AUSTRALIAN COMMISSION
ON SAFETY AND QUALITY IN HEALTH CARE

Infection prevention and control workbook

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Contents

Introduction

The role of the Australian Commission on Safety and Quality in Health Care (the Commission) is to lead and coordinate 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 through the implementation of evidence-based health care.

The online learning modules and this Workbook have been developed to support implementation of the National Safety and Quality Health Service (NSQHS) Standards, particularly the *Preventing and Controlling Infections Standard*, and develop healthcare worker (HCW) knowledge and understanding of the principles of IPC in the Australian healthcare setting. The primary aims of the NSQHS Standards are to protect the public from harm, and to improve the quality of health service provision. The NSQHS Standards provide a quality assurance mechanism that tests whether relevant systems are in place to ensure that expected standards of safety and quality are met. The *Preventing and Controlling Infections Standard* aims to improve IPC measures, prevent healthcare-associated infections (HAIs) and the spread of antimicrobial resistance (AMR), through the appropriate prescribing and use of antimicrobials. All public and private hospitals, day procedure services and public dental practices are required to be accredited to the NSQHS Standards.

The IPC online learning modules can be undertaken individually, or as a suite, dependent on need.

The modules and this Workbook are currently under review. This Workbook complements the modules and will also be progressively updated as the revised modules are; Updated content for Modules 1 (Principles of infection prevention and control) and 2 (Risk management systems of infectious agents and infectious diseases) is included in this version of the Workbook.

The suite of modules includes:

- Principles of infection prevention and control (updated February 2022)
- Risk management of infectious agents and diseases (updated February 2022)
- Basic microbiology and multi-resistant organisms (updated March 2022)
- Cleaning, disinfection and sterilisation
- Infectious agent health screening and immunisation of healthcare workers
- Outbreak investigation and management
- Management of occupational exposure
- Renovation, repairs and redevelopment risk management
- Basic epidemiology and statistics
- Surveillance and quality improvement.

This Workbook provides additional information to enhance the learning experience and should not be used as a standalone resource; each of the IPC modules reference relevant material in this Workbook. The Workbook is not a substitute for national, state, territory or local guidelines and policies, and these resources should always be referred to when implementing any IPC program.

The key resources for the online learning modules and the Workbook are the:

- National Safety and Quality Health Service (NSQHS) Standards https://www.safetyandquality.gov.au/standards/nsqhs-standards/preventing-and-controlling-infections-standard
- Australian Guidelines for the Prevention and Control of Infection in Healthcare (current edition) https://www.safetyandquality.gov.au/publications-and-resources/resource-library/australian-guidelines-prevention-and-control-infection-healthcare.

Module 1: Principles of infection prevention and control

This module provides an understanding of the basic principles of infection prevention and control, providing a framework for further study in infection prevention and control. By completing this module, you will understand:

- How healthcare-associated infections (HAIs) 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.

Everybody working in, and visiting, a healthcare facility including administrators, staff, patients and carers has a role and responsibility in preventing and controlling infection in the healthcare setting.

Healthcare-associated infections are one of the most common complications affecting patients in hospitals. Healthcare-associated infections cause unnecessary complications for patients and their families, and often result in extended hospital stays for the patient. Healthcare-associated infections can occur in many settings, from hospitals to community–based health services. Patients and all members of the health workforce are at risk of acquiring a healthcare-associated infection.

The National Safety and Quality Health Service (NSQHS) *Preventing and Controlling Infections Standard*, 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 infection prevention and control resources.

Colonisation, infection and 'The Chain of Infection'

Most infectious agents are microorganisms. Microorganisms exist naturally in the environment and do not always cause infection (e.g. there are 'good' bacteria, which are present in the body's normal flora that provide protection or other health benefits). Parasites, prions, and several classes of microorganisms, including bacteria, viruses, fungi, and protozoa can be involved in either colonisation or infection, depending on the susceptibility of the host.

Colonisation is the sustained presence of replicating infectious agents on, or in, the body without causing infection or disease. Colonisation is a potential source of transmission to others and may progress to infection.

Infection involves the invasion by, and reproduction of, pathogenic (disease-causing) organisms inside the body.

