided for review. These questions include:

- Has there been a change in infection rates?
- Why has the change occurred?
- How has this change occurred?
- What is the effect of this change and is it meaningful?
- If there has been an increase in infection rates, has there been a change in infection risk? What actions can be taken to address this change in risk?
- If there has been a decrease in infection rates or risk, are there learnings that can be applied across the organisation more broadly?

Initiating practice change and testing

When introducing quality improvement programs for IPC, it is important to understand the current infection risks and infection control practices used within the organisation. This information should be used to prioritise and focus strategies for practice change. Interventions to reduce infection risks may involve changes to current clinical practices, review of current programs or policies, and changes to equipment or processes.

Design intervention

When designing a quality improvement intervention, it is important to:

- clearly define the specific objectives and goals of the program
- clearly identify what needs to change
- clearly identify how the change will be measured.

An intervention needs to directly address the infection risk and be able to be measured. Two models that can be used in intervention design are:

- **The SMART format**
- **The Hierarchy of Effectiveness Model**

The SMART format

One way to address the infection risk is by writing the intervention in the **SMART** format.

Figure 5.4. The SMART format

Specific: clearly define the goal and the proposed outcome of the quality improvement program.

Measurable: identify what will be measured, and how will it be measured.

Achievable: determine if the organisation has the resources, skills and knowledge to deliver this change.

Realistic: determine if this change be made within the current context and resourcing of the organisation.

Time-bound: set a timeline to achieve each milestone in the program.

When designing interventions for quality improvement programs, there are a few important early steps that should be taken:

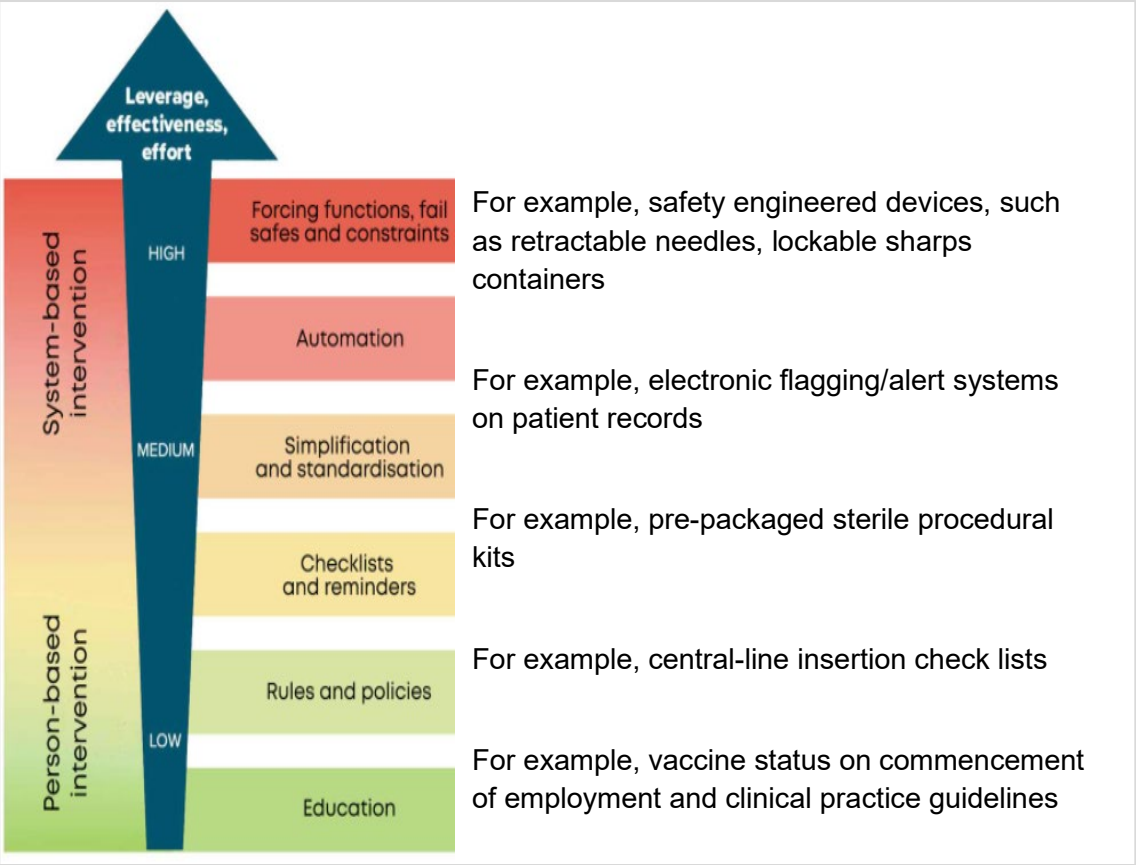
- Ensure that the intervention has executive or management support.
- Assess the needs of the organisation, or individual department, to determine what the specific issues are and why these may be occurring. For example, if the hand hygiene compliance rate is low, what other factors may be contributing to this behaviour?
- Review current practices or procedures. Consider what is working well, and why, and what is not working well, and why.
- Consider if the proposed intervention is appropriate for the local context. Does the local setting have the same conditions as the setting where the intervention has previously worked? What resources are available? How long will the intervention run for?
- Prioritise the strategies for improvement.
- Identify any barriers and facilitators to the interventions. Is the facility or department ready for change? Is the change sustainable?
- Is the intervention person-focused or system-focused? Is there evidence to support the intervention and under what conditions?
- How will the intervention be adjusted depending on the outcomes and progress of the intervention?

Ongoing evaluation of the impact of the intervention should also be considered during the design of the intervention.

The hierarchy of effectiveness

The hierarchy of effectiveness model (Figure 5.5) outlines the different types of interventions that can be used in health care, based on the coverage of the intervention and effort required to implement the intervention. The model promotes behavioural change by presenting the clinician with knowledge (awareness of intervention and rationale for the intervention), choice (option to participate in the intervention) and action (using the intervention).

Figure 5.5. Hierarchy of effectiveness model



Adapted from the Institute for Safe Medications Practice hierarchy of effectiveness of risk-reduction strategies, 2020

Strategies that are system-based, such as forcing functions, have a high impact and are more effective in preventing errors. However, these strategies may require more planning, more investment, and more effort to implement. Medium leverage strategies are moderately effective and require periodic updating and reinforcement. Strategies that are person-based are easier to implement but have low leverage because they focus on changing the behaviours of an individual and are least effective in preventing errors at a systems level.

Testing the effectiveness of practice change

Once an intervention has been put into action, the intervention should be routinely monitored to see if it has had any impact on reducing the risk or incidence of infection. An effective way to monitor an intervention is to use the Plan-Do-See-Act method.

Plan-Do-See-Act method

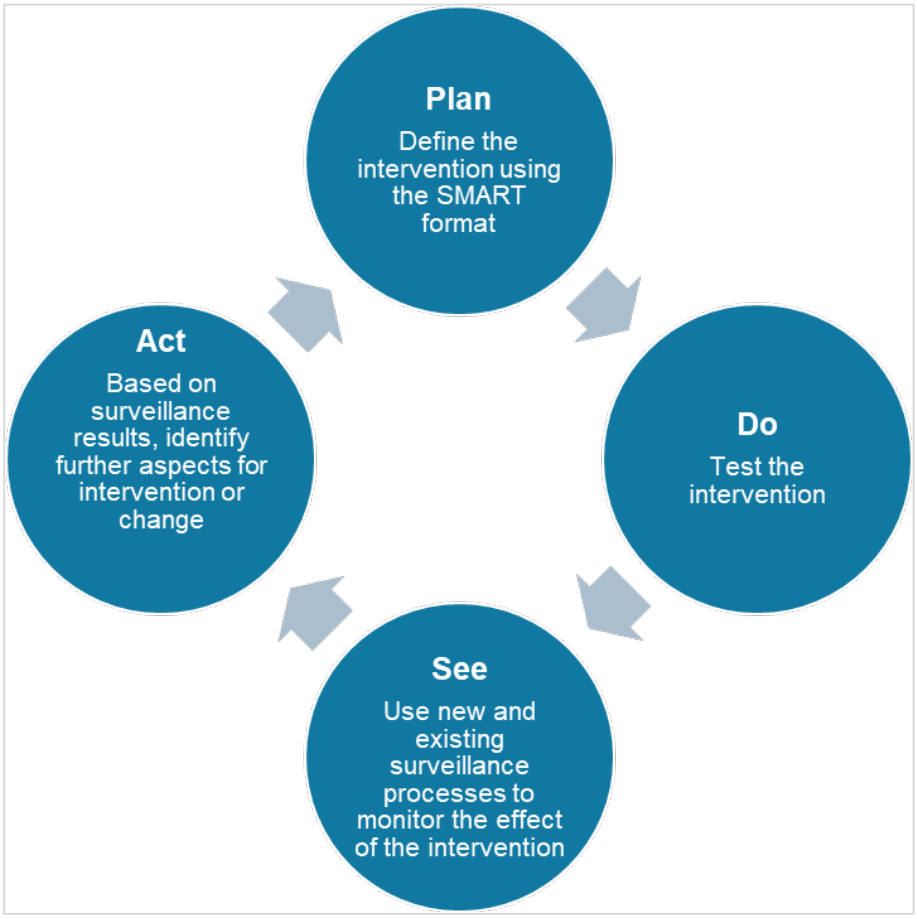
The Plan-Do-See-Act (PDSA) method can be used to plan and implement the proposed changes, monitor the response to the interventions, and review and act on results. The PDSA is an ongoing process of testing, checking and re-testing and is employed by many organisations as part of a quality improvement system.

Monitoring the impact of the intervention can be done by continuing previous surveillance efforts. The same surveillance methodology (that is, surveillance definitions, case finding methods) should be used to ensure that any future changes in the risk or incidence of infection are a direct result of the intervention.

Reporting of future surveillance data should provide comparison between the pre- and post-intervention periods, and clearly indicate when the intervention was introduced. Changes in

infection risk or rates over a period can be visualised by plotting surveillance data in a statistical process control chart (see Figure 5.6).

Figure 5.6. The Plan Do See Act method



Implementation of an intervention may or may not have any initial effect, and the intervention may need further refinement and testing. It is important to continue the surveillance effort during this period, as it will provide information on whether changes to the intervention are providing additional benefit and whether further changes to the intervention are necessary.

Surveillance should also continue after an intervention has been implemented to detect if the intervention has had a short-term or long-term effect. Interventions that have had a short-term effect may need to be followed up by additional interventions to have a sustained effect on the infection risk or rate.

Module 6. Preventing and managing occupational exposures

Contents

Overview of Module 6

Module 6 contains three parts:

Part 1: Introduction to occupational exposure to infectious agents

Part 2. Governance systems to prevent and manage occupational exposures

Part 3. Management of occupational exposures

The module describes the principles for preventing and managing occupational exposures in the healthcare environment. By completing this module, you will gain an understanding of:

- key definitions and concepts
- governance systems required to prevent and manage occupational exposures
- how to identify risks for occupational exposure
- strategies to assess, prevent and manage the risk of occupational exposure
- the role of quality improvement, surveillance, and reporting systems
- immediate management of occupational exposure, including basic first aid
- follow-up management, including risk assessment, treatment and support for the exposed person, and reporting.

It is recommended that you complete workbook Module 1. Principles of infection prevention and control and Module 2. Risk management systems for infectious agents and diseases before undertaking this module.

Organisations that are assessed against the National Safety and Quality Health Service (NSQHS) Standards (second edition)[121] should refer to the Preventing and Controlling Infections Standard.[122] The Standard sets the framework for systems to identify and manage risks associated with infections, including preventing and managing occupational exposures, in health service organisations.

[121] https://www.safetyandquality.gov.au/standards/nsqhs-standards
[122] https://www.safetyandquality.gov.au/standards/nsqhs-standards/preventing-and-controlling-infections-standard

Part 1: Introduction to occupational exposure to infectious agents

Part 1 covers the following topics:

- **Occupational exposure in the healthcare environment**
- **Managing occupational exposure in healthcare**

Occupational exposure in the healthcare environment

What is occupational exposure?

Occupational exposure is when a member of the workforce is exposed to a hazard in their work environment, such as an infectious agent, that has the potential to cause them harm.

Occupational exposure to an infectious agent may occur through direct or indirect contact with an infectious patient, visitor, or colleague, or because of a sharps injury. Table 6.1 provides examples of occupational exposures and the associated modes of transmission of infection.

Table 6.1. Occupational exposure to infectious agents – types and modes of transmission

Types of exposure	Mode of transmission	Examples of infections
Direct contact with the patient, contaminated equipment or environment	Contact transmission	Infectious skin conditions, scabies, multidrug-resistant organisms (MROs)
Sharps or puncture injuries	Contact transmission (inoculation)	Bloodborne viruses (BBV)
Intubation, respiratory suctioning, coughing, sneezing	Droplet transmission	Pertussis, meningococcal disease, coronavirus, influenza
Aerosol generating procedures, induced sputum, nebulisers	Airborne transmission	Tuberculosis, varicella zoster, measles, COVID-19
Ingestion of droplets, contaminated food or water	Oral–faecal transmission	Gastroenteritis

Members of the health workforce may also be at risk of occupational exposure to hazardous chemicals or materials, such as cleaning solutions, pharmaceuticals, and radiation; all of which require separate management protocols.

Who is at risk of occupational exposure?

All members of the health workforce, including clinical and non-clinical staff, are at risk of occupational exposure to infectious agents.

Managing occupational exposure in healthcare

Healthcare worker and patient safety are complementary in infection prevention and control (IPC). Protecting members of the health workforce from exposure to infectious agents also protects patients and other staff from this hazard.

The prevention and management of occupational exposure is a work health and safety obligation under national and state or territory legislation.

The Work Health and Safety Act[123] requires employers to:

- have systems and processes in place to identify hazards, and assess and control the risks for patients, visitors and members of the workforce, so far as is reasonably practicable (that is, what can be done and what is possible in the circumstances to ensure health, safety, and continuity of service delivery)
- ensure that workers and others are not exposed to infectious agents while at work, and where reasonably practicable, employees will take reasonable care to protect themselves and others from exposure to infectious agents at work.

Actions that both employers and employees can take to reduce the risk of exposure to infectious agents are summarised in Table 6.2. *The Work Health and Safety Act (2011)* also provides further guidance.

[123] https://www.legislation.gov.au/Details/C2018C00293

Table 6.2. Summary of employer and employees' responsibilities under the Work Health and Safety Act (2011)

Employer responsibilities	Employee responsibilities

Ensure that:
• healthcare workers comply with policies and procedures for preventing and managing occupational exposures to infectious agents
• processes are in place to identify, monitor and manage risks for occupational exposure to infectious agents in the workplace
• safe work procedures and IPC measures, including the use of personal protective equipment (PPE), are implemented
• workers with an infectious disease adhere to exclusionary (isolation) periods
• all incidents, hazards and unsafe working practices are reported.
Provide:
• an adequate supply of PPE for all healthcare workers
• instruction on using and maintaining PPE where other risk control measures are not feasible
• adequate provisions to manage sharps
• adequate access to first aid supplies (for example, eyewash equipment)
• adequate direction, support, and training to enable staff to fulfil their responsibilities to prevent exposure to infectious diseases where possible
• access to screening and immunisation programs.
	Employees must:
	• cooperate with reasonable instructions; that is, policy directives, policy guidelines, procedures and safe work instructions or clinical protocols relevant to their role, responsibilities, and accountabilities
	• participate in immunisation and health screening programs as per the local and jurisdictional requirements
	• be familiar and comply with protective measures when an exposure risk to a transmissible infectious agent is identified
	• adhere to safe work practices, including:
	  ○ hand hygiene
	  ○ standard and transmission-based precautions
	  ○ safe sharps handling and disposal of blood and body fluid spills
	  ○ waste management
	  ○ linen handling
	• adhere to recommended work exclusion periods to limit transmission of an infectious agent in the workplace.

Immediately release a worker when an occupational exposure occurs to receive first aid, risk assessment and treatment.	Seek immediate first aid, risk assessment and treatment when an occupational exposure occurs.
Encourage and support healthcare workers to participate in confidential testing after blood or body fluids exposure.	Participate in voluntary testing for BBV and other infectious agents based on the nature of the exposure.
Investigate all episodes of occupational exposure in conjunction with work health/staff health/IPC practitioners.	Immediately report all occupational exposure episodes associated with a risk of infectious diseases transmission.

Source: Adapted from SA Health Preventing and Responding to Work Related Exposure to Infectious Disease Policy Guideline,[124] April 2020

Requirements of the NSQHS Standards

The Clinical Governance Standard[125] and the Preventing and Controlling Infections Standard[122] of the NSQHS Standards include actions relating to the management of occupational exposure to infectious agents.

[124] https://www.sahealth.sa.gov.au/wps/wcm/connect/public+content/sa+health+internet/clinical+resources/clinical+programs+and+practice+guidelines/infection+and+injury+management/healthcare+associated+infections/prevention+and+management+of+infections+in+healthcare+settings/prevention+and+management+of+infection+in+healthcare+settings

[125] https://www.safetyandquality.gov.au/our-work/clinical-governance/clinical-governance-standard

The Clinical Governance Standard includes specific actions that relate to the implementation of safety and quality systems, and provision of a safe environment for the delivery of care. These actions are:

- Action 1.10 Risk management
- Action 1.11 Incident management systems and open disclosure.

Action 3.15 (Workforce screening and immunisation) of the NSQHS Preventing and Controlling Infections Standard[122] requires health service organisations to have a risk-based workforce vaccine-preventable diseases screening and immunisation policy and program that:

a. is consistent with the current edition of the Australian Immunisation Handbook
b. is consistent with jurisdictional requirements for vaccine-preventable diseases
c. addresses specific risks to the workforce, consumers, and patients.

More information on vaccine-preventable diseases and recommendations for members of the health workforce can be found in the current edition of the Australian Immunisation Handbook.[126]

Action 3.16 (Infections in the workforce) of the NSQHS Preventing and Controlling Infections Standard[122] requires health service organisations to have risk-based processes for preventing and managing infections in the workforce that:

a. are consistent with the relevant state or territory work health and safety regulation and the current edition of the Australian Guidelines for the Prevention and Control of Infection in Healthcare[127]
b. align with state and territory public health requirements for workforce screening and exclusion periods
c. manage risks to the workforce, patients and consumers, including for novel infections
d. promote non-attendance at work and avoiding visiting or volunteering when infection is suspected or actual
e. monitor and manage the movement of staff between clinical areas, care settings, amenity areas and health service organisations
f. manage and support members of the workforce who are required to isolate and quarantine following exposure to or acquisition of an infection
g. provide for outbreak monitoring, investigation, and management
h. plan for, and manage, ongoing service provision during outbreaks and pandemics or events in which there is increased risk of transmission of infection.

[126] https://immunisationhandbook.health.gov.au/
[127] https://www.safetyandquality.gov.au/our-work/infection-prevention-and-control/australian-infection-prevention-and-control-guidelines

Part 2. Governance systems to prevent and manage occupational exposures

Part 2 covers the following topics:

- **Infection prevention and control systems and occupational exposure**
- **Systems to prevent occupational exposure**
- **Systems for managing occupational exposure**
- **Skills and equipment to prevent and manage occupational exposure**

Infection prevention and control systems and occupational exposure

IPC systems are critical to prevent and manage occupational exposure. The Australian Guidelines for the Prevention and Control of Infections in Health Care[127][122] includes information to prevent and manage exposure to infectious agents. State and territory health departments and many public and private health service organisations also have policy and guidance documents. These should be used to develop local policies and procedures to prevent and manage occupational exposure to infectious agents.

Standard and transmission-based precautions are fundamental to reduce the risk of occupational exposures.

Standard precautions

Standard precautions are the first-line work practices for IPC. All healthcare workers should use standard precautions when caring for all patients, regardless of suspected or confirmed infection status. Standard precautions should be used for contact with or when handling blood (including dried blood), body fluids (excluding sweat), non-intact skin and mucous membranes.

Standard precautions include:

- hand hygiene, consistent with the 5 Moments for Hand Hygiene[128]
- the use of appropriate PPE
- the safe use and disposal of sharps
- environmental cleaning[129]
- respiratory hygiene and cough etiquette
- aseptic technique[130]
- reprocessing of reusable medical equipment and instruments
- waste management
- appropriate handling of linen.

Transmission-based precautions

Transmission-based precautions are used in addition to standard precautions. Understanding the means of transmission of an infectious agent is important for deciding the most appropriate transmission-based precautions to use.

[128] https://www.safetyandquality.gov.au/our-work/infection-prevention-and-control/national-hand-hygiene-initiative
[129] https://www.safetyandquality.gov.au/our-work/infection-prevention-and-control/environmental-cleaning-and-infection-prevention-and-control-resources
[130] https://www.safetyandquality.gov.au/our-work/infection-prevention-and-control/aseptic-technique

Key elements of transmission-based precautions are:

- PPE
- Patient placement
- Minimising patient movement.

Table 6.3 lists the three categories of transmission-based precautions and when to apply each one:

Table 6.3. The three categories of transmission-based precautions

Category	Route of transmission of infectious agent (known or suspected)
Contact precaution	Direct or indirect contact
Droplet precaution	Respiratory droplets
Airborne precaution	Airborne route

For some infectious agents, a combination of precautions may be required (for example, seasonal influenza requires both contact and droplet precautions).

For more information on standard and transmission-based precautions, see workbook Module 1. Principles of infection prevention and control.

Systems to prevent occupational exposure

Risk assessment for occupational exposure to infectious agents

Organisations should use a risk assessment and management approach to prevent and manage occupational exposures.

Definitions of key concepts used in risk assessment and management are:

- **Hazard:** A situation or thing that has the potential to harm a person.
- **Risk:** The possibility of harm (death, injury, illness) when exposed to a hazard.
- **Risk control:** Taking action to eliminate or control the risks so far as is reasonably practical.

Controls should be constantly reviewed and measured to evaluate their effectiveness. For example, in the context of occupational exposure, the **hazard** may be exposure to blood or body fluids during an exposure prone procedure. The **risk** is the potential exposure to a blood borne virus (BBV). The **control** would be using safety engineered devices to reduce the risk of sharps injury and using PPE to protect the healthcare worker from exposure to blood or body fluids.

The potential risk for occupational exposure to an infectious agent in health care should be determined by considering:

- the treatments and services provided in the setting
- whether the setting is clinical or non-clinical and if it is a hospital or community-based service
- whether the area has high or low patient activity
- the characteristics of patients, and the local epidemiology of potentially transmissible infectious agents
- the type of equipment used by members of the workforce
- patient behaviours and cognitive capacity

- the availability of training and skills of the members of the workforce to use equipment and perform specific procedures correctly
- access to and compliance with workforce immunisation programs.

Assessing the risk for occupational exposure to infectious agents is an ongoing process, informed by changes in the environment in which health services are delivered. Members of the workforce who have the potential for occupational exposure to infectious agents should be involved in risk assessments.

Risk assessments should be updated when:

- clinical procedures or the range of services in a health service organisation change
- new equipment is introduced into the organisation
- there is an outbreak of, or the potential for an outbreak of, a known or novel infectious agent.

Risk management for occupational exposure to infectious agents

Risk management occurs on many levels within an organisation. Table 6.4 provides examples of risk management strategies that can be used at various levels.

Table 6.4. Examples of risk management strategies by organisational levels

Level	Example
Organisation	Organisational policies, the provision of staff training, the provision of suitably qualified personnel to manage and treat occupational exposures, and incident reporting systems.
Department or Unit	Clinical procedure guides, the provision of appropriate equipment (for example, safety-engineered sharps devices, PPE), and staff training.
Individual	Considering the risks involved when carrying out a specific procedure, questioning the procedure's necessity as part of clinical decision-making and attending education sessions.

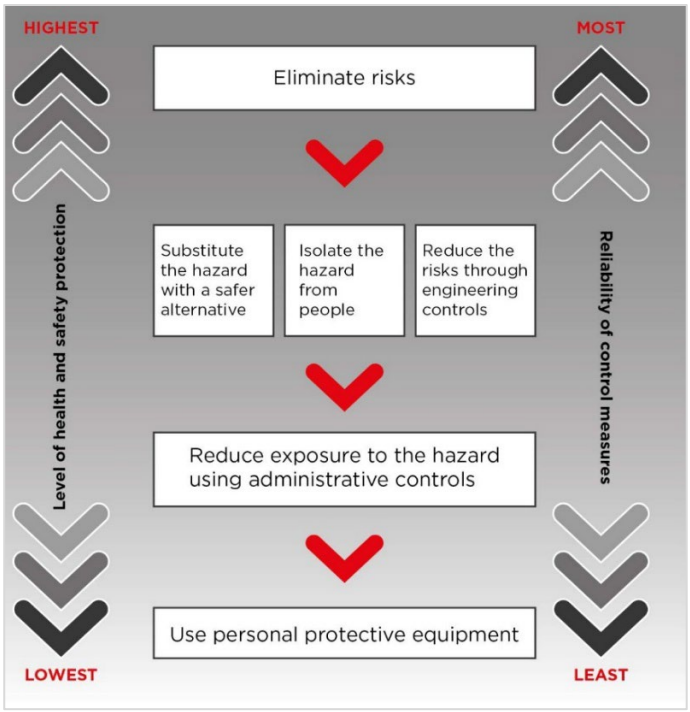
The hierarchy of controls

The hierarchy of controls (Figure 6.1) is a work health and safety management approach to controlling risk which ranks controls from most to least effective. Administrative controls and PPE are the least effective, as they do not control the hazard at the source and rely on human behaviour and supervision.

The hierarchy of controls supports the design of IPC programs and strategies to eliminate and/or minimise the risk of transmission of infectious agents. If it is not reasonably practicable to eliminate risks, then risks must be minimised using one or a combination of other controls, such as:

- substitution
- isolation
- engineering controls
- administrative controls
- PPE.

Figure 6.1. The hierarchy of controls



Source: Safe Work Australia. How to manage work health and safety risks: code of practice. Canberra: SWA; 2018:19, 'Hierarchy of control measures' licensed under CC BY-NC 4.0.

Table 6.5 includes examples of how the hierarchy of controls can be used to identify and manage risks for occupational exposure to infectious agents.

Table 6.5. Examples of strategies to reduce the risk of occupational exposure to infectious agents, based on the hierarchy of controls

Controls	Examples strategies
Elimination: Strategies that remove the infection risk entirely	• Clean and contain spills to eliminate the risk of exposure to clinical and biological waste. • Dispose of sharps at the point of care to prevent sharps injury. • Perform hand hygiene to remove infectious material from hands. • Restrict entry of potentially infectious healthcare workers and visitors to the organisation.
Substitution: Substitute the hazard with a safer alternative	• Replace reusable equipment that is difficult to clean, such as cannulated or channelled devices, with single-use equipment. • Introduce safety-engineered devices for cannulation and injections to prevent sharps injury. • Administer aerosolised medicines with spacers instead of nebulisers to prevent exposure to aerosols.
Isolation: Physically separating people from the infection hazard	• Use patient placement strategies,[131] such as single rooms or cohorting patients. • Use physical barriers, such as privacy screens, for infections transmitted by the droplet route.

[131] https://www.safetyandquality.gov.au/publications-and-resources/resource-library/patient-placement-guide-infection-prevention-and-control

Controls	Examples strategies
Engineering controls: Reduce the risk through engineering controls	• Optimise ventilation[132] to improve air quality, reduce exposure to infectious respiratory particles, and maintain indoor temperature and humidity (for example, ensuring correct air exchange rates, minimise crowding within indoor spaces, avoid recirculation of air if possible, and use High Efficiency Particulate Air filters). • Redesign waste management and cleaning areas to minimise exposure to infectious material. • Maintain airflow direction away from staff workstations and towards patient care areas where possible.
Administrative controls: Practices and policies that reduce or prevent exposure to hazards.	• Develop organisational policies consistent with the current version of the Australian Guidelines for the Prevention and Control of Infection in Healthcare.[133] • Provide training in IPC practices to the health workforce. • Provide a risk-based workforce vaccine-preventable diseases screening and immunisation program, consistent with the Australian Immunisation Handbook's current edition[126] and current jurisdictional requirements.
PPE: Effectiveness depends on access to appropriate PPE, correct use, and complementary substitution, administrative and engineering controls.	• Provide a sufficient accessible supply of a range of sizes and types of PPE relevant to the infection risks in the healthcare setting. • Provide training programs on the correct use of PPE (such as putting on, removal and disposal), and regular competency assessment. • Support fit checking and fit-testing protocols for particulate filter respirators (for example, P2/N95).

Source: Adapted from Hierarchy of controls in infection prevention and control factsheet

For more information on risk assessment and using the hierarchy of controls see Module 2. Risk management for infectious agents and diseases and Hierarchy of controls in infection prevention and control* factsheet.

**https://www.safetyandquality.gov.au/publications-and-resources/resource-library/use-hierarchy-controls-infection-prevention-and-control-factsheet*

Systems for managing occupational exposure

Each organisation should have local policies and procedures, which, at a minimum, include guidance on the immediate management of occupational exposure and processes for incident reporting.

Immediate management

Health service organisations must have systems in place that provide members of the workforce with access to:

- immediate first aid
- expert advice and confidential rapid assessment of their injury, infection risk, testing, and timely administration of treatment, if required
- ongoing support and follow-up treatment, as required.

[132] https://www.safetyandquality.gov.au/publications-and-resources/resource-library/optimising-ventilation-infection-prevention-and-control-healthcare-settings
[133] https://www.nhmrc.gov.au/sites/default/files/documents/infection-control-guidelines-feb2020.pdf

Reporting occupational exposure

Health service organisations must have systems in place for:

- members of the workforce to report occupational exposures to infectious agents when they occur
- maintaining records of all work health and safety incidents, including occupational exposure to infectious agents
- complying with their state or territory requirements for reporting occupational exposure to external organisations, such as Safe Work Australia, and public health authorities, if an occupational exposure results in a notifiable infection
- reporting on all occupational exposure incidents to the local governing body, the workforce, and other relevant groups.

Quality improvement systems

Information from reporting systems for occupational exposure to infectious agents should be used to:

- inform strategies for quality improvement programs to reduce the risk of occupational exposure
- improve clinical practice
- identify gaps in skills and knowledge
- evaluate compliance with the organisation's policies, procedures, and guidelines.

Incident reporting systems should support members of the workforce to communicate concerns. Review of processes as part of an incident management review should include members of the workforce, and timely feedback on the outcomes from this review should be provided to the relevant individuals.

Skills and equipment to prevent and manage occupational exposure

IPC training should be provided to all members of the health workforce. This training should include strategies to prevent and manage occupational exposure to infectious agents. Workforce training programs for preventing and managing occupational exposure to infectious agents should:

- be included in the organisation's induction and ongoing education and training programs
- include information on standard and transmission-based precautions, including appropriate use of PPE, sharps safety and linen and waste handling
- include assessment of, and address gaps in healthcare worker knowledge and skills on PPE use and first aid
- be targeted to specific risks for occupational exposure related to the range of services and activities of the organisation
- include the importance of the providing timely first aid following occupational exposure, and the skills required to administer appropriate basic first aid
- include information on reporting requirements, including who to contact when an occupational exposure occurs
- include instruction on how to obtain information on updates about the risk for occupational exposure in the organisation, such as the introduction of new equipment, changes to clinical procedures, or the emergence of novel infectious agents.

➢ All members of the health workforce should know how to provide basic first aid, and who to contact when an occupational exposure to an infectious agent occurs in their organisation.

Immunisation, screening, and the management of infections in the workforce

Immunisation is the process of inducing immunity to an infectious agent by giving a vaccine. Administering a vaccine stimulates the immune system to produce a protective immune response. This response usually mimics the host's response to natural infection but avoids the disease that is the harmful consequence of infection. On average, an immune response takes around 10 to 14 days to develop. Immunity developed from a vaccine may last for months to many years, depending on the nature of the vaccine, the type of immune response and factors specific to the individual (for example, age, presence of co-morbidities).

Vaccination can protect both the people vaccinated and others in the community who are not immune. It does this by increasing the level of immunity in the population, which is known as 'herd immunity' or 'community immunity'. Herd immunity minimises the spread of infection.

Each state and territory and many private health service organisations have requirements for staff vaccination status as part of their terms of employment. It is essential that staff are aware of these requirements and their immunisation status for vaccine-preventable diseases.

A workforce screening and immunisation program for vaccine-preventable diseases should include systems and processes for:

- assessment of the immune status of all members of the health workforce, including students, contractors and volunteers
- identification of the vaccine-preventable disease risks for the workforce
- providing access to vaccines to non-immune members of the workforce.

Identifying vaccine-preventable disease risks supports the implementation of strategies such as immunisation to protect members of the health workforce, patients, consumers, and the wider community against vaccine-preventable diseases.

More information on vaccine-preventable diseases can be found in the current edition of the Australian Immunisation Handbook.*

**https://immunisationhandbook.health.gov.au/*

Part 3. Management of occupational exposures

Part 3 covers the following topics:

- **Immediate management of occupational exposures**
- **Risk of infection with bloodborne viruses**
- **Identifying the source of exposure**
- **Managing the exposed healthcare worker**
- **Treatment options for occupational exposures**

Immediate management of occupational exposures

There are three important steps for immediately managing occupational exposure. These are:

Step 1: Immediate first aid

Step 2: Report the incident

Step 3: Risk assessment of the exposure

➢ The confidentiality of the exposed person and the source of the exposure must be always maintained.

Step 1: Immediate first aid

First aid should be administered immediately. The exposed member of the workforce should be:

- relieved of their duties as soon as possible
- provided with first aid to reduce the risk of infection or injury (see Table 6.6).

Table 6.6. Summary of first aid for occupational exposures, based on exposure site

Occupational exposure site	Immediate action
Skin	• Wash the area thoroughly with soap and water as soon as possible. • If soap and water are unavailable, a detergent wipe can be used until soap and running water can be accessed.
Mouth	• Ask the exposed person to spit out any fluid from their mouth. • Provide clean water to rinse the mouth out with (do not swallow). • Repeat above steps twice.
Clothing	• Remove contaminated clothing as soon as possible, and shower if necessary.
Eyes	• Flush the affected eye with normal saline or water. • Remove contact lenses if worn, flush eyes again and clean lenses before reinserting.
Needle stick/sharp injury	• Remove any embedded material and wash the site as per the instructions for a skin exposure. • Clean and dry the injury site, and apply a sterile dressing, if required. • If the affected area is bleeding, allow it to bleed. Never squeeze or rub the injury site to induce bleeding, as this will cause more injury to surrounding tissue.

After attending to first aid, the person who sustained the occupational exposure should seek immediate medical assessment. A medical practitioner or other suitably qualified clinician should assess the exposed person for the risk of infection and the need for post-exposure testing and treatment.

If the infectious status of the source of the exposure is unknown, an assessment of their risk of infection (for example, for BBV following a sharps injury) and baseline testing should be undertaken with their consent, and as appropriate.

In non-clinical settings, members of the workforce should be provided with basic first aid supplies to manage occupational exposures or other workplace injuries.

Step 2: Report the incident

Following Step 1, the occupational exposure must be reported immediately to the worker's direct manager or supervisor, and in accordance with the organisation's requirements for reporting occupational exposures. When documenting the incident, include as much detail as possible, making sure to record the date, time, location, and source of the exposure.

Step 3: Risk assessment of the exposure

The risk of infection varies following occupational exposure. A risk assessment of infection from the exposure should be conducted by a suitably qualified clinician who can order post-exposure testing and treatment if required. It is important to collect detailed information to support the risk assessment, such as:

- the type of exposure and nature of any injury; for example, splash, sharps injury, solid or hollow bore device, mucous membrane
- the source of exposure
- the time elapsed since the exposure occurred
- the infectious status of the source (if known)
- the type and amount of blood or body fluid involved; for example, blood, respiratory secretions, droplets, aerosols, amniotic fluid
- the susceptibility of the exposed person to infection; for example, immunisation status, pregnancy, other health concerns/medical history
- the length of contact time with blood or body fluid.

Risk of infection with bloodborne viruses

BBVs such as hepatitis B (HBV), hepatitis C (HCV) and human immunodeficiency virus (HIV), may be transmitted by significant percutaneous or mucosal exposure to infectious blood or other body substances.

The risk of infection from a BBV is dependent on the nature of the exposure, the volume of blood or body fluid involved, and the potential for the source to be positive and/or infectious for a BBV.

Hollow-bore devices that are used for cannulation, venepuncture, phlebotomy, or injection are of particular concern, because these devices may contain residual blood and therefore increase the risk of transmission of BBVs.

Table 6.7 describes the potential risk of infection associated with different types of injury.

Table 6.7. Potential risk of infection associated with different types of injury

Level of risk	Injury type
Higher risk injury	• Deep percutaneous injury • Visible blood on sharps • Needle used on a source's blood vessel
Lower risk injury	• Superficial injury, exposure through broken skin, mucosal exposure (usually splashes to eye or mouth) • Old, discarded sharps • No visible blood on sharp • Needle not used on blood vessels for example, suturing, subcutaneous injection needles
Injury with no risk	• Skin not breached • Contact of body fluid with intact skin • Needle (or other sharp object, such as a scalpel) not used before injury

Source: NSW Health HIV, Hepatitis B and Hepatitis C – Management of Health Care Workers Potentially Exposed, May 2017.[134]

Table 6.8 describes the risk of transmission of a BBV following exposure to blood or another body fluid from an infectious source (untreated, infected healthcare worker to patient, and untreated, infected patient to a healthcare worker).

Table 6.8. Risk of bloodborne virus transmission from exposure from an infectious source (in the absence of additional risk management)

Bloodborne virus	Risk of transmission from infected healthcare worker to patient	Risk of transmission from infected patient to healthcare worker
Hepatitis B virus*	0.2% – 13.19%	1% – 62%
Hepatitis C virus	0.04% – 4.35%	0% – 7%
Human immunodeficiency virus	0.0000024% – 0.000024%	0.3%

**There is a wide variability in the infectiousness of people with hepatitis B reported in the literature, which depends on their hepatitis B e-antigen status.*
Source: CDNA National Guidelines – Healthcare Workers Living with Blood Borne Viruses / Perform Exposure Prone Procedures at Risk of Exposure to Blood Borne Viruses, Oct 2019.[135]

Post-exposure prophylaxis (PEP) is available following exposure to HIV and HBV and is recommended for all injuries assessed to be of a higher risk of infection, such as those injuries involving an infectious or potentially infectious body fluid. Post-exposure prophylaxis may also be considered for lower risk injuries. The decision about appropriateness of PEP is a matter for a suitably qualified medical expert.

Identifying the source of exposure

Patient source of exposure

All organisations should have processes to assess a source patient's infectious status during an occupational exposure investigation. These should be consistent with state and territory legislation and policy requirements, including requirements for consent and privacy.

A designated person should assess the patient's history to determine the level of risk for infection for the exposed person. The member of the workforce who sustained the occupational exposure

[134] https://www1.health.nsw.gov.au/pds/ActivePDSDocuments/PD2017_010.pdf
[135] https://www.health.gov.au/resources/publications/cdna-national-guidelines-healthcare-workers-living-with-blood-borne-viruses-perform-exposure-prone-procedures-at-risk-of-exposure-to-blood-borne-viruses?language=en

should not be involved in the assessment of the patient's history and in testing or counselling of the source patient.

> ➢ If the source patient can be identified, their identity must be always protected.

Patient history

Depending on the nature of the occupational exposure, the information collected from the patient history may include:

- the patient's vaccination or immunisation history or immune status for vaccine-preventable diseases
- the patient's history of infection (for example, serological testing results) or treatment for infections, such as tuberculosis or BBVs
- any other clinical information that may be relevant to the risk of transmission of an infectious agent to the exposed person (for example, risk behaviours, clinical treatments).

The source patient must give informed consent before any testing to determine their infectious/immune status. The source patient must be offered appropriate pre- and post-testing counselling before testing for HBV, HCV and HIV, and provided follow-up treatment as appropriate.

The source patient has the right to refuse all testing for infectious agents and to refuse to disclose their infectious status, regardless of the nature of the occupational exposure.

Other or unknown sources of exposure

All reasonable efforts should be made to identify the source. In situations where the source of the exposure is unknown, the risk of infection and appropriate follow-up treatment should be based on the information collected during the risk assessment of the exposure.

When the source of the exposure is unknown, the following information should be considered to determine the risk of infection:

- The type of exposure
  - percutaneous injury
  - mucous membrane exposure
  - non-intact skin exposure
  - intact skin exposure
  - aerosol/droplet exposure
  - other – environmental, zoonotic
- Type and amount of fluid/tissue
  - blood
  - fluids containing blood
  - other potentially infectious fluid or tissue (semen; vaginal secretions; saliva; cerebrospinal, synovial, pleural, peritoneal, pericardial or amniotic fluids; or wound exudate)
  - direct contact with concentrated viruses or bacteria
- The likelihood of the source being positive for a BBV or other transmissible infection
- The prevalence of BBVs and other infectious agents of concern (for example, influenza, COVID-19) in the community of the likely source.