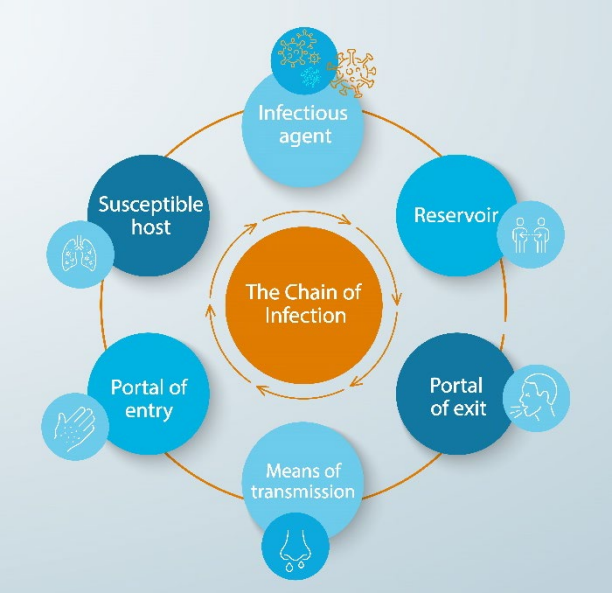
Healthcare-associated infections (HAIs) are infections acquired in health service organisations (also known as 'nosocomial' infections). Some of these infections occur because of healthcare interventions ('iatrogenic' infections). Healthcare-associated infections may manifest after people leave the health service organisation.

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. The Chain of Infection illustrates the interaction between a susceptible host and an infectious agent, leading to the transmission of infection. For transmission of an infectious agent to occur within a healthcare setting, all the following elements are required:

- Infectious agent (pathogen)
- Reservoir
- Portal of exit
- Means of transmission
- Portal of entry
- Susceptible host.

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



Infectious agents are the microorganisms that may be transmitted during health care, such as bacteria, viruses, fungi, and protozoa.

Reservoirs are habitats where microorganisms survive. In the health service organisation, a reservoir may include individuals, contaminated water or food, or a fomite. A fomite is an inanimate object that can carry microorganisms on its surface. In the 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.

The **portal of exit** is 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:

- Coughing or sneezing, via the mouth and nose
- Diarrhoea via the anus
- Blood or pus from a wound site or injury.

The **means of transmission** is the way an infectious agent is transmitted from the reservoir to a susceptible host. Transmission can be via contact, droplet and airborne transmission.

The **portal of entry** refers to the way a pathogen enters a susceptible host. Often, infectious agents use the same portal to enter a new host, that they used to exit the source host. For example:

- Inhalation via nose
- Ingestion via the mouth
- Blood or body fluids exposure via breaks in the skin.

A **susceptible host** is 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 healthcare
- The presence of invasive medical devices (e.g. intravascular cannula, mechanical ventilators)
- Immune status, which is influenced by immunosuppressive therapy or disease, previous exposure, pregnancy, age and vaccination.

Infection prevention and control

Infection prevention and control 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.

Understanding the means of transmission of an infectious agent and knowing how and when to apply the basic principles of infection prevention and control, is critical to preventing and controlling the spread of infection.

Infection prevention and control is integral to clinical care and often requires a range of strategies to be successful. Infection prevention and control is part of, not additional to, standard care. Successful approaches for preventing and reducing harm arising from healthcare-associated infections involve applying a risk management framework to manage 'human' and 'system' factors associated with the transmission of infectious agents. This approach ensures that infectious agents, whether common (e.g. gastrointestinal viruses) or evolving (e.g. influenza or multidrug-resistant organisms), can be managed effectively.

Involving patients and their carers is an essential component of infection prevention and control. Patients need to be sufficiently informed to be able to participate in reducing the risk of transmission of infectious agents. For more information on partnering with consumers, refer to the Partnering with Consumers Standard.

Standard precautions

Standard precautions are work practices that provide a first-line approach to infection prevention and control 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 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. Standard precautions should be used when handling blood (including dried blood), all other body fluids (excluding 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
- The use of appropriate personal protective equipment
- 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.

Actions 3.06 to 3.09 of the National Safety and Quality Health Service (NSQHS) *Preventing and Controlling Infections Standard* require health service organisations to implement practices that support standard and transmission-based precautions.