Testing is not recommended for materials or objects contaminated with blood or other body fluids, such as needles or other sharp instruments, environmental surfaces, waste, or linen implicated in an exposure. The reliability and interpretation of findings in these circumstances are unknown. Testing might also be hazardous to individuals handling the contaminated and sharp instruments.

Managing the exposed healthcare worker

The initial risk assessment, including the characteristics of the occupational exposure, should inform the testing and treatment options offered to the exposed healthcare worker.

Baseline blood testing or other health screening may be required to determine an exposed person's immunity and infection status for a range of infectious agents and potential risk of infection. Examples of baseline testing:

- HBV surface antigen status (if non-immune)
- HCV antibody and polymerase chain reaction (PCR) status
- HIV antibody and antigen status
- Antigen status for varicella zoster, pertussis, or measles
- COVID-19 screening, such as PCR or rapid antigen testing.

Determining baseline serology can support comparison with subsequent test results. If serological testing is recommended, it should be offered as soon as possible or practicable after the exposure occurs. Testing of the exposed person should be strongly encouraged and should only be undertaken with informed consent of the healthcare worker.

Other screening tests may be used in particular circumstances. For example, screening healthcare workers who have been identified as having a significantly high level of exposure to a case of active tuberculosis (TB). A risk assessment would be conducted to determine:

- the length and type of exposure
- any history of prior exposure to TB (including working in high-risk settings and high-risk demographic backgrounds).

This information would determine the need for laboratory and other testing, including tuberculin skin tests.

Follow-up testing will identify if the healthcare worker is seroconverting from a negative status to a positive status, as the incubation time for a BBV can be as long as six months from the time of exposure.

The need for and frequency of follow-up serological testing of exposed workers should be determined by an appropriately qualified medical practitioner.

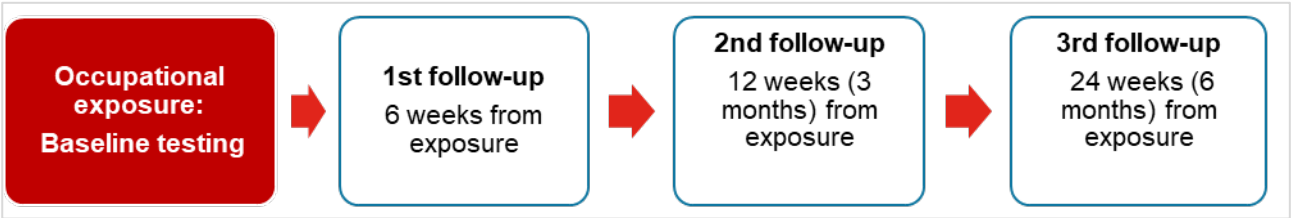
Workers with evidence of previous immunity to HBV do not require follow-up blood testing. Non-immune individuals will require immunisation and further HBV testing.

Tetanus status should be assessed for any member of the workforce who sustain abrasions or wounds. Consult the current edition of the Australian Immunisation Handbook* for further advice.

https://immunisationhandbook.health.gov.au/

Figure 6.2 provides an example for follow-up testing timeframes.

Figure 6.2. Example of the continuum for baseline assessment and follow-up time frames



- In high-risk exposure, consideration should be given to checking Hep C PCR at 3 weeks' post-exposure if earlier diagnosis is desired.
- Hepatitis B surface Antigen (HBsAg) may give a false positive if tested within two weeks of giving Hepatitis B vaccine.

Treatment options for occupational exposures

In some situations, it may be appropriate to offer post-exposure prophylaxis (PEP) or treatment, including vaccination, to the exposed person to reduce the risk that they will acquire an infection.

The decision to provide PEP should be determined by a medical practitioner based on an assessment of the risk of infection and the nature of the exposure.

Types of post-exposure prophylaxis or treatments

Table 6.9 describes recommended prophylaxis or treatment based on exposure type.

Table 6.9. Recommended treatment or prophylaxis based on type of occupational exposure

Treatment	Exposure type
Antibacterial medication	May be prescribed if the healthcare worker has had a high-risk exposure to a bacterial infection, such as meningococcal disease or pertussis. For example, exposure to sputum from involvement with intubation or suctioning an infected patient's sputum.
Antiviral medication	Most commonly prescribed when a healthcare worker has been exposed to blood or body fluids known or suspected to be infected with HIV. Antiviral medication may also be considered for some exposures to other viruses, including influenza.
Immunoglobulin	May be prescribed for non-immune healthcare workers after exposure to a vaccine-preventable disease to provide antibodies for specific infectious agents. For example, following exposure to viruses such as measles, varicella or hepatitis B.
Vaccination	Offered post-exposure when the healthcare worker does not have immunity against a specific vaccine-preventable disease. For example, following exposure of a non-immune healthcare worker to hepatitis A virus, measles, or varicella.

It is recommended that any form of post-exposure prophylaxis or treatment be prescribed and administered as close to the time of the exposure as possible. For example:

- PEP for HIV exposure should be prescribed and started within 72 hours of the exposure.
- When hepatitis B immunoglobulin is indicated, it should be administered as soon as possible after exposure, preferably within 24 hours, but before 72 hours following the exposure.

Counselling

An exposure to any infectious agent is a stressful event. An individual's response to an occupational exposure can be wide-ranging. At times, they may be concerned or anxious in the days following the exposure.

Both the healthcare worker and the source patient involved in the occupational exposure should be provided with access to counselling support for as long as required, regardless of the risk of infection. Counselling should include information on the risk of infection from the exposure and the consequences of positive test results. Counselling should also include information on actions the individual can take to prevent secondary transmission of infectious agents, such as any potential infection risks for their immediate contacts, such as family or sexual partners.

In the case of potential exposure to a BBV, the exposed person should be advised that during the six-month period following their exposure, they should:

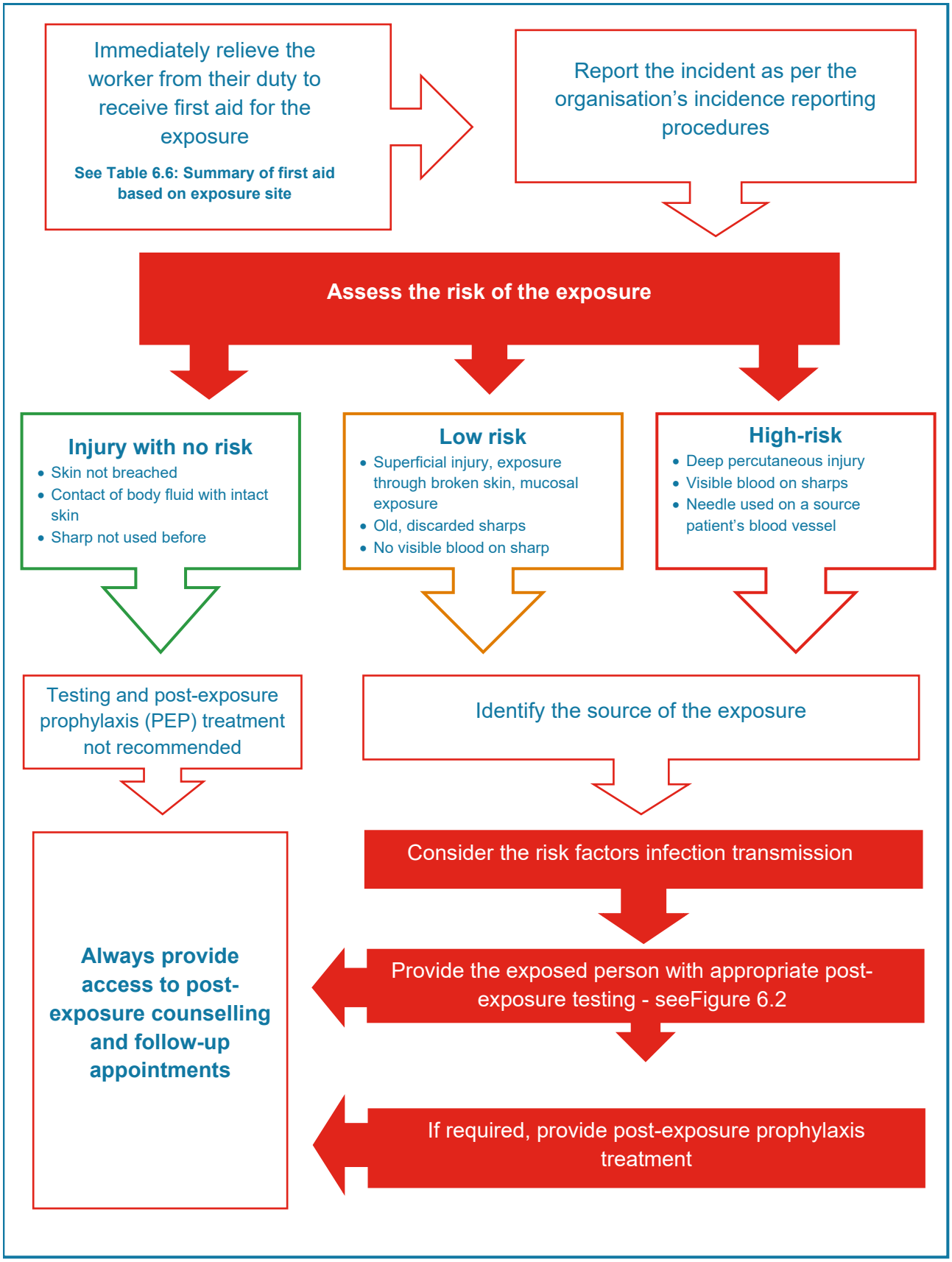
- not donate plasma, blood, body tissue or parts, breast milk or sperm
- protect sexual partners by abstaining or adopting safe sexual practices, such as using condoms
- seek expert medical advice about pregnancy and breastfeeding
- not share items like toothbrushes and razors
- not share any injecting equipment if involved in injecting drug use
- clean up their own blood spills
- seek medical attention for any acute illness that occurs during the follow-up period.

Healthcare workers performing exposure-prone procedures should refer to state, territory or local policy for additional measures to be undertaken.

The risk of side effects from PEP should also be discussed. Any risks from the PEP or the potential infection during pregnancy or breastfeeding should also be discussed.

Figure 6.3 summarises the steps for managing occupational exposure in the healthcare setting.

Figure 6.3. Sample flow chart for immediate management of occupational exposure to blood and or body fluid



Module 7. Health workforce screening and immunisation for vaccine-preventable diseases

Contents

Overview of Module 7

Module 7 contains two parts:

Part 1: Vaccine-preventable disease screening and immunisation for the health workforce

Part 2: Vaccine-preventable disease risk assessment and management

This module provides an understanding of the basic principles of health workforce screening and immunisation for vaccine-preventable diseases. After completing this module, you will understand:

- the role of screening and immunisation programs in preventing the transmission of vaccine-preventable diseases
- the elements of workforce screening and immunisation programs for vaccine-preventable diseases
- governance systems to support health workforce screening and immunisation programs for vaccine-preventable diseases
- strategies to assess, prevent and manage the risk of vaccine-preventable diseases.

It is recommended that you complete the following workbook modules before undertaking this module:

- Module 1. Principles of infection prevention and control
- Module 2. Risk management of infectious agents and diseases
- Module 6. Preventing and managing occupational exposures.

Part 1: Vaccine-preventable disease screening and immunisation for the health workforce

Part 1 covers the following topics:

- **Introduction to workforce screening and immunisation**
- **Requirements of the NSQHS Standards for workforce screening and immunisation programs**
- **The purpose of workforce screening and immunisation programs**
- **The elements of workforce screening and immunisation programs**

Introduction to workforce screening and immunisation

The transmission of vaccine-preventable diseases in healthcare settings has the potential to cause serious illness and avoidable death among patients, the workforce, consumers, and the wider community. Workforce screening and immunisation programs can reduce the burden and transmission of these diseases.

Protecting people against vaccine-preventable diseases is an integral part of an organisation's infection prevention and control (IPC) and work health and safety programs. Workforce screening and immunisation programs complement IPC strategies, such as standard and transmission-based precautions, to reduce the risk of transmission of infectious agents.

Staff responsible for implementing IPC programs should have a basic understanding of the principles of health workforce screening and immunisation. This knowledge should be used to inform strategies to protect people from the transmission of vaccine-preventable diseases.

Requirements of the NSQHS Standards for workforce screening and immunisation programs

Action 3.15 (Workforce screening and immunisation) of the NSQHS Preventing and Controlling Infections Standard[136] requires health service organisations to have a risk-based workforce vaccine-preventable diseases screening and immunisation policy and program that:

a. is consistent with the current edition of the Australian Immunisation Handbook
b. is consistent with jurisdictional requirements for vaccine-preventable diseases
c. addresses specific risks to the workforce, consumers and patients.

Action 3.16 (Infections in the workplace) of the NSQHS Preventing and Controlling Infections Standard[136] requires organisations to have risk-based processes for preventing and managing infections in the workforce that:

a. Are consistent with the relevant state or territory work health and safety regulation and the current edition of the Australian Guidelines for the Prevention and Control of Infection in Healthcare
b. Align with state and territory public health requirements for workforce screening and exclusion periods
c. Manage risks to the workforce, patients, and consumers, including for novel infections
d. Promote non-attendance at work and avoiding visiting or volunteering when infection is suspected or actual
e. Monitor and manage the movement of staff between clinical areas, care settings, amenity areas and health service organisations

[136] https://www.safetyandquality.gov.au/standards/nsqhs-standards/preventing-and-controlling-infections-standard

f. Manage and support members of the workforce who are required to isolate and quarantine following exposure to or acquisition of an infection
g. Manage and support members of the workforce who are required to isolate and quarantine following exposure to or acquisition of an infection
h. Plan for, and manage, ongoing service provision during outbreaks and pandemics or events in which there is increased risk of transmission of infection.

Action 3.16 supports workforce screening and immunisation requirements by ensuring organisations have systems in place that are consistent with state and territory public health requirements. This includes:

- policies and processes for workforce screening for infectious agents including vaccine-preventable disease
- policies and procedures to support members of the health workforces comply with exclusion periods
- policies and procedures to prevent and manage infections in the workforce
- risk assessment and management plans for infectious agents, including novel infections.

The purpose of workforce screening and immunisation programs

A workforce screening and immunisation program assesses the risk of vaccine-preventable diseases to members of the health workforce. All health service organisations, regardless of their size or function, should have screening and assessment processes in place.

A screening and immunisation program should include systems and processes to:

- assess the vaccine-preventable disease status of all members of the workforce, including students, contractors and volunteers
- identify vaccine-preventable disease risks for the workforce
- provide access to vaccines for all members of the workforce as required
- ensure risk assessment and management strategies are in place for non-immune staff who are unable to be vaccinated or do not respond to vaccination.

Workforce screening and immunisation programs for vaccine-preventable diseases also assist organisations and members of the workforce to meet the Safe Work Australia legal obligations in relation to work health and safety.[137]

The Australian Guidelines for the Prevention and Control of Infection in Healthcare[138] and the Australian Immunisation Handbook[139] provide information on health workforce screening and immunisation programs. State and territory health departments, and many individual public and private health service organisations, also have policies and guidance on these programs. These documents should be used to develop local policies and procedures for implementation of vaccine-preventable diseases screening and immunisation programs.

The role of immunisation

Immunisation is the process of inducing immunity to an infectious agent by giving a vaccine. Administering a vaccine will stimulate the immune system to produce a protective immune response. This response usually mimics the host's response to natural infection.

[137] https://www.safeworkaustralia.gov.au/law-and-regulation/duties-under-whs-laws
[138] https://www.safetyandquality.gov.au/publications-and-resources/resource-library/australian-guidelines-prevention-and-control-infection-healthcare
[139] https://immunisationhandbook.health.gov.au/

On average, an immune response takes around 10 to 14 days to develop. Immunity developed from a vaccine may last for months or many years, depending on the nature of the vaccine, the type of immune response and factors specific to the individual (for example, age, presence of co-morbidities).

Vaccination protects the population

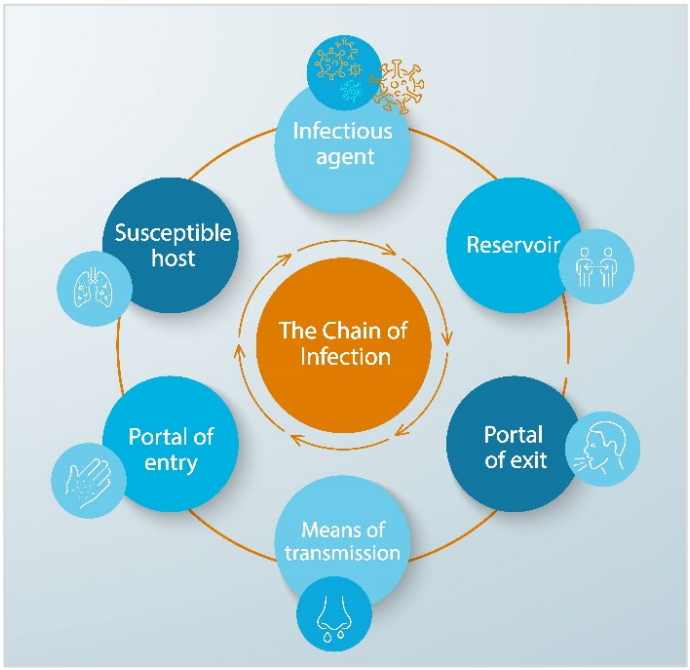
Vaccination can protect both the vaccinated person and others in the community who are not immune. Vaccination increases the level of immunity in the population, which is known as ‘herd immunity’ or ‘community immunity’. Herd immunity helps minimise the spread of infection in the community.

It is important that healthcare workers keep a record of their immunisation status. State and territory health departments and many private health service organisations require proof of immunisation status as part of their terms of employment. It is essential that members of the health workforce are aware of their immunisation status for vaccine-preventable diseases.

Screening and immunisation programs disrupt the transmission of infectious agents

The transmission of infectious agents, such as vaccine-preventable diseases, occurs via a series of interlinked events, called the ‘Chain of Infection’.

Figure 7.1. The Chain of Infection



The Chain of Infection consists of:

- an infectious agent (pathogen)
- a reservoir
- a portal of exit
- a means of transmission
- a portal of entry
- a susceptible host.

Table 7.1 illustrates the Chain of Infection using Measles as an example.

Table 7.1. The elements in the Chain of Infection in Measles

Element	Description
Infectious agent	The Rubeola virus (Measles – vaccine-preventable disease).
Reservoir	Humans are natural hosts for measles and the virus can be found in the respiratory tract of infected people.
Portal of exit	Measles leaves the host through tiny droplets when an infected person breaths, coughs or sneezes.
Means of transmission	Through contaminated air/air currents (direct) or touching contaminated surfaces (indirect) then touching eyes, nose, or mouth.
Portal of entry	The virus enters the body through inhalation of the virus or direct transmission to eyes, mouth or nose.
Susceptible host	Unvaccinated populations/people, close contacts of an infected person.

Vaccine-preventable diseases screening and immunisation programs can interrupt the Chain of Infection. Workforce vaccine-preventable diseases screening programs help to identify potential reservoirs for infectious agents. Workforce immunisation programs also help to protect susceptible hosts (including healthcare workers and patients) against vaccine-preventable diseases.

For more information on the Chain of Infection, see workbook Module 1. Principles of infection prevention and control.

The elements of workforce screening and immunisation programs

Governance systems for workforce screening and immunisation programs

Each organisation should have processes in place to identify vaccine-preventable disease risks to members of the health workforce, patients and consumers, and determine how these risks will be managed. These programs assist organisations to meet the requirements of Action 1.10 (Governance, leadership and culture) of the NSQHS Preventing and Controlling Infections Standard.[136]

Action 1.10 requires that health service organisations:

a. Identify and document organisational risks.
b. Use clinical and other data collections to support risk assessments.
c. Manage risks to the workforce, patients, and consumers, including for novel infections.
d. Act to reduce risks.
e. Regularly review and act to improve the effectiveness of the risk management system.
f. Report on risks to the workforce and consumers.
g. Plan for, and manage, internal and external emergencies and disasters.

These programs should be an integral component of, and complementary to, the organisation's IPC and workplace health and safety programs.

Workforce screening and immunisation programs should include:

- systems to communicate with the health workforce regarding the requirements of the policy, and their obligations, and how to access screening and immunisation services
- pre-employment vaccine-preventable disease status assessment, screening, and immunisation for all members of the health workforce

- systems for the ongoing assessment of vaccine-preventable diseases risks, and access to vaccination, as appropriate, throughout the course of employment
- access to trained individuals to assess vaccine-preventable disease status and vaccine-preventable disease risks
- systems for risk assessment and management of non-immune workers, and immunocompromised workers
- systems for documenting the vaccine-preventable disease status and immunisation history of members of the health workforce and monitoring their compliance with the policy.

Priority infectious agents and diseases in workforce screening and immunisation programs

The Australian Immunisation Handbook[139] recommends that Australian health service organisations prioritise the following diseases in their workforce screening and immunisation programs:

- COVID-19
- Diphtheria
- Hepatitis A
- Hepatitis B
- Influenza
- Measles
- Mumps
- Pertussis
- Rubella
- Tetanus
- Tuberculosis (TB)
- Varicella.

Part 2: Vaccine-preventable disease risk assessment and management

Part 2 covers the following topics:

- **Strategies to assess the risk of vaccine-preventable diseases**
- **Strategies to prevent the risk of vaccine-preventable diseases**
- **Strategies to manage the risk of a vaccine-preventable disease outbreak**

Strategies to assess the risk of vaccine-preventable diseases

Vaccine-preventable disease risks

A vaccine-preventable disease risk is the possibility of infection with a vaccine-preventable disease. Members of the health workforce, patients, or consumers may have a vaccine-preventable disease risk due to the delivery of care or other activities that occur within a health service organisation (for example, visiting a patient or occupational exposure injury).

Workforce exposure to vaccine-preventable diseases is considered an occupational exposure. For more information on the prevention and management of occupational exposures, please refer to workbook Module 6. Preventing and managing occupational exposures.

Assessing vaccine-preventable disease risks for the health workforce

Assessing the risk for workforce exposure to a vaccine-preventable disease is an ongoing process and should be informed by the environment in which health services are delivered, the role of individual healthcare workers, local disease epidemiology, and the immune and vaccine status of the workforce or population.

Assessment of vaccine-preventable disease risks should be done at both the organisation and employee level prior to commencing employment and during employment.

Members of the workforce who have the potential for occupational exposure to vaccine-preventable diseases should be involved in risk assessments.

An organisation's IPC program should include access to vaccination services by trained personnel who can assess risk, put in place strategies to reduce risk, and respond effectively to occupational exposures. Furthermore, the workforce should be trained on how to use standard and transmission-based precautions to reduce the risk of exposure to vaccine-preventable diseases.

Factors to consider during a vaccine-preventable disease risk assessment

A risk assessment for vaccine-preventable diseases should be conducted for each member of the health workforce, taking the following points into consideration:

- confirmed history of vaccination or infection with a specific vaccine-preventable disease
- serological evidence of immunity to a vaccine-preventable disease
- uncertain history of previous vaccination or disease status
- unvaccinated or no known history of vaccine-preventable disease or infection
- contraindications to vaccination and suitability of place of employment (for example, non-immune to measles and risks associated with working in an emergency department).

This risk assessment should occur during recruitment, on commencement of employment, and throughout the individual's ongoing employment.

Other risk factors to consider

Other factors to consider when performing a risk assessment for vaccine-preventable diseases can include:

- **Opportunity of exposure**
  - Contact with patients or other consumers, with the possibility of direct or indirect contact with blood or body fluids.
  - Contact with patients or other consumers, but no contact with blood and body fluids.
  - No direct contact with patients or other consumers.
- **Consequences of exposure**
  - Corporate risk, such as not meeting duty of care, litigation, workers compensation claims, risk of regulatory breach.
  - Increased risk of acquisition of a vaccine-preventable disease.
  - Occupational acquisition of a specific vaccine-preventable disease.
  - Healthcare-associated infection with a specific vaccine-preventable disease.
  - No increased risk of a specific vaccine-preventable disease.

Establishing and maintaining risk assessment processes

The following questions will assist organisations to establish and maintain processes for vaccine-preventable disease risk assessment:

- Can all existing members of the workforce provide history or evidence of vaccination or immunity to specific vaccine-preventable diseases?
- Does the organisation have processes or services available to assess and screen members of the workforce for their vaccination or immune status, such as a serology service?
- Does the organisation have processes available to record and analyse data regarding vaccination or immune status of the workforce?
- Are there processes in place that protect members of the workforce from exposure to vaccine-preventable diseases?
- Do all recruitment advertisements include the organisation’s requirements for pre-employment vaccine-preventable disease status assessment and immunisation?

Using a risk matrix to assess the level of risk

A risk matrix is a qualitative tool used to assess the risk of an event, such as occupational exposure to a vaccine-preventable disease, and the consequences associated with the event. A risk matrix can generate a risk rating to describe the level of risk to members of the workforce and the organisation from vaccine-preventable diseases.

Information from a risk matrix can be used to:

- document the organisation’s vaccine-preventable disease risks in its risk management plan
- inform actions to reduce risks
- report on risks to the workforce and consumers
- plan for, and manage, internal and external risks arising from outbreaks of vaccine-preventable diseases in both the organisation and the community.

A Workforce Immunisation Risk Matrix[140] was developed by the Commission to support organisations to undertake risk assessment for vaccine-preventable diseases. See Figure 7.2 and Table 7.2.

Figure 7.2. Workforce immunisation risk matrix

A. Workforce immunity and vaccination status + access to workforce screening			
• **Up-to-date records of immune status and vaccination history available for all members of the workforce**	**YES +**	**NO +**	**NO +**
• **Workforce screening + vaccination program in place***	**YES**	**YES**	**NO**
B. Risk of disease exposure	⇩	⇩	⇩
No increased risk of exposure to disease or infection associated with working in the health service organisation	**Low**	**Medium**	**High**
Members of the workforce have a risk of exposure to vaccine-preventable disease due to the nature of their role	**Medium**	**High**	**Very high**
Hospital-based outbreak of vaccine-preventable disease (no evidence of community transmission)	**Medium**	**High**	**Very high**
Community-wide outbreak of a vaccine-preventable disease	**High**	**Very high**	**Very high**
Disease with no available vaccine	**Very high**	**Very high**	**Very high**

**Vaccination programs should include catch-up vaccination, such as annual influenza vaccination*

Table 7.2. Description of risk levels

Risk level	Description
Low	Risk is managed by routine procedures. There is minimal risk of harm or injury from the risk.
Medium	Risk is managed by specific monitoring or audit procedures. There is potential for harm or injury from the risk.
High	There is a serious risk that must be addressed immediately. Consequences to individuals and the organisation are high due to a high potential for harm or injury.
Very high	There is a serious risk that must be addressed immediately. The magnitude of the consequences to the individual and organisation of an event, should it occur, are considered very high with potentially significant harm or injury.

Using the Workforce Immunisation Risk matrix to identify the level of risk

Follow the steps below to identify the level of risk using the workforce immunisation risk matrix.

Step 1: Under 'Part A. Workforce immunity and vaccination status + access to workforce screening', select the pair of responses that best describe the current situation in the organisation or department to identify the risk level.

Step 2: Consider the incidence of vaccine-preventable diseases in the community, including outbreaks and seasonal epidemics, along with any outbreaks of vaccine-preventable diseases in the health service organisation.

[140] https://www.safetyandquality.gov.au/publications-and-resources/resource-library/nsqhs-standards-workforce-immunisation-risk-matrix

Step 3: Identify the risk rating (Low, Medium, High, Very high). The health service organisation should develop and plan to prioritise strategies and identify resources to address vaccine-preventable disease risks to members of the workforce based on the risk rating.

EXAMPLE

Assessing the risk during an outbreak of pertussis in a hospital

Up-to-date immune and vaccination status records are not available for all members of the workforce in a rehabilitation hospital, but a workforce screening and immunisation program is in place.

Currently, there is a hospital-based outbreak of pertussis (which is a vaccine-preventable disease), but there is no evidence of community transmission.

The risk rating is **High** for the rehabilitation hospital. This hospital will need to consider how to protect members of the workforce from the pertussis outbreak and whether the current immunisation program includes a pertussis vaccination.

Strategies to prevent the risk of vaccine-preventable diseases

The role of standard and transmission-based precautions

Understanding the means of transmission of an infectious agent and knowing how and when to apply the basic principles of IPC is critical to the prevention and control of outbreaks in the healthcare setting.

A two-tiered approach is used for the prevention and control of infectious agents in the healthcare setting:

1. Standard precautions
2. Transmission-based precautions.

1. Standard precautions

The use of standard precautions is the primary strategy to minimise the transmission of vaccine-preventable diseases and other infections. Standard precautions include:

- hand hygiene, consistent with the 5 Moments for Hand Hygiene[141]
- the use of appropriate personal protective equipment (PPE)
- the safe use and disposal of sharps
- environmental cleaning[142]
- respiratory hygiene and cough etiquette
- aseptic technique[143]
- reprocessing of reusable equipment
- waste management
- appropriate handling of linen.

[141] https://www.safetyandquality.gov.au/our-work/infection-prevention-and-control/national-hand-hygiene-initiative
[142] https://www.safetyandquality.gov.au/our-work/infection-prevention-and-control/environmental-cleaning-and-infection-prevention-and-control-resources
[143] https://www.safetyandquality.gov.au/our-work/infection-prevention-and-control/aseptic-technique

Transmission-based precautions

Transmission-based precautions are applied in addition to standard precautions. Transmission-based precautions reduce transmission opportunities of a particular infectious agent. Understanding the means of transmission is important for deciding the most appropriate transmission-based precautions to use.

Table 6.3 lists the three categories of transmission-based precautions and when to apply each one.

Table 7.3. The three categories of transmission-based precautions

Category	Route of transmission of infectious agent (known or suspected)
Contact precaution	Direct or indirect contact
Droplet precaution	Respiratory droplets
Airborne precaution	Airborne route

For some infectious agents, a combination of precautions may be required. For example, seasonal influenza requires both contact and droplet precautions.

For more information about standard and transmission-based precautions, please see workbook Module 1. Principles of infection prevention and control.

Immunisation programs for seasonal infections

Health service organisations should have processes in place to respond to seasonal risks for specific infectious agents such as influenza, as well as outbreaks or pandemics such as the COVID-19.

Seasonal immunisation programs for vaccine-preventable diseases such as influenza provide workers with protection against variants of seasonal viruses. Strains of influenza change from season to season and vaccines are updated annually in response to these changes. Typically, the influenza vaccine is quadrivalent vaccine as it contains four influenza virus strains – two influenza A viruses and two influenza B viruses.

In Australia, it is recommended that influenza vaccination is given annually, usually in autumn, as influenza typically increases from June to September and peaks in August. Widespread availability of influenza vaccine is part of a community public health program to reduce the risk of illness and death in the community, and the burden on the health system due to increased hospitalisations.

Booster and catch-up vaccinations

Catch-up vaccinations aim to provide optimal protection against vaccine-preventable diseases by completing a person's recommended vaccination schedule. A catch-up vaccination is required for incomplete or overdue vaccinations.

A booster vaccination is recommended for some immunisations as immunity wanes over time. For example, a booster vaccination for tetanus is recommended for adults over 50 years of age if they have not received a booster in the past 10 years. Seasonal influenza vaccinations are another type of booster vaccination.

The Australian Immunisation Handbook[139] provides guidance on both catch-up and booster immunisations protocols.

Strategies to manage the risk of a vaccine-preventable disease outbreak

A targeted screening and immunisation program may be required to respond to an outbreak of a vaccine-preventable disease such as measles or pertussis (whooping cough) or respond to a novel infectious agent such as COVID-19. If an outbreak occurs, it is critical to identify non-immune members of the workforce and individuals with waning immunity to a specific infectious agent. These people should be offered vaccination and/or redeployment as appropriate, to prevent further spread of the infectious agent within the organisation and the general community.

To learn more about outbreak management, please see workbook Module 8. Epidemiology and outbreak prevention and management.

Strategies to protect workers who may be vulnerable to vaccine-preventable diseases

Members of the workforce who are particularly vulnerable to vaccine-preventable diseases include:

- pregnant women
- individuals who are immunocompromised
- individuals with non-intact skin
- non-immune individuals
- individuals exposed to a vaccine-preventable disease (for example, hepatitis A vaccine post exposure to sewerage for plumber)
- vaccine refusers.

Vulnerable workers should be offered support and counselling about their capacity to fulfil the requirements of the roles to which they may be assigned. All state and territory health departments have policies regarding management of vaccine-preventable disease risks for vulnerable members of the workforce. This may include re-deployment where possible, and not employing workers who refuse screening and vaccination.

Module 8. Epidemiology and outbreak prevention and management

Contents

Overview of Module 8

Module 8 contains two parts:

Part 1: Basic epidemiology for infectious diseases

Part 2: Outbreak prevention and management

This module provides an understanding of the use of epidemiological methods in infection prevention and control (IPC) programs. It also covers the key principles for preventing and managing outbreaks of infectious agents in organisations.

After completing this module, you will understand:

- the role of epidemiology in IPC
- how to use epidemiological methods to describe the amount of disease in a population
- how to use epidemiological methods to identify outbreaks
- the key aspects of outbreak prevention and control plans
- the formation of outbreak management teams
- outbreak management strategies
- the elements of an outbreak response.

Understanding how a disease spreads within a population enables the organisation or network to implement appropriate strategies to prevent, control and respond to infectious agents that cause outbreaks, epidemics, or pandemics.

> An individual health service organisation may belong to a health network, a health district, an area health service, or a corporate group.

Staff who are responsible for the implementation of an IPC program in an organisation or network should have a basic understanding of epidemiology. This will help to inform strategies to prevent and respond to infectious disease outbreaks.

Part 1: Basic epidemiology for infectious diseases

Part 1 covers the following topics:

- **The role of epidemiology in infection prevention and control**
- **Requirements of the National Safety and Quality Health Services Standards**
- **Using epidemiology to describe the rate of infection in a population**
- **Using epidemiology to identify outbreaks**

The role of epidemiology in infection prevention and control

Epidemiology is the study of how diseases spread within and between populations.

The epidemiology of an infection is how an infection spreads within and between populations. Understanding the epidemiology of an infection helps to identify who is most at risk of infection at a particular time. This information is critical to implement effective IPC strategies and can be used to establish interventions that minimise the risk of infection to patients, the community, and the health workforce.

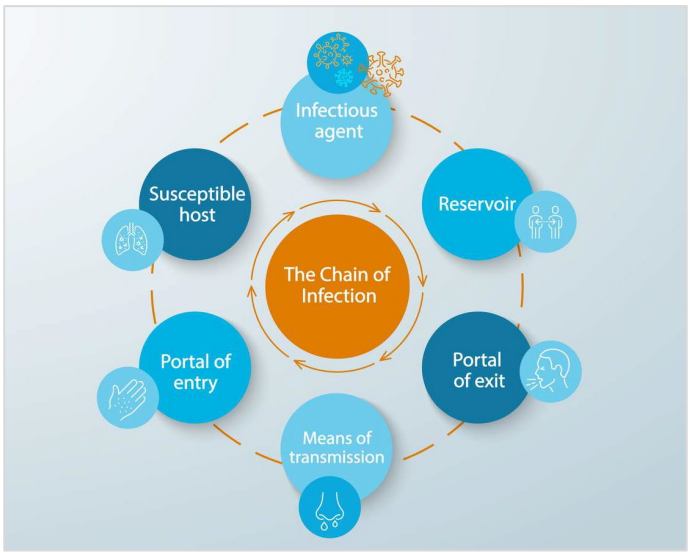
In IPC, epidemiology is used to understand the interaction between the six elements of the Chain of Infection, and how this interaction leads to the emergence and spread of an infection within or between populations.

Epidemiology investigates the relationship between the six elements of the Chain of Infection (Figure 8.1), by asking questions such as:

- **Who** has the infection?
- **What** infectious agent has caused the infection?
- **When** did the infection occur?
- **Where** was the infection acquired and identified?
- **How** does the infection spread to others?

In health care, these questions may be answered through routine infection surveillance and monitoring activities. However, if a novel infection emerges, an organisation or network may need to commence new surveillance activities to answer these questions.

Figure 8.1. Chain of infection



Workbook Module 1. Principles of infection prevention and control provides more information on the Chain of Infection.

Workbook Module 5. Basics of surveillance and quality improvement provides more information on infection surveillance.

Requirements of the National Safety and Quality Health Services Standards

Action 3.05 (Surveillance) of the NSQHS Preventing and Controlling Infections Standard[144] states that a health service organisation must have a surveillance strategy for infections and infection risk. The strategy must monitor, assess and use surveillance data to reduce the risks associated with infections. It is important to incorporate epidemiological data into assessments of risk factors for infection or outbreak.

Using epidemiology to describe the rate of infection in a population

The rate of infection in a population is calculated using the following information:

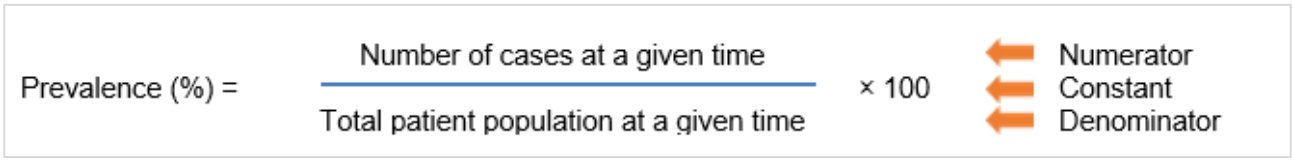
- **Numerator**: representing the number of infections
- **Denominator:** representing the number of individuals at risk of getting an infection (the at-risk population)
- **Constant:** a multiple of 10, usually 100, which is used to obtain a percentage. The constant makes the resulting rate meaningful, as it is often difficult to understand the practical impact of an infection rate that is less than 1.

The formula for calculating the rate of infection is:

(Numerator ÷ Denominator) × Constant = Infection rate (%)

The prevalence of an infection is the amount or 'burden' of infection in an at-risk population. It describes all cases of an infection in a population. Figure 8.2 provides the formula to calculate prevalence of infection.

Figure 8.2. Formula for calculating prevalence of infection

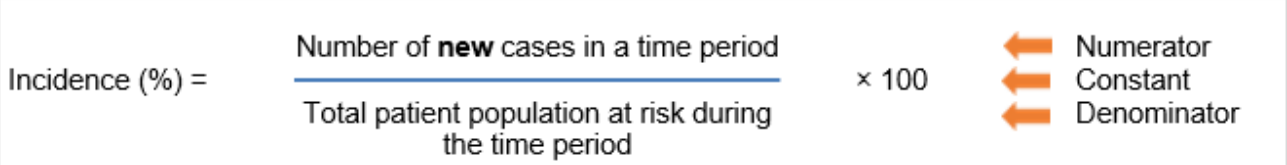


In addition to knowing the amount of infection in a population, it may be important to know when the amount of infection in the population is changing. This information will assist in timing the implementation of IPC strategies or an outbreak response to be most effective.

One way to measure the amount of infection in the population at a given time is to calculate the incidence of the infection. The incidence describes the number of new infections in an at-risk population for the time period that the population was exposed to the infection. Figure 8.3 provides the formula used to calculate incidence of infection.

[144] https://www.safetyandquality.gov.au/standards/nsqhs-standards/preventing-and-controlling-infections-standard

Figure 8.3. Formula for calculating incidence of infection



- **Prevalence**: The numerator is the number of cases at a given time. The denominator is the total population for the number of cases. For example, this could be the represented by the population in a ward, hospital, community, state or territory, or country.
- **Incidence**: The denominator represents the number of individuals at risk of getting an infection (the at-risk population). This may be expressed as patient-days if the population is hospital based or may be the total population if the population is community based. For More information, refer to workbook Module 5. Basics of surveillance and quality improvement.

The prevalence and incidence of an infection are usually reported as:

- the proportion of the population that is at risk of getting an infection, or
- a percentage of the population that is at risk of getting an infection.

The amount of infection in a population will change over time. For example, some infections are seasonal, such as those caused by influenza and respiratory syncytial virus (RSV). The amount of infection caused by these infectious agents peaks at certain times of the year. This means that the prevalence and incidence of these infections changes throughout the year.