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 water and either antimicrobial or non-antimicrobial soap, or soap solution.

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. As wet hands can more readily acquire and spread microorganisms, 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.

Alcohol-based hand rubs 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* (previously known as *Clostridium difficile*) and norovirus and other non-enveloped viruses. When caring for patients who have diarrhoea, soap and water should be used for hand hygiene after contact with the patient and their immediate environment.

Even when gloves have been worn, hand hygiene is essential

The National Hand Hygiene Initiative (NHHI)

The Commission established the 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 infection prevention and control education
- Monitoring hand hygiene compliance and performance feedback
- Using hand hygiene programs that ensure culture change.

Standard 3.10 Hand Hygiene of the NSQHS Standards requires that health service organisations have a hand hygiene program incorporated into their overarching infection prevention and control 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 hand hygiene compliance audits, and actions in response to 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.

What are the 5 Moments for Hand Hygiene?

The 5 Moments for Hand Hygiene 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: 5 Moments for Hand Hygiene: Source: The Australian Commission on Safety and Quality in Health Care (accessed Dec 2021)

Moment 1 - Before touching a patient

When: Perform hand hygiene on entering the patient zone before touching the patient.

Why: To protect the patient against acquiring infectious agents from the hands of the healthcare workers.

To prevent: Patient colonisation with infectious agents.

Rationale: Healthcare workers are likely to have potentially infectious agents on their hands. Performing hand hygiene before touching a patient prevents potentially infectious agents being transferred to the patient during patient contact.

Moment 2 - Before a procedure

When: Immediately before a procedure. Once hand hygiene has been performed, the patient's environment should not be touched prior to the procedure starting.

Why: To protect the patient from potential organisms (including their own) from entering their body during a procedure.

To prevent: Endogenous and exogenous infections in patients.

Rationale: Healthcare workers are likely to have potentially infectious agents on their hands or may pick up potentially infectious agents from the patient's skin. Performing hand hygiene immediately before a procedure prevents these microorganisms entering the patient's body during the procedure.

Moment 3 - After a procedure or body fluid exposure

When: Hand hygiene immediately after a procedure or body fluid exposure as hands may be contaminated with body fluid.

Why: To protect the healthcare worker and the healthcare environment from becoming contaminated with potential microorganisms from the patient.

To prevent: 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.

Rationale: After touching a patient the healthcare worker will have the patient's microorganisms on their hands. These microorganisms can be transmitted to the next patient and/or an environmental surface that the healthcare worker touches.

Moment 4 - After touching a patient

When: After touching a patient. Perform hand hygiene before you leave the patient zone.

Why: To protect the healthcare worker and the healthcare environment from becoming contaminated with potentially infectious agents from the patient.

To prevent: Colonisation/infection of the healthcare worker and contamination of the healthcare environment.

Rationale: After touching a patient the healthcare worker will have the patient's microorganisms on their hands. These microorganisms can be transmitted to the next patient and/or an environmental surface that the healthcare worker touches.

Moment 5 - After touching a patient's surroundings

When: 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.

Why: To protect the healthcare worker and the healthcare environment from becoming contaminated with potentially infectious agents from the patient's surroundings.

To prevent: Colonisation/infection of the healthcare worker and contamination of the healthcare environment.

Rationale: After touching a patient the healthcare worker will have the patient's microorganisms on their hands. These microorganisms can be transmitted to the next patient and/or an environmental surface that the healthcare worker touches.

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 (e.g. 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, highly accessible and 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 healthcare-associated infections. Healthcare worker hand hygiene compliance can be monitored using reliable indicators, such as hand hygiene compliance, hand hygiene product placement, product utilisation, patient experience and rates of healthcare-associated infections.

Hand hygiene observational audits are the most common method used to monitor hand hygiene compliance. Hand hygiene observational audits can be used to accurately assess hand hygiene compliance in accordance with published guidelines, using a standardised hand hygiene assessment tool. Information from hand hygiene monitoring can be used to identify where gaps in knowledge or practice exist, and where there may be issues related to access to hand hygiene products or handwashing facilities.

For further information on measuring, monitoring, and improving hand hygiene, refer to the National Hand Hygiene Initiative (NHHI) User Manual.