For other infections, increased prevalence may occur due to sudden changes in the environment (for example, an outbreak of aspergillosis due to the commencement of building works), or changes to how an infectious agent causes and spreads disease (for example, antimicrobial resistance).

Identifying changes in the amount of infection in a population allows organisations and networks to:

- recognise an outbreak, or spike in infectious agents
- optimally time the implementation of IPC responses for seasonal infections
- understand why the effectiveness of existing IPC strategies may have changed
- understand how to better respond to similar circumstances in the future.

CASE STUDY

Calculating the prevalence of an infection

Residential Home B had 118 residents between 01 January 2020 and 31 December 2020. A survey during this time identified that 21 residents were diagnosed with a urinary tract infection. What is the prevalence rate of urinary tract infections in Residential Home B?

Use the formula:

(Numerator ÷ Denominator) × Constant = Prevalence rate

The numerator is 21 cases of urinary tract infection.

The denominator is the total number of residents (118) at Residential Home B between 01 January 2020 and 31 December 2020.

The constant is 100. This multiplier has been chosen as it will convert the prevalence into a percentage and provide a value greater than 1.

The calculation is: = 21 ÷ 118

= 0.177 × 100

= 17.7%

Based on the calculation above, the prevalence rate of urinary tract infection for Home B from 01 January 2020 to 31 December 2020 was 17.7%.

➢ The constant is a multiple of 10, usually 100. However, it can also be 1000 or 10,000 depending on the numerical value of the denominator used to obtain a percentage (only ×100 will give you a percentage). The constant makes the resulting rate meaningful, as it is often difficult to understand the practical impact of an infection rate that is less than 1.

CASE STUDY

Calculating the incidence of infection

Five patients from Ward A were identified with a *Staphylococcus aureus* bloodstream infection (SABSI) in a 30-day period. During these 30 days, another 16 patients moved in and out of the ward, and there was a total bed occupancy of 257 patient-days. What is the incidence rate for SABSI in Ward A?

Use the formula:

(Numerator ÷ Denominator) × Constant = Incidence rate

The numerator is number of patients with a *Staphylococcus aureus* bloodstream infection in the ward (5).

The denominator is total bed occupancy for the ward during the time under surveillance (257 patient-days).

The constant is 100. This multiplier has been chosen as it will result in a value greater than 1 (see comment above about percentage calculation).

The calculation is: = 5 ÷ 257

= 0.019 × 100

= 1.9%

Based on the calculation above, the incidence of SABSI in Ward A was 1.9%, which is equivalent to 19 infections per 1,000 patient days.

Using epidemiology to identify outbreaks

What does epidemiological data tell us about outbreaks of infection?

Epidemiological data can be used to identify whether changes in the amount of infection in a population are deviations from the usual (baseline) amount of infection, and whether an outbreak has occurred. This is done by creating an epidemic curve for the infection.

An epidemic curve is a column or line graph that plots the amount of infection on the y-axis, against time which is on the x-axis – see Figure 8.4.

The epidemic curve shows:

1. **The start of the outbreak**

   The case definition should be used to determine the start of the outbreak. Often the start of the outbreak on the epidemic curve corresponds to a point in the curve where the amount of infection begins to rise above the baseline level.

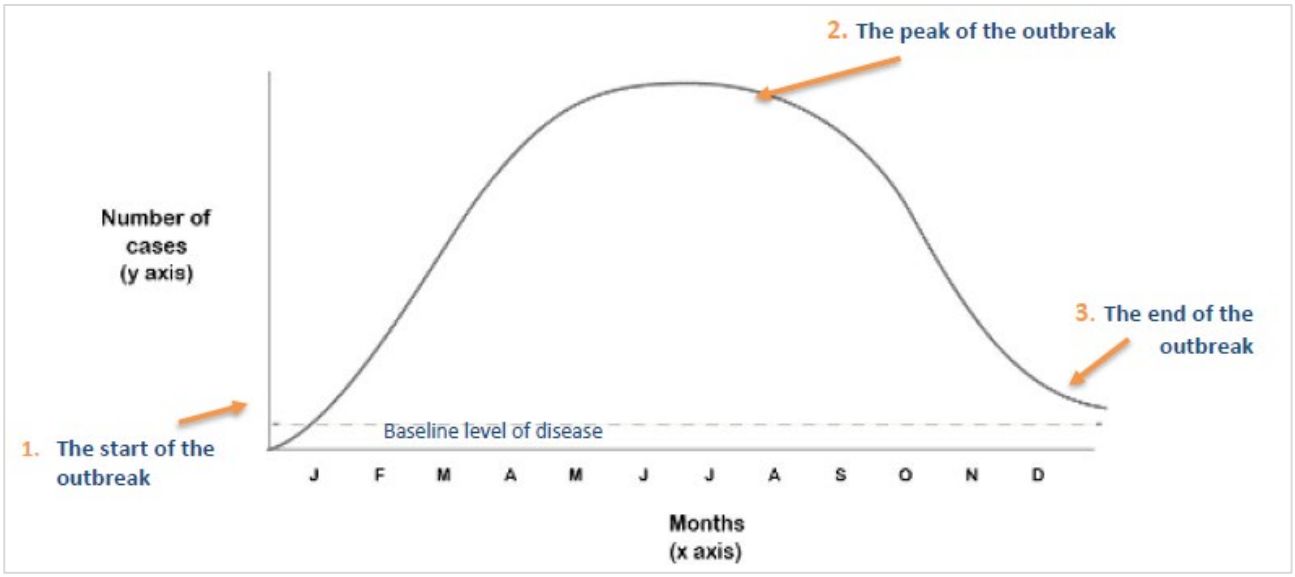
2. **The peak of the outbreak**

   This is when the amount of infection is at its highest.

3. **The end of the outbreak**

   This occurs after the peak of the curve, when the amount of infection either returns to the baseline level or decreases to a level that is above the baseline level indefinitely.

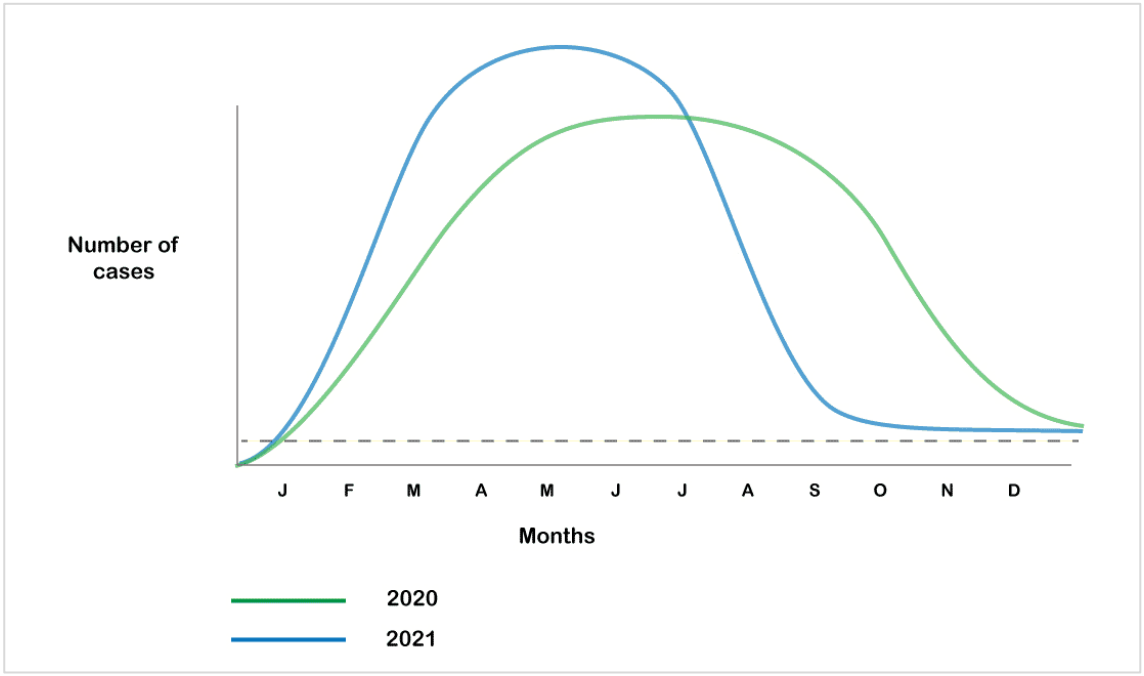
Figure 8.4. Example of an epidemic curve graph to measure the trajectory of an outbreak



If the amount of infection decreases to a level that is above the baseline level indefinitely, the infection is considered to be endemic within the population.

An epidemic curve can also be overlayed or extended with historical data to determine if the behaviour of infection has changed over time, see Figure 8.5. This additional information is useful for studying seasonal diseases that may have changed behaviours over time (for example, earlier seasonal onset, longer outbreak periods, sharper outbreak onset or cessation).

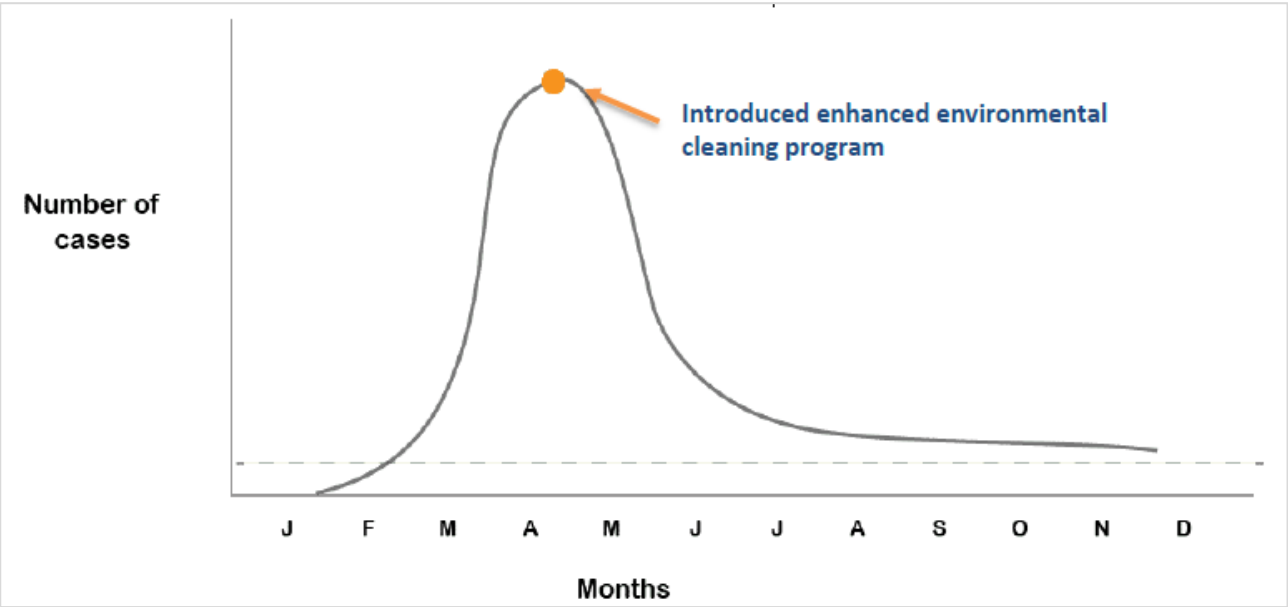
Figure 8.5. Epidemic curve, current and historical data



IPC interventions used to respond to the outbreak can also be added to the epidemic curve. The addition of this information will highlight whether the implementation of a particular strategy had an observable effect on reducing the burden of infection.

Figure 8.6 is an example epidemic curve that records the implementation of an IPC intervention (introduction of an enhanced environmental cleaning program) and the impact of this intervention on the rate of infection during an outbreak. Note how the number of infections starts to drop away after enhanced environmental cleaning commenced.

Figure 8.6. Example of the impact of an infection prevention and control intervention on an epidemic curve



Part 2: Outbreak prevention and management

Part 2 covers the following topics:

- **Outbreaks, epidemics, and pandemics**
- **Preventing and controlling outbreaks**
- **Outbreak prevention and control plans**
- **Forming the outbreak management team**
- **Outbreak management strategies**
- **Elements of an outbreak response**

Outbreaks, epidemics, and pandemics

An outbreak of an infection is a sudden increase in the number of cases of an infection above what is normally expected in the population. Outbreaks are usually limited to specific geographic areas, and are linked by time, person, and/or place.

An outbreak that spans a large geographic area, for example a whole country, is referred to as an **epidemic** (see Figure 8.7).

Figure 8.7. Visual representation of an epidemic

An outbreak that affects multiple countries and continents is referred to as a **pandemic** (Figure 8.8).

Figure 8.8. Visual representation of pandemic

An **outbreak** of infection can be described as either:

- an incident in which two or more people experiencing a similar illness are linked by time or place
- a greater than expected incidence of infection compared to the usual background rate for the particular location
- a single case for certain rare diseases
- a suspected, anticipated or actual event involving microbial or chemical contamination of food/water.

Common outbreaks that can occur in health settings include:

- gastroenteritis (usually of viral aetiology, caused by Norovirus)
- *Clostridioides difficile* infection (CDI)
- methicillin resistant *Staphylococcus aureus* (MRSA) infection
- multi-resistant Gram-negative bacilli infection
- influenza or other respiratory illnesses.

An outbreak of an infectious agent within an organisation or network can impact the safety of the patient population, staff, and visitors; incur large financial costs; and may detrimentally affect the reputation of the organisation.

Preventing and controlling outbreaks

Health service organisations should have processes in place to identify, prevent and manage outbreaks of infectious agents. This should be part of an organisation-wide risk management plan for emergencies and disaster management.

There are a number of actions in the NSQHS Standards[145] that require organisations to consider and address the risks associated with outbreaks of infection. These actions are described in Table 8.1:

Table 8.1. Required actions from NSQHS Preventing and Controlling Infections Standard

Action	Description
3.02g	Plan for public health and pandemic risks.
3.13c	Provide access to training on cleaning processes for routine and outbreak situations, and novel infections.
3.14e	Have processes to evaluate and respond to infection risks for novel infections, and risks identified as part of a public health response or pandemic planning.
3.16g	Provide for outbreak monitoring, investigation, and management.
3.16h	Plan for, and manage, ongoing service provision during outbreaks and pandemics or events in which there is increased risk of transmission of infection.

Organisations and networks should use a risk management approach to develop and implement procedures for the prevention and control of outbreaks.

For more information about risk management in infection prevention and control see workbook Module 2. Risk management for infectious agents and diseases.

[145] https://www.safetyandquality.gov.au/standards/nsqhs-standards

Outbreak prevention and control plans

Outbreak prevention and control plans should include strategies to prevent or minimise the impact of an outbreak on the broader patient population, the health workforce, visitors and potentially the community.

An outbreak prevention and management plan should consider:

- What infectious agents have the potential to cause an outbreak in patients, the health workforce, and the wider community?
- What may facilitate the spread of an infectious agent within the organisation or within the network, such as likely reservoirs, the means of transmission, healthcare environment (for example, room occupancy, ventilation) and the prevalence of susceptible hosts?
- What existing surveillance and monitoring strategies are available to detect outbreaks?
- What new surveillance and monitoring strategies are needed?
- What strategies are available to prevent and control the spread of infection?

An outbreak prevention and control plan should include the following:

- A description of key roles and responsibilities for the outbreak management team
- Staff education and training for outbreak management, including training on the principles of IPC, risk assessment and use of personal protective equipment (PPE)
- Detail on access to additional resources during an outbreak, such as stockpiles of PPE, medication, additional environmental cleaning resources and staff redeployment plans
- Access to pathology services for specimen processing
- Implementation of immunisation programs for healthcare workers, if required
- Strategies to ensure ongoing service provision and minimal disruption to the delivery of health services.

Further guidance

- Communicable Diseases Network Australia publishes the Series of National Guidelines (SoNGs),[146] which provide nationally consistent advice and guidance to public health units on responding to a notifiable disease event.
- State and territory health departments have developed guidance on outbreak prevention, management and planning, and disease control.
- The Australian Guidelines for the Prevention and Control of Infection in Healthcare[147] are national guidelines that promote and facilitate IPC and include principles for the prevention and management of outbreaks.

Forming the outbreak management team

An organisation's outbreak management team may include:

- members of the organisation or network executive
- managers of wards or services affected by the outbreak
- IPC staff
- work health and safety and/or staff health representative
- corporate services staff (for example, cleaners, waste managers)
- a microbiologist

[146] https://www1.health.gov.au/internet/main/publishing.nsf/Content/cdnasongs.htm
[147] https://www.nhmrc.gov.au/about-us/publications/australian-guidelines-prevention-and-control-infection-healthcare-2019

- an infectious diseases physician
- an epidemiologist and/or biostatistician
- a public health representative
- a communications/media adviser.

The outbreak management team should be tailored to meet the local circumstances and available local resources. A lead and deputy lead investigator should be assigned and identified in the outbreak management plan.

Once an outbreak has been identified, the outbreak management team should be mobilised to implement the organisation or network outbreak management plan.

The functions of the outbreak management team include:

- establishing and refining the case definition
- assessing and determining the likely means of transmission
- ongoing review of the epidemic curve
- identifying where the outbreak has occurred
- identifying the source of the outbreak and any associated patient movement
- identifying the population at risk (ward, department) or persons exposed
- identifying suitable strategies to control the spread of the outbreak
- reviewing the effectiveness of implemented strategies
- reviewing relevant literature for information on controlling the outbreak
- providing regular communication about the status of the outbreak to relevant stakeholders, such as the organisation's executive, the health workforce, and the wider community
- liaising with local public health units as necessary, especially if the outbreak involves a notifiable infectious disease or involves other facilities.

Outbreak management strategies

Standard and transmission-based precautions

Understanding the means of transmission of an infectious agent and knowing how and when to apply the basic principles of IPC is critical to the prevention and control of outbreaks in healthcare settings.

Standard precautions are work practices that provide a first-line approach to IPC in the healthcare environment and should be adopted by all healthcare workers when caring for all patients, regardless of suspected or confirmed infection status.

Standard precautions

Standard precautions include:

- hand hygiene, consistent with the 5 Moments for Hand Hygiene[148]
- the use of appropriate PPE
- the safe use and disposal of sharps
- environmental cleaning[142]
- respiratory hygiene and cough etiquette
- aseptic technique[143]
- reprocessing of reusable medical equipment and instruments
- waste management

[148] https://www.safetyandquality.gov.au/our-work/infection-prevention-and-control/national-hand-hygiene-initiative

- appropriate handling of linen.

Transmission-based precautions

Transmission-based precautions are used in addition to standard precautions, that interrupt the specific means of transmission of a particular infectious agent. Understanding the means of transmission of an infectious agent is important for deciding the most appropriate transmission-based precautions to use to prevent transmission and manage infectious agents in the event of an outbreak.

Table 6.3 lists the three categories of transmission-based precautions and when to apply each one.

Table 8.2. The three categories of transmission-based precautions

Category	Route of transmission of infectious agent (known or suspected)
Contact precaution	Direct or indirect contact
Droplet precaution	Respiratory droplets
Airborne precaution	Airborne route

For some infectious agents, a combination of precautions may be required. For example, seasonal influenza requires both contact and droplet precautions.

For more information about standard and transmission-based precautions, see workbook Module 1. Principles of infection prevention and control.

Other outbreak management strategies

In addition to standard and transmission-based precautions, other strategies may be needed to control the spread of the outbreak. See Table 8.3 for a list of additional strategies.

Table 8.3. Additional outbreak management strategies

Strategy	Description
Increasing the frequency of environmental cleaning	A modified cleaning program may be needed to control or reduce reservoirs for the infectious agent (for example, increasing the frequency of cleaning frequently touched surfaces within a ward in a ward where there is an outbreak of carbapenemase-producing Enterobacterales).
Improving efficiency of environmental cleaning	Cleaning techniques could be reviewed to ensure that the method used to clean the environment is effective and appropriate for the infection risk.
Using single use or dedicated patient care equipment	Where possible, patient care items and cleaning materials should be allocated to the area affected by the outbreak. If dedicated equipment cannot be provided, single-use items should be used and discarded in the appropriate waste streams.
Restricting the movement of patients, staff, and visitors	During an outbreak, it may be necessary to minimise movement within, or restrict entry to, affected areas for a period of time to contain the spread of the infection and protect the broader patient population, members of the health workforce, visitors, and potentially the community.
Adjusting environmental controls	Factors such as temperature, humidity and air flow may increase the risk of infection transmission. To improve ventilation and air quality, consider reducing the density of staff, visitors and patients within clinical areas, and use ventilation systems which can be adjusted increase air flow and filter infectious particles in the air, such as HEPA filtration systems,
Prophylactic treatment/immunisation	In some circumstances, it may be necessary to consider the use of prophylaxis or immunisation to control the spread of a specific infectious agent.
Exclusion from high-risk activities	Some healthcare interventions may increase the risk of transmission of an infectious agent. Where there is no clinical urgency, these procedures should be avoided and/or alternative treatments should be considered. For example, aerosol-generating procedures, such as the use of nebulisers, are not recommended for patients with airborne diseases, as these procedures can aerosolise infectious material, increasing the risk of transmission to others.