Personal protective equipment

Personal protective equipment (PPE) refers to a variety of barriers used alone or in combination, to protect mucous membranes, airways, skin, and clothing from contact with infectious agents. Selection of personal protective equipment is based on the type of interaction with a patient, as well as known or possible infectious agents and the likely mean(s) of transmission. Personal protective equipment should always be made available to the healthcare worker at the point of care.

> PPE, when used as part of **standard precautions**, protects against anticipated blood and body fluid exposure.
> When used as part of **transmission–based precautions**, PPE serves as a physical barrier against the specific mean(s) of transmission.

Factors to be considered when selecting PPE are:

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

Selecting personal protective equipment

Aprons and gowns

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

Removing aprons and gowns

Aprons and gowns are single-use and should always be removed immediately after use and before leaving the patient care area. Apron 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/NZS4146 (2000) Laundry Practice.

Table 1 provides information on the characteristics of aprons and gowns suitable for standard and transmission-based precautions.

Table 1: Types of aprons and gowns

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 workers 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 workers arms, volume of body substances likely to be encountered, and the probable presence of an infectious agent and the means of transmission.
Full body gown	When there is a risk of contact with a patient's broken skin, extensive skin to skin contact (e.g. lifting a patient with scabies), or a risk of contact with blood and body fluids which are not contained (e.g. vomiting). When 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 (e.g. 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 • Maybe single-use or reusable

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

Note: Some types of gowns are designed to be re-used. When used, these gowns should beused for one procedure or patient care episode. These gowns need to be laundered or reprocessed according to **AS/NZS4146 (2000)** — Laundry Practice.

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.

Removing face and eye protection

Face shields, protective eyewear and masks should be removed after gloves have been removed, and hand hygiene has been performed. The back of the face shield, protective eyewear or mask should only be touched when removing. The front is considered contaminated and, if reusable, should not be touched with bare hands prior to 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 (ARTGA), or by heat as per Standard AS/NZS 4187: 2014.

Table 2 provides examples of the use of protective eyewear and face shields as part of standard precautions.

Table 2: Types of protective eyewear

Type of care	Examples	Face and eye protection required
Routine care	General examination (e.g. 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: 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.

Considerations when using a surgical mask include:

- Masks should be changed between patients and when they become soiled or wet
- Masks should never be reapplied after they have been removed
- Masks should not be left dangling around the neck
- Touching the front of the mask while wearing it should be avoided
- Hand hygiene should be performed upon touching or discarding a used mask.

Surgical masks are categorised into three types, based on the level of protection provided. Table 3 provides information on these categories and use of surgical masks.

Table 3: Types of surgical masks

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, 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, H_20/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: Australian Guidelines for the Prevention and Control of Infection in Healthcare (2019), Section 3.3

Gloves

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

Gloves should be changed when performing multiple tasks with the same patient. To minimise the transmission of infectious agents, multiple tasks with the same patient should progress from clean to dirty (where possible), with gloves being changed between each task and hand hygiene performed at each glove change.

Removing 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.

Table 4 provide practical information on use the different types of gloves available for use in health service organisations.

Table 4: Types of gloves

Glove	Indication of use	Examples
Non-sterile gloves	• Potential for exposure to blood, body fluids, secretions, and excretions • Contact with mucus membranes	• Venipuncture • Vaginal examination • Dental examination • Emptying of a urinary catheter bag • Naso-gastric aspiration • Management of minor cuts and abrasions
Sterile gloves	• Potential for exposure to blood, body fluids • Contact with susceptible sites or clinical devices where sterile 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 filed
Reusable utility gloves	• Indicated for non-patient-care activities • 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 disinfection patient care equipment • Instrument cleaning in sterilizing services units
Gloves suitable for clinical use		
NRL (latex) gloves	• 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 (e.g. nitrile)	• Procedures involving high-risk exposure to blood-borne viruses where high barrier protection is needed • Suitable alternative to latex if there are no issues with glove fit or sensitivity	

Adapted from: 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 sequence for putting on and removing personal protective equipment as shown in Tables 5 and 6, taking care to perform hand hygiene before putting on personal protective equipment, and between each step when removing personal protective equipment, especially before touching the face.