For more information on environmental cleaning, see workbook Module 4. Clean and safe healthcare environment.

For information on ventilation systems for healthcare environments, see the Optimising ventilation for infection prevention and control in healthcare settings* factsheet.

**https://www.safetyandquality.gov.au/publications-and-resources/resource-library/optimising-ventilation-infection-prevention-and-control-healthcare-settings*

Elements of an outbreak response

The level of response to an outbreak within an organisation or network will vary depending on factors such as:

- the infectious agent involved
- timeliness of detection and preventive actions
- the virulence of the infectious agent
- the means of transmission of the infectious agent
- the vulnerability of the affected population
- the location of the outbreak.

Table 8.4 lists eight common steps that should form part of every outbreak response.

Table 8.4. Steps of an outbreak response

Steps	Details
STEP 1 **Confirm the outbreak**	An investigation into a suspected outbreak should begin as soon as possible to ensure a timely and appropriate response. It should focus on confirming whether there is an outbreak and the timing of the onset of the outbreak. The first case(s) identified in an outbreak are often referred to as the index case(s). All investigations should start with collection of information about the index case(s), including: • type and timing of symptom onset • demographic information • details of the patient's admission. The next phase of the investigation should consider any commonality, or links, between cases. IPC strategies should be implemented immediately whilst proceeding with investigation.
STEP 2 **Report the outbreak**	Each organisation and network should have clearly defined communication processes, and responsibilities, for notification in the event of an outbreak. Information about a suspected or confirmed outbreak needs to be reported as early as possible to relevant stakeholders, including: • patients and visitors who may be at risk (including those already discharged as other facilities may be at risk for example, nursing homes) • members of the health workforce who may be at risk • IPC staff • the organisation or network executive • relevant staff for example, cleaners, corporate services, waste managers • the relevant pathology service, to activate surge capacity for laboratory testing • the local public health unit, if a notifiable disease or otherwise required by public health legislation. When notifying stakeholders, it is important to include information about: • when the outbreak started (date, place, time, person) • the cause of the outbreak (i.e., the infectious agent and its means of transmission) • who has been affected by the outbreak (i.e., the number of known and suspected cases involved) • who is at risk and what precautions are needed to minimise their risk • what strategies have been put into place to control the outbreak • who to contact for follow-up information.

Steps	Details
STEP 3 **Develop a case definition**	A case definition is a set of criteria used to decide whether a person has the infection of concern. The case definition should include the following information: • clinical information about the disease • risk factors for the infection (for example, age profile, gender, co-morbidities) • information about the area affected by the outbreak • details about the specific period of time when an individual may have been at risk of exposure to the infectious agent. The case definition is usually broad at the beginning of the investigation and is refined over time as more information about the outbreak becomes available. For More information on case definitions refer to the Communicable Disease Network Australia[149] (CDNA) and/or state and territory guidance on case definitions.
STEP 4 **Review and reinforce IPC strategies to minimise risk and prevent further outbreaks**	Throughout the course of the outbreak, there should be ongoing assessment and evaluation of the effectiveness of the IPC strategies that have been put in place to manage the outbreak. The use of standard precautions and appropriate transmission-based precautions should always continue for the duration of the outbreak. All interventions used to reduce the risk of transmission should be regularly reviewed using quality improvement systems, to ensure these measures are still appropriate and effective.

[149] https://www.health.gov.au/resources/collections/cdna-surveillance-case-definitions

Steps	Details

STEP 5
Identify new cases
	Once a case definition has been developed, any individual with symptoms that fit the case definition needs to be identified. The most common way to do this is by collating a line list. A line list includes information such as:
	• Identifying information, for example:
	  ○ Name
	  ○ Medical record number
	  ○ Date of admission
	• Demographic information, for example:
	  ○ Age
	  ○ Gender
	  ○ Address
	• Clinical information, for example:
	  ○ Date/time of onset of signs and symptoms
	  ○ Types of signs and symptoms
	  ○ Place of onset of signs and symptoms
	  ○ Date of admission to hospital
	  ○ Treatment
	  ○ Mortality
	• Laboratory information, for example:
	  ○ Microbiology results
	  ○ Antimicrobial susceptibility results
	• Potential risk factors, for example:
	  ○ Contact with known case, or individuals with similar symptoms
	  ○ Recent travel
	  ○ Immunosuppression
	  ○ Environmental exposure
	  ○ Other co-morbidities
	• In the line list, individuals can be identified using the case definition as:
	  ○ Confirmed – usually laboratory verified
	  ○ Probable – usually has typical features
	  ○ Suspected or possible – usually has fewer typical clinical features.
	Line lists can be populated from routine diagnostic testing and/or from contact tracing.

STEP 6 **Communicate the status of the outbreak to stakeholders**	Ongoing communication during an outbreak is vitally important. The goal of communication during an outbreak is to ensure the safety of patients, the health workforce, other healthcare consumers and the wider community. Good communication is necessary to support the coordinated efforts to control the outbreak and will ensure that: • information is shared in a timely manner • information is accurate, consistent, and clear, and tailored for the relevant stakeholders • existing communication systems, such as staff email, electronic flagging of patients' healthcare records (for patients with positive results or contacts of the index case) and signage to reinforce IPC strategies are used • internal and external enquiries and feedback is processed and responded to in a timely way. A range of methods should be used to communicate with at-risk patients and populations, with consideration of appropriately addressing accessibility, health literacy, language and cultural differences.

Steps	Details
STEP 7 **Identify the source of the outbreak**	A hypothesis on the source of the outbreak can be developed from information gathered during the investigation, development of the case definition and ongoing contact tracing. When developing a hypothesis, it is important to consider: • Is the infection associated with the delivery of healthcare? • Did clinical signs and symptoms develop after admission or were these present on admission? • What populations are affected? • What are the common links for exposure to the infectious agent? • What are the clinical signs of infection? For example, fever, inflammation, vomiting, diarrhoea, delirium? • Has the infectious agent been identified? What is it? • Has environmental sampling been undertaken, if appropriate, and what are the results? • What is the current literature/other evidence reporting about the infectious agent?
STEP 8 **Review IPC strategies and resources and update if necessary**	Once the outbreak has resolved, the organisation or network should: • review and update their local outbreak management plans • review and update their local IPC programs • review and update environmental cleaning and building maintenance schedules and programs • review environmental controls such as ventilations systems • restock emergency stockpile resources • provide healthcare workers with debriefing or counselling services, as required • review healthcare worker vaccination programs and compliance • review healthcare workers' compliance with IPC practices, such as use of PPE, aseptic technique, and hand hygiene • provide follow-up communication to the patients, the health workforce, and the community.

Applying the outbreak response steps outlined in Table 8.4 will help organisations be prepared and respond promptly to protect patients, workforce, consumers and the wider community, and manage outbreaks of infectious agents. These steps are a guide and may occur concurrently and differ depending on priorities at the time.

To learn more about using quality improvement systems as part of an infection prevention and control response, refer to workbook Module 5. Basics of surveillance and quality improvement.

Glossary

Term	Definition
Case definition	A set of criteria used to describe whether a person has the infection of concern.
Contact tracing	A method of case finding used during an outbreak of an infectious disease to identify individuals who may have been in contact with the index case. Contact tracing usually commences once the means of transmission and the case definition have been established.
Endemic	When a disease becomes constantly present in a particular area/region.
Epidemic	An outbreak that spans a large geographic area, for example a whole country.
Epidemiology	The study of how diseases spread within, and between, populations.
Incidence	The number of new infections in an at-risk population for the time period that the population was exposed to the infection.
Index case	The first case(s) identified in an outbreak.
Novel infection	An infectious disease that has newly appeared in a human population.
Outbreak	A sudden increase in the number of cases of an infection above what is normally expected in the population. Outbreaks are usually limited to specific geographic areas, and are linked by time, person, and place.
Pandemic	An outbreak that affects multiple countries and continents.
Prevalence	All cases of an infection in a population.
Virulence	The ability of an organism to infect the host and cause a disease.

Module 9. Introduction to reprocessing reusable medical devices

Contents

Overview of Module 9

Module 9 contains two parts:

Part 1: Reprocessing reusable medical devices

Part 2: Managing risk in reprocessing

This module provides a basic understanding of the reprocessing of reusable medical devices. By completing this module, you will understand:

- the three main reprocessing methods: cleaning, disinfection, sterilisation
- the factors that influence the effectiveness of reprocessing
- how to manage risks associated with reprocessing.

This module is not intended to provide detailed training on reprocessing or sterilisation methods. There are a number of education providers (for example, TAFE colleges) who offer certification (III or IV) in sterilisation services.

This module provides general principles and is targeted to staff who use and reprocess reusable medical devices. This includes allied health professionals, medical and nursing staff, and clinical technicians (such as dental, anaesthetic and sterilisation assistants).

This module does not provide information on the reprocessing of reusable medical devices potentially contaminated with prions. Prions are abnormal proteins that replicate in host cells. Prions are of significant concern for human and animal health, as they are transmissible, and can cause disease that is rapidly progressive, invariably incurable, and fatal. Prions have a long incubation period and are resistant to heat, chemicals, and irradiation.

Human prion diseases are classified as Transmissible Spongiform Encephalopathies and include Classic Creutzfeldt-Jakob Disease (CJD) and Variant Creutzfeldt-Jakob Disease (vCJD). For information on reprocessing in this context, please refer to the national Creutzfeldt-Jakob disease – Infection control guidelines.*

**https://www.health.gov.au/resources/publications/creutzfeldt-jakob-disease-infection-control-guidelines*

Part 1: Reprocessing reusable medical devices

Part 1 covers the following topics:

- **Introduction**
- **Requirements of the National Safety and Quality Health Services Standards**
- **Determining reprocessing requirements for reusable medical devices**
- **Reprocessing methods**
- **Operational processes for reprocessing**
- **Factors that influence the effectiveness of reprocessing**

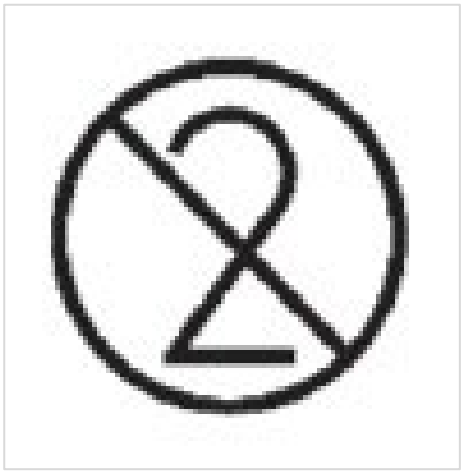
Introduction

Definition of a reusable medical device

A reusable medical device is a medical device that is designated or intended by its manufacturer as suitable for reprocessing or reuse.

Single-use medical devices must not be reprocessed or reused. Single-use medical devices are designed for use on an individual patient during a single procedure then discarded. A single-use medical device will be labelled with a no reuse symbol, see Figure 9.1.

Figure 9.1. Symbol indicating a device must not be reused



Reusable medical devices that are used in health care for diagnostic and treatment purposes for patients must be reprocessed according to their intended use and the guidance outlined in the manufacturer's instructions for use.

Examples of reusable medical devices include blood pressure cuffs, stethoscopes, flexible endoscopes, and surgical instruments. A reusable medical device must be included on the Australian Register of Therapeutic Goods (ARTG)[150] before it can be supplied in Australia.

[150] https://www.tga.gov.au/australian-register-therapeutic-goods

Australian Register of Therapeutic Goods (ARTG)

The ARTG is the public database of therapeutic goods that can be legally supplied in Australia. The Therapeutic Goods Administration (TGA) applies a risk-based approach to assessing and approving a device for inclusion on the ARTG. The TGA reviews the evidence at hand and considers expert advice to determine whether the benefits of using the device outweigh any possible risks.

Similarly, disinfectants and other chemicals used for reprocessing need to be listed on the ARTG before they can be used in Australia. A listed product has been checked by the TGA to ensure that all claims made on the product label are supported by evidence. The TGA also checks that the product meets the relevant labelling requirements.

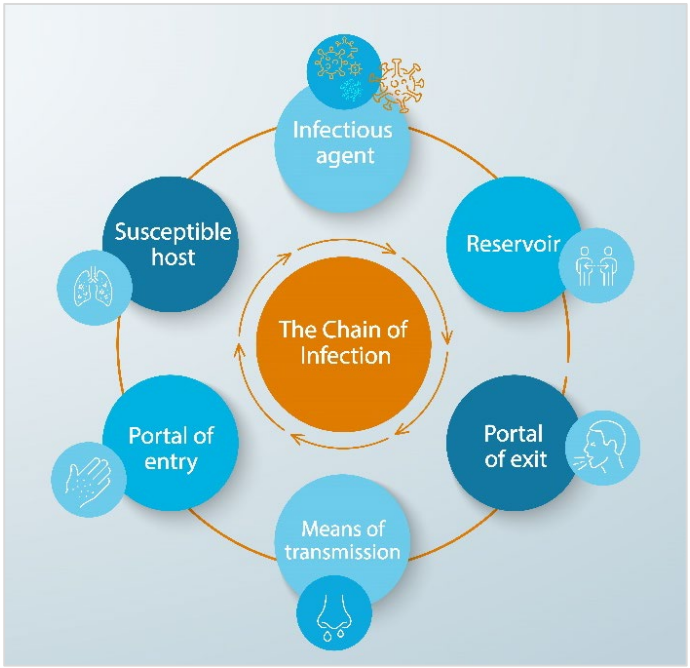
The potential impact of contaminated reusable medical device

During use, a reusable medical device may be in contact with skin, mucous membrane, or sterile tissue and body cavities, and may be exposed to blood, body fluids and infectious agents. A contaminated reusable medical device has the potential to act as a reservoir for infectious material and can spread infection from one patient to another.

The Chain of Infection

The transmission of infectious agents within a health service organisation occurs via a series of interlinked events. This is called the Chain of Infection, see Figure 9.2. The Chain of Infection illustrates the interaction between a susceptible host and an infectious agent, leading to the transmission of infection.

Figure 9.2. The Chain of Infection



For transmission of an infectious agent to occur within a healthcare setting, the following elements of the Chain of Infection are required:

- an infectious agent (pathogen)
- a reservoir
- a portal of exit
- a means of transmission

- a portal of entry
- a susceptible host.

The objective of infection prevention and control (IPC) is to interrupt the Chain of Infection. Reusable medical devices must be effectively cleaned and stored according to their intended use and the guidance in the manufacturer's instructions for use. If this is not done, reusable medical devices can act as a reservoir for infectious agents and become a means of transmission, and a source of potential infection, through direct contact with susceptible hosts.

For more information about reservoirs and the Chain of Infection, see workbook Module 1. Principles of infection prevention and control.

Consistent with the Preventing and Controlling Infections Standard[151] of the National and Safety Health Service (NSQHS) Standards, health service organisations should have processes in place to appropriately reprocess reusable medical devices in a way that supports a sustainable approach to the use of IPC resources.

What is reprocessing?

Reprocessing is a multistep process that removes infectious material from a reusable medical device so the device is safe for reuse.

In general, the steps required to reprocess a reusable medical device depend on how the device has been used and the reprocessing guidance outlined in the manufacturer's instructions for use. The steps would typically include cleaning, inspection and disassembly, functional testing (if applicable), disinfection (if applicable), packaging and labelling, and sterilisation (if applicable).

Why is reprocessing important?

The reprocessing of reusable medical devices is an important patient safety measure to prevent the spread of infection. Reprocessing protects:

- patients, consumers, and members of the workforce from exposure to infectious agents
- the healthcare environment from cross-contamination.

Requirements of the National Safety and Quality Health Services Standards

Action 3.17 (Reprocessing of reusable medical devices) of the NSQHS Preventing and Controlling Infections Standard[151] requires health service organisations that use reusable medical devices to have in place:

a. processes for reprocessing that are consistent with relevant national and international standards, in conjunction with manufacturers' guidelines
b. a traceability process for critical and semi-critical equipment, instruments and devices that is capable of identifying:
   - the patient
   - the procedure
   - the reusable equipment, instruments and devices that were used for the procedure
c. processes to plan and manage reprocessing requirements.

[151] https://www.safetyandquality.gov.au/standards/nsqhs-standards/preventing-and-controlling-infections-standard

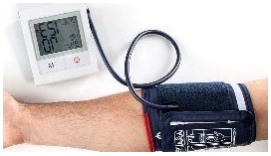
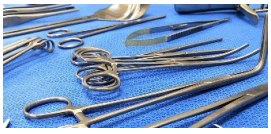
Determining reprocessing requirements for reusable medical devices

Depending on its intended use and the level of infection risk associated with its use, a reusable medical device may require reprocessing that involves disinfection or sterilisation, in addition to cleaning.

The Spaulding classification system

The Spaulding classification system is used to determine the minimum level of reprocessing required for reusable medical devices. The system is based on devices being categorised as non-critical, semi-critical and critical. Using the Spaulding classification system, not all reusable medical devices require sterilisation. Table 9.1 provides examples of how the Spaulding classification system categorises different reusable medical devices.

Table 9.1. Categorising reusable medical devices using the Spaulding classification system

Category of reusable medical device	Definition	Examples of reusable medical devices
Non-critical items 	Non-critical items are reusable medical devices that come into contact with intact skin, but not mucous membranes. These devices require cleaning, which may be followed by low or intermediate level disinfection.	Examples of non-critical equipment include: • blood pressure cuffs • commodes • bedpans • ECG leads • stethoscopes • non-invasive ultrasound probe (doppler).
Semi-critical items 	Semi-critical items are reusable medical devices that come into contact with mucous membranes and/or non-intact skin. These devices require cleaning, followed by high level disinfection or sterilisation, as appropriate.	Examples of semi-critical equipment include: • invasive ultrasound equipment (vaginal ultrasound transducer) • anaesthetic equipment (laryngoscopes) • speculum • gastroscopes • dental mouth mirror • dental hand piece • respiratory therapy equipment.
Critical items 	Critical items are reusable medical devices that enter sterile tissue or the vascular system. These devices require cleaning, followed by sterilisation. It is essential that these devices are sterile at the time of use.	Examples of critical equipment include: • reusable surgical equipment (biopsy forceps, retractors) • foot care equipment (nail splitters, podiatry scissors) • urology endoscope • biopsy forceps • orthopaedic drill.

Reprocessing methods

Cleaning

The first step of reprocessing for all reusable medical devices is cleaning. Cleaning removes foreign material, such as soil and other organic matter, from the surface of the device. Cleaning must be carried out in accordance with manufacturer's instructions for use.

Reusable medical devices should be thoroughly cleaned as soon as practical after use. If organic matter is allowed to dry on the device, the level of cleaning required to remove the dried matter may damage the device. When reusable medical devices are comprised of multiple parts, they may need to be disassembled so individual parts can be inspected and cleaned in accordance with manufacturer's instructions for use.

Reusable medical devices must always be cleaned before disinfection or sterilisation if these additional steps are required. If cleaning is not undertaken prior to these steps, the presence of residual organic matter will reduce, or nullify, the effectiveness of these subsequent processes.

A pre-clean (and/or pre-treatment) (Figure 9.3) may be required by a central reprocessing (sterilisation) service before items are sent to a sterilising service. This prevents organic matter drying on items before undergoing cleaning. Refer to local facility protocols for guidance on cleaning and transport requirements of reusable medical devices to sterilising services.

Figure 9.3. Precleaning a reusable medical device (endoscope) before high-level disinfection

➢ If a reusable medical device cannot be cleaned, then it cannot be reused

Disinfection

Disinfection is a process that inactivates non-sporing infectious agents using either heat (moist or dry heat) or a chemical disinfectant. Disinfection is required if an item cannot withstand sterilisation. Disinfection is suitable for most semi-critical reusable medical devices.

The ARTG lists the disinfectants, sterilants and sanitary products[152] that are to be used to reprocess reusable medical devices.