Table 5: Sequence for putting on personal protective equipment*

	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 • 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 : Australian Guidelines for the Prevention and Control ofInfection in Healthcare, Section 3.3 PPE (2019)

Table 6: Sequence for removing personal protective equipment*

	1. Remove and dispose of gloves
	2. Perform hand hygiene
	3. Remove and dispose of gown
Alternatively gloves and gown can be removed as one step. Then perform hand hygiene	
	4. Remove protective eyewear
	5. Perform hand hygiene
	6. Remove mask and dispose of mask
	7. Perform hand hygiene

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

Respiratory hygiene and cough etiquette

Respiratory hygiene and cough etiquette must always be used as a standard infection prevention and control precaution. Respiratory hygiene and cough etiquette prevents the dispersal of respiratory secretions into the air.

HCWs and visitors who are unwell with respiratory or other infections should not attend a healthcare service whilst symptomatic.

Patients, visitors, and healthcare workers should always:

- Cover the 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 protect patients from healthcare-associated infections and healthcare workers from contact with blood, body fluids and body tissue. Aseptic technique, when performed correctly, 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 (e.g. 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 (e.g. 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.

An **aseptic technique** aims to prevent pathogenic organisms, in sufficient quantities to cause infection, from being introduced into susceptible body sites by the hands of staff, or from surfaces or equipment. Aseptic technique protects patients during invasive clinical procedures by utilising infection prevention and control measures that minimise the presence of microorganisms. Aseptic technique is achievable in clinical and non-clinical settings by applying the five principles of aseptic technique and modifying practice to mitigate infection risks.

A **sterile technique** uses practices that are aimed at preventing the introduction of all microorganisms into a sterile field, on to equipment or into a procedure site. This 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.

Five essential principles of aseptic technique

There are essential principles that should be applied when performing a procedure that requires aseptic technique. These principles are:

1. Sequencing

Sequencing involves a series of actions that ensure 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 prior to starting the procedure. When considering the steps for sequencing, the healthcare worker should consider the following points:

Perform a risk assessment:

- 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?
- Do you know how to perform this procedure?
- What personal protective equipment is needed for the procedure?
- What action is required to mitigate these risks?

Pre-procedure preparation:

- 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.

Performing the procedure:

- Set up the equipment immediately prior to performing the procedure
- Maintain standard precautions
- Perform the procedure in a safe, logical order.

Post procedure practices:

- 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 at the time of the procedure to minimise any infection risks, or if 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, if practical, the removal of the risk factor. These factors include:

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

Where practical, these factors should either be removed (e.g. wait until cleaning has finished, replace damaged equipment), or otherwise controlled, to reduce the risk of contamination and infection transmission.

3. Hand hygiene

Healthcare workers should always follow the 5 Moments for Hand Hygiene 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 prior to the procedure and before performing hand hygiene. If gloves become grossly contaminated or torn during a procedure, the gloves need to 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 (e.g. 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 (e.g. 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 (e.g. a non-touch technique if suitable or sterile gloves if sterile equipment or the procedure site requires handling).

5. Personal protective equipment (PPE)

Personal protective equipment 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 personal protective equipment required (gowns, gloves)?
- What is the correct sequence for putting on and removing personal protective equipment?

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 of time (usually less than 20 minutes). Examples of these procedures 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 of these procedures include:

- Surgery
- Wound debridement
- Vascular access insertions
- Drain insertions
- Catheterisations (urinary, cardiac, or peritoneal dialysis).

The Commission on Safety and Quality in Health Care has resources available to support health service organisations implement the recommendations for aseptic technique from the NSQSH Standards and the Australian Guidelines for the Prevention and Control of infection in Healthcare. These resources are available at: safetyandquality.gov.au/asepticتechnique.

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 and Amendment 1: 1996, AS/NZS 4261: 1994 and Amendment 1: 1997 or relevant international standard e.g. ISO 23907: 2019
- 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.

A systems approach to sharps injury reduction

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

- 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 (e.g. 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 (e.g. sharps disposal containers and passive or active sharps devices engineered to prevent sharps injury)
- Occupational exposure protocols
- Occupational vaccination programs.

Environmental cleaning

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

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; and 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 include:

- Items that are used for more than one patient must be cleaned between patients to reduce the risk of infection transmission (e.g. 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.