The efficacy of disinfection depends on a number of factors, including:

- the presence of organic matter on the reusable medical device
- the level of microbial contamination on the reusable medical device, including the presence of a biofilm or bacterial endospores
- the design of the reusable medical device
- the concentration of the chemical disinfectant
- pH and temperature of the chemical disinfectant
- contact time between the disinfectant and the reusable medical devices

[152] https://www.tga.gov.au/resources/resource/guidance/disinfectants-sterilants-and-sanitary-products

- temperature, if a thermal disinfection process is used.

When used in accordance with manufacturer's instructions for use, there are three levels of disinfection. These are described in Table 9.2.

Table 9.2. The three levels of disinfection and the effect of each

Disinfection Level	Effect
High	Kills all infectious agents, except large numbers of bacterial endospores.
Intermediate	Kills all infectious agents, except bacterial endospores.
Low	Kills most bacteria, as well as some viruses and fungi, but does not kill bacterial endospores.

➢ An **endospore** is a simple form of a bacterium. Endospores have a protective protein coat which makes the spore resistant to external conditions such as heat or radiation, as well as some chemicals such as disinfectants and antimicrobial agents. Spores enable bacteria to reproduce and survive in harsh environmental conditions.

Sterilisation

Sterilisation destroys all microorganisms, including bacterial spores, on the internal and external surfaces of an instrument or device. Sterilisation is required when a reusable medical device enters sterile tissue or the vascular system, because microbial contamination of these locations could result in severe clinical disease, such as bloodstream infection and/or sepsis.

Steam sterilisation is the most common form of sterilisation used for reprocessing reusable medical devices. This method of sterilisation has a high safety margin, reliability, validity and lethality, and is used for reusable medical devices which are heat resistant.

Reprocessing heat and moisture-sensitive reusable medical devices requires the use of a low-temperature sterilisation method (for example, ethylene oxide, hydrogen peroxide plasma, peracetic acid and aldehyde).

Operational processes for reprocessing

Developing and documenting operational processes

For some reusable devices, reprocessing will only require cleaning. For example, a stethoscope only requires cleaning. Other items may be more complex and may require a combination of cleaning and disinfection, and/or sterilisation (Figure 9.4), depending on their intended use. Each reusable medical device will require a different operational process and different reprocessing equipment to make it safe for reuse.

Figure 9.4. Loading a tray in a sterilising unit/machine

The operational processes for reprocessing reusable medical devices should be clearly specified and documented in an organisation's policies or procedure guides.

Considerations when developing and documenting reprocessing processes are provided in Table 9.3.

Table 9.3. Considerations for reprocessing of reusable medical devices

Element for reprocessing	Questions to consider for reprocessing reusable medical equipment
Equipment	• What equipment is needed to reprocess the reusable medical device? • How will the reusable medical device be loaded and removed from reprocessing equipment? • How will the reprocessing equipment be cleaned after use? • What are the requirements for the safe storage and disposal of chemicals used for reprocessing?
Cleaning	• Is disassembly of the reusable medical device required? • Is pre-cleaning/pre-treatment of the reusable medical device required? for example, does it require soaking? • Is manual cleaning of the reusable medical device required? • How will the reusable medical device be dried after cleaning? • What is the role of visual examination in determining the effectiveness of cleaning?
Disinfection	• What method of disinfection is required? • What are the manufacturer's instructions for effective disinfection? • How is the effectiveness of disinfection determined?
Sterilisation	• What method of sterilisation is required? • What are the manufacturer's instructions for effective sterilisation? • How is the effectiveness of sterilisation determined?
Inspection and packaging	• Is packaging required and if so, how, and when should the reusable medical device be packaged? • When would you inspect an item for signs of damage?
Storage and transportation	• How and where will the reprocessed reusable medical device be stored? • How will the reusable medical devices be transported before and after use, if required? • What monitoring systems are required in the storage area?
Monitoring	• What systems are needed to monitor the operational effectiveness of reprocessing equipment? • What traceability and tracking processes need to be in place? • How will issues detected from monitoring systems be addressed?

Factors that influence the effectiveness of reprocessing

Design of the device

The design of a reusable medical device should serve its intended clinical function, as well as enable adequate reprocessing (for example, can the device be cleaned, and subsequently disinfected or sterilised, as required).

When making procurement decisions, health service organisations should consider:

- How can the reusable medical device be cleaned?
- Does the reusable medical device require disassembly for reprocessing and whether disassembly and re-assembly is possible?
- Is the design and size of the reusable medical device, including finishes and composition, compatible with the required reprocessing processes and equipment?

- Can the reusable medical device be reprocessed on site, or are external services required to reprocess the device?
- What type of disinfection is required? Chemical or thermal? High- or low-level disinfection?
- Are the chemicals listed within manufacturer's instructions for use listed on the ARTG?
- Does the manufacturer's instructions for use provide information for cleaning, disinfection or sterilisation meet IPC requirements?
- Do staff require additional training to reprocess the device?
- What inventory level is required to maintain clinical activity whilst device is being reprocessed?

The surfaces of a reusable medical device should be regularly examined for breaks in integrity that would impair cleaning, disinfection or sterilisation. Any device that no longer functions as intended or cannot be adequately cleaned and/or disinfected or sterilised should be repaired before reprocessing and reuse or discarded.

Reprocessing product selection

The selection of products for cleaning, disinfecting and sterilising reusable medical devices should be based on:

- documented microbial efficacy of these products
- compatibility between the product and the reusable medical device
- compatibility between the product, reprocessing equipment, and the water supply.

Compatibility is also dependent on:

- concentration of the cleaning, disinfectant, or sterilising product
- contact time with these products.

Specifications for product and water compatibility for the device, reprocessing products and equipment can be found in the relevant manufacturer's instructions for use.

Reprocessing environment design

Reprocessing should be undertaken in a space that enables effective segregation of clean and dirty activities, and a unidirectional workflow to mitigate the risk of cross-contamination.

Measures to minimise the risk of contamination in the reprocessing environment include:

- keeping windows closed
- maintaining unidirectional airflow from clean to dirty
- maintaining a clean and safe environment; keep surfaces accessible for routine environmental cleaning
- extraction of fumes using appropriate ventilation systems and fume cabinets
- ready access to handwashing sinks and alcohol-based hand rub products
- ready access to appropriate personal protective equipment (PPE)
- implementing environmental controls, such as minimising foot traffic and removing clutter
- monitoring and maintaining temperature and humidity levels
- monitoring the quality of the water used for reprocessing regularly.

Infrastructure considerations include:

- appropriate depth of cleaning sinks and appropriate cleaning accessories to prevent the generation of aerosols
- surface finishes, including walls, doors, floors, and fixtures, that can withstand frequent cleaning
- dedicated storage systems for reprocessed items to maintain the integrity of the item

- dedicated external area for decanting and storage of consumables (cardboard and other potential contaminants must not be brought into the reprocessing environment)
- dedicated, safe area for the storage of chemicals.

Poor quality water can be a risk of contamination and a reservoir for infectious agents and may contaminate devices and reprocessing equipment if used during reprocessing. The use of poor-quality water may also damage the device or reprocessing equipment. It may be necessary to treat water before it can be used for reprocessing activities.

For more information on facility design, please refer to the Australasian Health Facility Guidelines* and the current Australian Standard on Reprocessing of reusable medical devices for information of water quality requirements for effective reprocessing.

**https://healthfacilityguidelines.com.au/*

Who should reprocess reusable medical devices?

Non-critical reusable medical devices should be cleaned immediately after use by staff who have used the equipment. For example, a clinician should clean a stethoscope immediately after it has been used on one patient and before it is reused on another patient.

Reprocessing of semi-critical and critical reusable medical devices should be undertaken by individuals who are trained in:

- sterilisation, for example, have a Certificate III or IV in sterilisation services
- the specific reprocessing method that is required for the device based on manufacturer's instructions for use, the purpose of various equipment and the Spaulding classification system.

Use of inappropriate reprocessing methods or equipment may result in ineffective reprocessing, and the transmission of infectious agents during clinical procedures.

Access to a central reprocessing service should be considered if staff with the appropriate qualifications and expertise are not available or if the demand for reprocessing is infrequent.

Storing reprocessed medical devices

All reprocessed reusable medical devices must be stored in a way that maintains their level of reprocessing and provides protection from sharp objects that may damage their packaging (Figure 9.5). To ensure clean–dirty separation, reprocessed reusable medical devices should not be stored in the same area as contaminated reusable medical devices.

Figure 9.5. Appropriate storage of reprocessed reusable medical devices

Non-critical and semi-critical reusable medical devices should be stored in a clean, dry place to prevent environmental contamination, consistent with the requirements in the Australasian Health Facility Guidelines[153] for the storage of sterile stock.

In addition to these requirements, semi-critical and critical reusable medical devices should be stored in designated storage areas, which have been designed to protect the reusable medical device and its packaging from environmental degradation (for example, effects of light, humidity, and temperature), dust, vermin and sunlight.

It is important to maintain the sterility of critical items during storage. This can be achieved by ensuring that:

- packaged items go through a drying cycle and are checked for moisture before storage and use
- the integrity of the sterile barrier system has been maintained (no holes, tears, damage)
- items are used within their use-by date.

[153] https://healthfacilityguidelines.com.au/

Part 2: Managing risk in reprocessing

Part 2 covers the following topics:

- **Systems to identify and manage risks in reprocessing**
- **Health and safety risks in** reprocessing
- **Financial and environmental impact of reprocessing**

Systems to identify and manage risks in reprocessing

Processes to identify and manage risks in reprocessing

Consistent with Action 1.10 (Risk management) of the NSQHS Preventing and Controlling Infections Standard,[151] health service organisations are required to have documented processes in place to identify and manage risks.

For the reprocessing of reusable medical devices, these processes should include systems to:

- identify risks, such as routine monitoring processes
- respond to risk, such as quality control systems and traceability systems.

The key steps for risk assessment and management are describe in Table 9.4.

Table 9.4. Key steps for risk assessment and management in reprocessing of reusable medical devices

Step	Considerations
Identify hazards	What are the real or potential hazards that could cause harm in the organisation?
Assess risks	What are the risks if someone is exposed to these hazards, and how likely is it that someone could be exposed to a hazard in the organisation?
Control risks	What actions can be taken to control the risk?
Review control measures	How effective are the controls that are in place, and how can they be modified as required, to ensure the ongoing safety of everyone?

Risk management strategies and the hierarchy of controls* can be applied to manage risks associated with reprocessing.

For more information refer to workbook Module 2. Risk management for infectious agents and diseases.

**https://www.safetyandquality.gov.au/sites/default/files/2022-05/using_the_hierarchy_of_controls_in_conjunction_with_infection_prevention_and_-_fact_sheet.pdf*

The hierarchy of controls is a model used in work health and safety management to eliminate and minimise risks. Used in conjunction with the fundamental two-tiered approach to IPC, standard and transmission-based precautions, organisations can develop systems to prevent, manage and control infections.

Routine monitoring

Routine monitoring is a key aspect of risk management in reprocessing. The purpose of routine monitoring is two-fold:

- to check that reprocessing equipment is functioning correctly
- to check that reusable medical devices are being reprocessed correctly so that they are safe for reuse.

Examples of routine monitoring of reusable medical devices:

- visual inspection of the device before and after use
- visual inspection after cleaning
- checking the operating cycles for reprocessing equipment
- regular testing of reprocessing equipment (for example, daily testing of ultrasonic cleaners)
- microbiological surveillance of endoscopes with lumens
- visual inspection of packaging
- use of chemical and biological indicators in sterilisation.

Examples of routine monitoring for reprocessing equipment and products:

- water quality monitoring
- routine equipment calibration
- checking product expiration
- checking product suitability and compatibility
- preventative maintenance and testing of equipment.

These routine monitoring activities are essential for ensuring that the risk of infection associated with device reuse is minimised.

Traceability of semi-critical and critical reusable medical devices

Where an infection has occurred because of the use of a reusable medical device, traceability processes are used to identify the at-risk population and minimise further spread of infection.

> ➢ Traceability refers to the capacity to identify the linkage between a reusable medical device and the patient and procedure for which the reusable medical device was used.

Lookback investigations and outbreak management

If there has been a breakdown in a reprocessing procedure or protocol, a ‘lookback’ investigation may be necessary. This process will identify, trace, recall, counsel, and test patients or healthcare workers who may have been exposed to an infectious agent, usually a bloodborne virus. The process would also involve recalling all potentially affected items. Lookback investigations must be managed with due regard to ethical and legal considerations.

In the event of such an incident (for example, failure of sterilisation or disinfection), report and escalate the incident in accordance with organisational and jurisdictional risk management processes and immediately notify the local public health unit. Monitoring of critical incidents and other sentinel events is an important part of surveillance. An analysis of the incident should follow a structured procedure to identify the process and contributing factors, explore and identify risk reduction strategies, and implement solutions to reduce the risk of the incident reoccurring.

Health and safety risks in reprocessing

In addition to infection risk, there are other risks associated with reprocessing that organisations should be aware of and address in documented processes.

Infection risks associated with exposure to sharps, blood and body fluid

The health workforce may be exposed to sharps, blood and body fluid when reprocessing medical devices. Staff must receive IPC training as part of their employment. This training should include information on standard and transmission-based precautions, and the measures to be taken if an individual is exposed to blood and body fluid. Ready access to hand-washing sinks, alcohol-based hand rub products and appropriate PPE must be provided.

Risk posed by physical exertion

Staff involved in the reprocessing of reusable medical devices may be required to lift and carry loads. Manual handling training must be undertaken by staff prior to working in the reprocessing environment.

Exposure to chemicals

When reprocessing reusable medical devices, staff may be exposed to chemicals used for cleaning, disinfecting, or sterilising these devices. Exposure to chemical residue may also occur after reprocessing. Exposure may result in adverse reactions, such as skin, eye, or respiratory irritation.

Exposure to these chemicals can be minimised by:

- always following the manufacturer's instructions for use for handling, decanting and disposal
- using PPE such as gloves, face protection and protective eyewear
- training and access to equipment to manage chemical spills, including access to a chemical spill kit
- use of an appropriately designed space with sufficient ventilation and lighting.

Figure 9.6. Signs for emergency showers and eye wash

Only chemical products listed on the ARTG Disinfectants, sterilants and sanitary products[152] are to be used to reprocess reusable medical devices. The organisation should also have current safety data sheets available for all chemicals that are used for reprocessing. Any adverse reactions to these chemicals should be documented in the organisation's incident register and reported to the ARTG. Refer to the information at ARTG Reporting adverse events.[154]

[154] https://www.tga.gov.au/resources/resource/guidance/reporting-adverse-events

Organisations should provide access to appropriate first aid equipment with signage, for example, eye baths or showers, in the event of an accidental exposure to chemicals, see example of signage at Figure 9.6.

Refer to your local work health and safety guidance for the safe handling and storage of chemicals used in reprocessing.

Financial and environmental impact of reprocessing

Reprocessing is a resource intensive activity and involves regulatory requirements set by the relevant state or territory Environment Protection Authority (EPA). Organisations should routinely assess the environmental impact of reprocessing activities.

These impacts include:

- water and energy demands
- wastewater management
- environmental exposure to chemicals used in reprocessing
- disposal of chemicals used for cleaning, disinfection, and sterilisation
- disposal of:
  - reusable medical devices
  - reprocessing equipment.

Reprocessing contributes to sustainability by enabling the reuse of reusable medical devices. However, the patient safety impact, cost implications, and environmental sustainability issues must be considered when deciding whether to use single-use and reusable medical devices.

Reprocessing equipment to improve water and energy efficiency should be considered as part of facility upgrades and when designing new facilities.

For more information on sustainability in health care, refer to the Commission's Sustainable Healthcare Module.*

**https://www.safetyandquality.gov.au/standards/nsqhs-standards/sustainable-healthcare-module*

Module 10. Renovation, repairs and redevelopment risk management

Contents

Overview of Module 10

Note: This module is due for redevelopment in 2024.

Module 10 contains two parts:

Part 1. Description of activities and classification by class

Part 2. Construction Survey Tool

This module contains:

- an overview of basic risk minimisation strategies
- an example of how to show the method of risk assessment used
- methods to recognise the appropriate infection prevention measures for each classification
- methods to demonstrate an understanding of the monitoring options to use for different projects in the healthcare setting
- a description of significant infectious agents that are associated with renovation and redevelopment in healthcare facilities.

Building works, repairs and maintenance are ongoing in most healthcare facilities. A pre-emptive approach to risk management and strategic planning is paramount. A clearly defined and documented plan that is activated early in a sustained and coordinated approach is needed. This plan needs clearly defined responsibilities for each service.

A risk assessment should be conducted during the pre-planning stage as part of the overall preparation to undertake building works. This is the responsibility of a project management team, and the infection control professional should be included as a key member of that team.

Reducing risk

Independent risk factors exist when renovation, repairs or redevelopment of building works in healthcare facilities are undertaken. If redevelopment is undertaken where healthcare services are provided, there is a risk for exposure to opportunistic infectious agents including invasive fungal infections.

Evidence exists demonstrating that preventive measures are effective in decreasing the incidence of work area and construction-related fungal infections. Preventative measures are also cost-effective, because patient safety can be maintained, and cases of infection prevented.

Risk management

A risk assessment and risk management process must be part of any maintenance, repairs, redevelopment or renovation activity to be undertaken in a healthcare facility.

Issues to be addressed as part of this process include:

- addressing corporate risk associated with the project
- defining the scope of the project and/or work to be undertaken
- determining if the project will impact on high-risk areas for environmental contamination, for example, ceiling tiles, plumbing and air conditioning ducting, and
- participating in a project management team to oversee the project and ensure compliance with relevant legislation, regulations, building codes, standards and contract provisions.

Other issues to be addressed as part of the risk management process include:

- using risk management assessment tools to assess the likelihood that these hazards will impact on safety
- identifying management systems for hazards that cannot be eliminated to determine how they are going to be managed, and
- ensuring the education of healthcare workers, patients and maintenance or redevelopment workers on the required risk management strategies to be undertaken at the planning stage and throughout the project.

Identifying the risk

It is important that the populations and services at risk of infection be identified along with the potential infectious agents and potential modes of transmission of the infectious agents.

Direct and indirect hazards must also be identified for the healthcare facility, including maintenance or modifications of services offered during the project, and the need to utilise external or alternate services for the term of the project.

Hazards

Potential and real hazards related to the project must also be identified. This includes specific confines and control strategies for infectious agents and environmental contaminants, contingency plans for service failures or disruptions (for example, water, power supply, fires, delays in material supply, industrial action) and integrating these into existing risk registers and management systems the healthcare facility has for disaster management where appropriate

A proactive approach

Lack of planning, risk identification and management prior to the work commencing may lead to direct exposure to infectious agents for patients and healthcare workers. This significantly increases the risk of environmental contamination with infectious agents.

Risk management needs to be proactive and start at the time the initial decisions to undertake the project or activity are made. The process needs to consider and act on a potential risk or chance of an adverse event occurring. This process is more effective than managing an adverse event once it has occurred with a reactive rather than proactive response.

A team approach

Risk management and minimisation is best achieved by a team approach. This can be achieved by developing a project risk management plan and undertaking ongoing risk assessments during the project.

Risk management can be achieved by identifying key people to be in the project management team at the planning stage. By using the expertise of those directly involved in the project and other key personnel, including infection prevention and control (IPC), work health and safety, engineering and maintenance staff, waste managers, cleaning staff, and facility management, risk management is very effective.

For more information about risk management, please refer to workbook Module 2. Risk management for infectious agents and diseases.

Infectious agents

Fungi (especially filamentous fungi) and bacteria are infectious agents that can be found in most areas of any building. They can lay dormant and are often identified in areas where dust collects, for example, ceiling space and ceiling tiles, high areas, and behind equipment.

Infectious agents are also located in pipes (water and sewerage), air conditioning ducts, bird droppings and soil, and these include *Pseudomonas* sp., *Clostridium* sp., *Legionella* sp., *Escherichia coli* and other anaerobic bacteria that are associated with sewerage pipes and soils.

Often infectious agents are hardy and resistant to temperature extremes and other environmental variables. Some will flourish in warm moist areas, while others like dry environments. Several of these infectious agents are spore-forming, which will increase their resistance to chemicals and environmental conditions.

Other factors that impact on the resilience of these infectious agents to survive include:

- bio-films
- dust
- poorly maintained filters, and
- undisturbed environments.

For more information on infectious agents, refer to workbook Module 2. Risk management of infectious agents and diseases and Module 3. Basic microbiology and multidrug-resistant organisms.

In addition to redevelopment, repairs or renovation projects, maintenance activities such as cleaning can lead to large numbers of infectious agents being dispersed. When these infectious agents are dispersed into the atmosphere, they can spread over a large area very quickly.

Activities such as removing ceiling tiles for inspection of ceiling space, interrupting plumbing or water pipes, servicing air handlers or cleaning of air-conditioning duct work should therefore also be considered as part of the risk management process.

Due to the ubiquitous nature of these infectious agents (especially *Aspergillus spp*.) in the healthcare environment, it is important that prior to any maintenance or repairs, refurbishment or redevelopment activities, a healthcare facility should:

- identify the location of high-risk patient populations in relation to the project and/or work area
- identify ventilation systems, the areas they supply and their potential impact
- determine methodology and frequency for air monitoring requirements, and
- consider taking baseline air samples to establish values prior to the commencement of building works and identify possible contaminants and their locations, for example, ceiling dust, water damage, service shafts, fire retardants, bird or other animal nests, and bird droppings.

Aspergillus Spp.

The most common infectious agent implicated in healthcare-associated infection related to maintenance activities, renovation, repairs, or redevelopment is *Aspergillus spp*. Over the last 30 years, numerous outbreaks have been reported of healthcare-associated invasive fungal infections. Most frequently reported outbreaks have been in the haematology-oncology setting, but also in the intensive care, transplant and renal units. These outbreaks have been associated with both major and minor projects.

Aspergillus spp. is the most notorious construction related infectious agent but other fungi including *Scedosporium* have also been linked to building works. *Aspergillus fumigatus* has been responsible for the majority of these outbreaks.

Aspergillus species are ubiquitous thermotolerant moulds that produce numerous spores known as conidia 2-4um in diameter. The small size of these fungal spores allows ready dispersion on air currents and deposition into human alveoli.

Individuals at particular risk for invasive disease include those with malnutrition and patients receiving chemotherapy for haematological malignancies with a prolonged period of neutropenia. Recipients of bone marrow transplants or solid-organ transplants are also at risk. Pulmonary disease in immunocompromised patients is the most common presentation.

Invasive aspergillosis is an opportunistic infection that occurs mainly among patients with prolonged neutropenia.

The mortality rate exceeds 50% and can reach 90% in allogenic haematopoietic stem cell transplant recipients. During the 1990s, the management of invasive aspergillosis in neutropenic patients improved with the advent of new diagnostic tools and new antifungal drugs.

Invasive aspergillosis can also occur after solid-organ transplantation and during long-term corticosteroid therapy. It is an emerging opportunistic infection in patients with chronic respiratory disease and in patients who are receiving immunosuppressive therapies.

Aspergillosis is perceived as less of a concern in non-neutropenic patients; therefore, it tends to be diagnosed at a more advanced stage, at which point even new antifungal therapies have poor efficacy.

The epidemiology of invasive aspergillosis is changing; it is increasingly observed in the non-neutropenic patient such as critically ill patients in intensive care units.

Outbreaks of aspergillosis have occurred in lung transplant patients, haematology and oncology patients, renal transplant patients, and surgical patients including ophthalmology patients, bone marrow transplant patients and haematopoietic stem cell transplant recipient patients in association with building works.

Outbreaks and risk factors

Patient and geographic risk areas in a healthcare setting

Risk assessment related to a ward, department or services will identify areas in which risk is no greater than in the general community, to areas where services or patients will have significant risk. Much of the risk is associated with treatment or care provided. Potential exposure to infectious agents may be liberated or dispersed by repairs, maintenance, redevelopment or renovations.

Many of these higher risk areas have additional requirements for environmental control in place to protect the patient, for example, high-efficiency particulate air (HEPA)filtration, restricted access and clothing requirements. Table 10.1 provides an example of patient and geographic risk areas in a health service organisation redevelopment.

Table 10.1. Patient and geographic risk areas in a health service organisation redevelopment

Risk rating	Area/Department
Low	• Office areas • Public areas • Workshops • Unoccupied wards areas not accommodating patients
Potential	• Nuclear medicine • Non-invasive radiology including Magnetic Resonance Imaging (MRI) and Computerised Tomography (CT) • Preadmission units and discharge clinics • Research laboratories • General outpatient areas except surgery and oncology • Psychiatric services • Allied health, for example, physiotherapy, occupational therapy, social work, dietetics • General wards • All other patient care areas unless stated in moderate or highest risk
Moderate	• Emergency department • Pharmacy • Pathology laboratory • Respiratory units • Physiotherapy respiratory function units • Coronary care unit • Cardiology clinics • Outpatients unit (surgery and oncology) • Invasive radiology • Paediatrics wards • Obstetrics wards including labour ward and delivery suites • Surgical wards • Geriatric and long-term care wards

Risk rating	Area/Department
High	• Units accommodating immunocompromised patients (for example, HIV/AIDS units) • Intensive care units and high-dependency units • Sterilising services unit • Sterile stock storerooms • All operating suites • Day surgery units • Haematology/oncology inpatient and day units • Solid organ transplant units (for example, renal transplant unit) • Bone marrow transplant units • Neonatal intensive care/special care units • Cardiac catheterisation/angiography units • Haemodialysis unit • Endoscopy units • Anaesthesia and pump areas • Recovery units • Pharmacy clean rooms • Aseptic areas • Admixture rooms

Adapted from: Australasian Health Facility Guidelines: Part D- IPC, Accessed June 2019

For more information about infectious agents, see workbook Module 8. Epidemiology and outbreak prevention and management.

Risk rating

Activities within the healthcare setting relating to redevelopment, renovation, repairs and maintenance need to be risk rated. This is based on the scope of the activity and location of the activity. It is also based on the degree of service interruption and potential or real risks for contamination or dispersal of infectious agents within the healthcare setting.

Risk will be increased if the activity or project to be undertaken involves clinical common areas. These activities may include open plan areas like corridors in a ward or unit, multiple patient care areas (more than one patient room) and critical areas including sterilising services, operating theatres, ICU and oncology units. Table 10.2 provides an example of Redevelopment activities and classification for risk rating.

Assess the impact

When the project or activity is being planned, the impact on the work area and associated areas or services needs to be considered.

The simple insignificant activity of visual inspection into ceiling space may have implications for access to work areas that are blocked by ladders, and patients in that area may be at increased risk (oncology patients).

Therefore, when considering risk the patient risk groups and the activity need to be considered together as well as impact on services and access.

Table 10.2. Redevelopment activities and classification for risk rating

Classification	Type of redevelopment activity
Type I – insignificant	Inspection and non-invasive activities. These include but are not limited to: • activities that require lifting or removal of ceiling tiles for visual inspection only • painting (not sanding) • electrical trim work • minor plumbing (in a localised area, for example, patient bathroom) • maintenance activities that do not generate dust or require cutting of walls or access to ceilings other than for visual inspection.
Type 2 – Minor	Small-scale, short duration, maintenance, or renovation activities that create minimal dust. These include but are not limited to: • access to duct spaces • cutting of walls or ceilings where dust migration can be controlled for the installation of minor electrical work or cables • sanding to repair small patches • minor plumbing work in one patient care area (one patient room); for example, disruption to water supply.
Type 3 – Moderate/major	Work that generates a moderate to high level of dust or work that cannot be completed in a single work shift. This includes but is not limited to: • sanding of walls for painting or wall covering • removal of floor coverings and ceiling tiles • plasterwork, duct work or electrical work above ceilings • major plumbing work, for example, interruption of sewerage pipes • removal of fixed building items, for example, countertops, sinks.
Type 4 – Major	Major maintenance, demolition, excavation or construction projects that require consecutive work shifts to complete. These include but are not limited to: • removal of ceiling tiles and ceilings • major plumbing work in clinical common areas or affecting more than two patient rooms • removal of plaster walls, block works, bricks, or mortar • new construction involving large areas of open soil.

Adapted from: Australasian Health Facility Guidelines: Part D – IPC,[155] Accessed June 2019

[155] https://aushfg-prod-com-au.s3.amazonaws.com/Part%20D%20Whole_7_2.pdf

Risk rating matrix

Using a risk rating matrix (see Table 10.3) provides a starting point for development of the required precautions for the scope of the project, including IPC precautions.

Table 10.3. Risk rating matrix – probability of contamination

Areas of vulnerability	Insignificant probability of contamination	Minor probability of contamination	Moderate probability of contamination	Major probability of contamination
Low	Class I	Class II	Class II	Class III
Potential	Class I	Class II	Class III	Class IV
Moderate	Class I	Class II	Class III	Class IV
Highest	Class II	Class III	Class IV	Class IV

Adapted from: Australasian Health Facility Guidelines: Part D- IPC, Accessed June 2019

Description of activities and classification

Describing activities and classification by class provides the project management team and the infection control professional with a guide to risk minimisation based on activity. When utilising the risk rating matrix, it allows the project management team to allocate appropriate resources to the project at the pre-project stage, sustaining this throughout the project and on its completion.

Table 10.4 describes the class of IPC required to minimise the risk of transmission of harmful organisms during various project works.

Table 10.4. Description of activities and classification by class

Class of IPC	Activity conducted during project
Class 1	• Minimise raising or disturbing dust during activity • Vacuum ceiling as tile is being displaced or removed for inspection • Immediately replace ceiling tiles displaced for visual inspection • Vacuum work areas • Minimise patient's exposure to construction/renovation area, and • Ensure construction zone is thoroughly cleaned when work is complete
Class 2	• Restrict access to the work area to essential staff undertaking the activity • Wet mop and/or vacuum to remove visible dust during activity • Use of drop sheets to control dust and airborne infectious agents • Water mist work surfaces while cutting or sawing • Seal windows and unused doors with duct tape • Seal air vents in construction/renovation area • Disable ventilation system until the project is complete • Place dust mat at entrance and exit to work areas • Contain debris in covered containers before transporting for disposal • Wipe horizontal surfaces to keep dust free • Identify high risk patients who may need to be temporarily kept away from construction area • Ensure that patient care equipment and supplies are free from dust exposure, and • Ensure construction zone is thoroughly cleaned when work is complete with wet mop with hot water and detergent and /or vacuum with HEPA filtered vacuum

Class of IPC	Activity conducted during project
Class 3	In addition to measures introduced in Class 1 and 2: • ensure that IPC consultation has been completed and infection prevention measures approved • erect impermeable dust barrier from true ceiling to floor (for example, 2 layers of 6mm plastic sheeting). • ensure windows, doors, plumbing penetrations, electrical outlets and intake and exhaust vents are sealed with plastic and duct-taped • clean and vacuum air ducts and spaces above ceiling as far as accessible, if necessary • ensure construction workers wear protective clothing that is removed before entering patient areas • remove dust barrier carefully to minimise spreading dust and other debris associated with construction • remove debris at the end of each working day • increase frequency of cleaning in areas adjacent to construction zone, and design traffic pattern for construction workers that avoid patient care areas and a traffic pattern for clean or sterile supplies and equipment that avoids the construction area.
Class 4	In addition to measures introduced in Class 1, 2 and 3: • erect an impermeable dust barrier and anteroom with walk off mat into patient care area • check integrity of barriers daily and repair any damage as soon as identified • seal holes, pipes, conduits, and punctures appropriately • ensure negative pressure ventilation systems in construction area is separate to patient care areas by sealing off or redirecting directly to outside. Consider HEPA filtration to redirected air • regularly visit the patient care areas adjacent to the construction zone to ensure preventative measures are effective • use dust monitors in adjacent areas that have been calibrated to the environment.

Adapted from: Australasian Health Facility Guidelines: Part D- IPC, Accessed June 2019

Construction Survey Tool

Below is an example of a construction/ project survey too. This type of tool maybe used for documentation of daily inspection of construction area by Infection Control or delegate.

Construction Area			
Barriers Patient doors adjacent to area closed	Yes	No	N/A
Dust proof plastic sheeting barriers in place and sealed at ceiling height	Yes	No	N/A
Dust proof rigid barrier walls in place and sealed at ceiling height	Yes	No	N/A
Ceiling space sealed within the work area (between the ceiling tiles and the next slab or roof)	Yes	No	N/A
Project Area Debris removed in covered container	Yes	No	
Rubbish in appropriate container	Yes	No	
Entry and exit points clearly identified	Yes	No	
Traffic Control Restricted to construction workers and necessary staff only	Yes	No	
All doors and exits free of debris	Yes	No	
General public and patient access diverted	Yes	No	
Comments			

Roles and responsibilities for planning, consultation, implementation and monitoring of infection prevention activities

Work plans

The project management team should develop a work plan to cover the following points

- planning and consultation
- project design
- education
- isolation
- environmental contamination controls
- waste management
- environmental cleaning

- monitoring activities
- inspections
- laboratory surveillance, and
- air sampling.

Commissioning

The scope and location of the project or activity will determine if these examples for the work plan are relevant for inclusion in the project planning. These need to be determined by the project management team. For More information on risk management and IPC strategies, refer to Australian Healthcare Facility Guidelines (AusHFG), Section D.[156]

Personnel

The following are a list (by no means exclusive) of personnel involved in the project management team:

- architects and builders
- engineering services
- facility administration
- environmental services, and
- IPC.

Table 10.5 is an example of the infection prevention roles and responsibilities that need to be considered during construction and renovation. Responsibilities may vary in different facilities.

Table 10.5. Example of infection prevention roles and responsibilities during construction work

Planning and consultation	**Responsibility**
Infection prevention staff must be consulted, and involvement should be sought at the planning stage to assist with: • education • design of the project to maximise the safety of staff and patients, and • review of the schematic design to ensure all preventative measures to maximise dust control are in place.	Architects/ builders Engineering services IPC service
Project design	**Responsibility**
The IPC service, in collaboration with facility administration and nursing/ medical staff, must identify patient population(s) that may be at risk and the appropriate preventative measures to ensure their safety. This include providing construction/ renovation workers sole access to ensure they avoid patient care areas.	IPC service. Facility administration
Patients who are at increased risk or immunocompromised should be moved to an area away from the work area/ construction zone if the air quality cannot be assured during construction.	IPC service Facility administration
Traffic patterns for construction workers should be established that avoid patient care areas and traffic areas for patient services, for example, food delivery.	Architects/ builders Engineering services IPC service
Management must identify whose responsibility it is to stop construction projects if breaches in preventative measures arise.	Facility administration

[156] http://www.healthfacilityguidelines.com.au/

Planning and consultation	Responsibility
Education	**Responsibility**
All personnel involved in the construction/renovation activity should be educated and trained in the infection prevention measures, methods for dust containment and removal of construction debris should be outlined.	Architects/ builders Engineering services
Dust control – Isolation and ventilation	**Responsibility**
A dust barrier should be created from the floor to the true ceiling and edges sealed. Plastic sheeting can be used for short term dust barriers.	Architects/ builders Engineering services
All potential sources of air leak should be sealed in the work area/ construction zone. Traffic patterns for construction workers should be established that avoid patient care areas.	Architects/ builders Engineering services
If possible, an elevator or staircase should be designated for the sole use of construction workers. The ventilation of the elevator or shaft should not be re-circulated in the facility.	Architects/ builders Engineering services
When major demolition or excavation is undertaken, damping down to limit dust should be considered.	Architects/ builders Engineering services
Open ends of exhaust vents should be capped to prevent air exhausted from the work area/ construction zone from being drawn back into patient care areas or released to outdoor streets around the healthcare facility.	Architects/ builders Engineering services
All windows, doors, vents and other sources of potential air leak should be sealed in the work area/ construction zone.	Architects/ builders Engineering services
The work area/ construction zone should be under negative pressure and all exhausted air should be to the outside of the facility. The exhaust location must not be a risk to other air intakes or external services/ people. Consideration should be given to HEPA filtration for exhausted air from work area.	Architects/ builders Engineering services
Environmental cleaning	**Responsibility**
Areas adjacent to patient areas should be vacuumed with a vacuum fitted with a HEPA filter and damp dusted daily or more frequently if needed.	Environmental services
Waste containment	**Responsibility**
If a dedicated lift/ corridor is not available, then dedicated times should be allocated and cleaning should be completed following these times.	Architects/ builders Engineering services
All waste containers should be covered and all debris removed daily via a dedicated work area/ construction zone access corridor and/ or lift.	Architects/ builders Engineering services
Monitoring – Daily inspection	**Responsibility**
The IPC service should conduct daily inspections of the adjacent patient care areas for breaches in infection prevention measures. The need for additional cleaning of adjacent patient areas should be assessed and confirmation of adequate dust control can be made by air sampling during the highest level of demolition work or during periods of high dust generation.	IPC service

Planning and consultation	Responsibility
Laboratory surveillance	**Responsibility**
A baseline rate of clinical isolates of *Aspergillus* spp. and other significant infectious agents should be established before starting construction/ renovation work. Throughout the project the rate of clinical isolates should be monitored. An increase in the rate should be investigated to determine if associated with the construction/renovation works. All preventative infection measures should be reviewed to ensure that a breach has not occurred, and corrective action should be undertaken immediately.	IPC service
Air sampling	**Responsibility**
Air sampling aims to detect *Aspergillus* spp. Colonies in association with the building works. Sabouraud's dextrose agar (SABG). Sabouraud's agar, a selective inhibitory mould agar (IMA) media for fungi is used for this test to monitor for *Aspergillus* spp.	IPC service

Acronyms and Initialisms

Term	Definition
ABHR	alcohol-based hand rub
AFB	acid-fast bacillus
AGP	aerosol-generating procedure
AMR	antimicrobial resistance
AMS	antimicrobial stewardship
APAS	Australian Passive AMR Surveillance
ARGN	aminoglycoside-resistant gram-negative bacteria
ARTG	Australian Register of Therapeutic Goods
AS	Australian Standard
AS/NZS	Australian Standard/New Zealand Standard
ATP	adenosine triphosphate
AURA	Antimicrobial Use and Resistance in Australia
BBV	bloodborne virus
BFE	bacterial filtration efficiency
BSE	Bovine Spongiform Encephalopathy
CA-MRSA	community-associated methicillin-resistant *staphylococcus aureus*
CDI	*Clostridioides difficile* infection
CDNA	Communicable Diseases Network Australia
CJD	Creutzfeldt-Jacob Disease
CSF	cerebrospinal fluid
CT	computerised tomography
COVID-19	Coronavirus disease 2019
CPE	carbapenemase-producing *Enterobacterales*
DNA	deoxyribonucleic acid
ECG	electrocardiograph
EPA	Environment Protection Agency
ESBL	extended-spectrum beta-lactamase
GAS	Group A beta-haemolytic streptococcus
GISA	glycopeptide-intermediate *S. aureus*
HAI	healthcare-associated infection
HA-MRSA	healthcare-associated methicillin-resistant *staphylococcus aureus*
HBV	hepatitis B virus
HCV	hepatitis C virus
HIV	human immunodeficiency virus
ICU	intensive care unit

Term	Definition
IMA	Inhibitory mould agar
IPC	infection prevention and control
ISO	International Organisation for Standardization
MALDI-TOF	matrix-assisted laser desorption ionisation-time of flight
MERS-CoV	Middle East respiratory syndrome Coronavirus
MRGN	multidrug-resistant gram-negative
MRI	magnetic resonance imaging
MRO	multidrug-resistant organism
MRSA	methicillin-resistant *Staphylococcus aureus*
NHHI	National Hand Hygiene Initiative
NHIG	normal human immunoglobulin
NHSN	National Healthcare Safety Network
NRL	natural rubber latex
NSQHS	National Safety and Quality Health Service
PCR	polymerase chain reaction
PEP	post-exposure prophylaxis
PFR	particulate filter respirator
PPE	personal protective equipment
PrPC	cellular prion protein
RNA	ribonucleic acid
RSV	respiratory syncytial virus
SABG	Sabouraud's dextrose agar
SABSI	*staphylococcus aureus* bloodstream infection
SARS	severe acute respiratory syndrome
SARS-CoV-2/COVID-19	severe acute respiratory syndrome Coronavirus 2
SSI	surgical site infection
SSPE	subacute sclerosing panencephalitis
TB	tuberculosis
TSE	transmissible spongiform encephalopathy
TGA	Therapeutic Goods Administration
vCJD	variant Creutzfeldt-Jakob Disease (mad cow disease)
VRE	vancomycin-resistant *Enterococcus*
VZV	varicella-zoster virus
VISA/VRSA	vancomycin-intermediate/resistant *S. aureus*
ZN	Ziehl-Neelsen

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