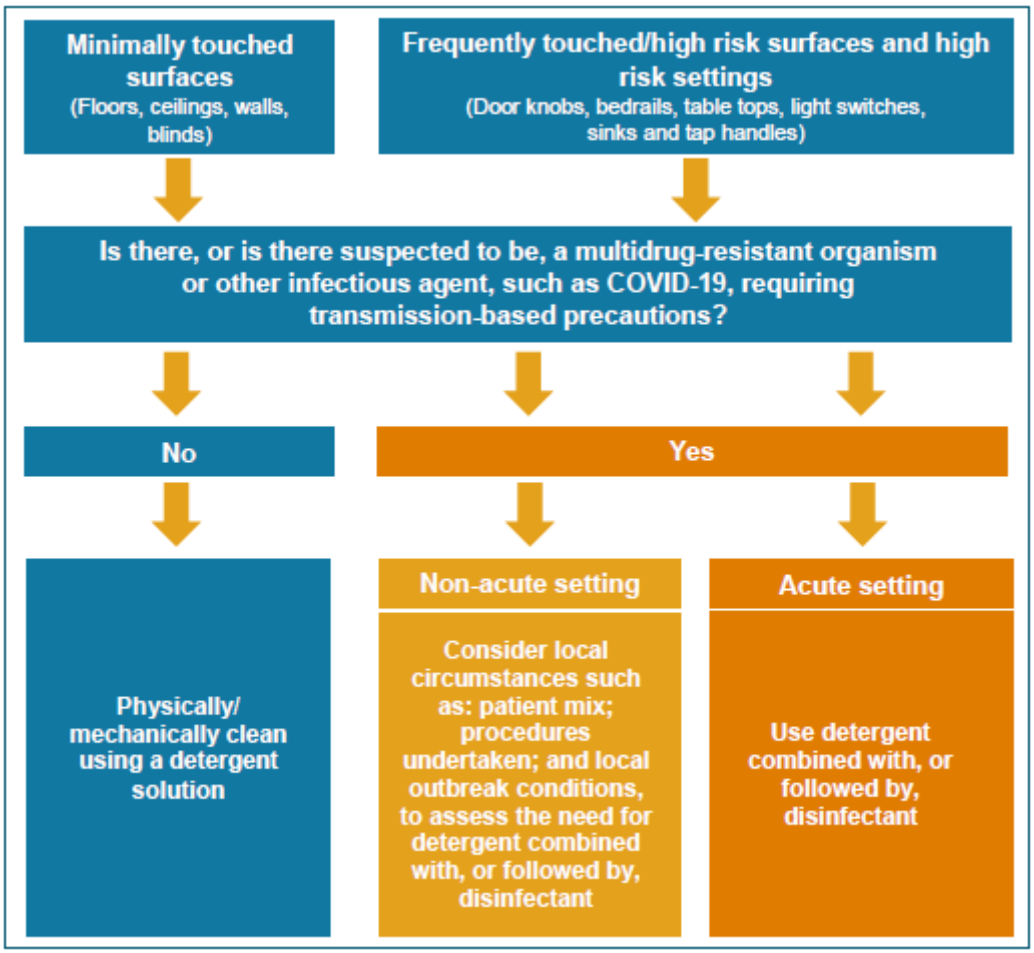
Neutral detergents contain a surfactant that facilitates the removal of dirt and organic matter. A neutral detergent and warm water are suitable for most cleaning processes.

Disinfectants are chemical agents that rapidly kills or inactivates 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). Disinfection should always be undertaken following, and in addition to, 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 2 provides general advice for cleaning product selection.

Figure 2: Cleaning product selection.



* *Principles of Environmental Cleaning: Product Selection*, Australian Commission on Safety and Quality in Healthcare (2020).

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

Management of blood and body fluid spills

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

- A scoop and scraper
- Single-use personal protective equipment 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 personal protective equipment 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

- Using detergent and water, clean the area with disposable cloth or paper towel, dispose of cloth or paper towel into the clinical waste bag
- Remove and dispose of personal protective equipment into the clinical waste bag, dispose of 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.

Further information on environmental cleaning is covered in full detail in the Clean and Safe Environment learning module and chapter of this workbook.

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

- Environmental cleaning practices for small HSOs
- Environmental cleaning: Information for cleaners
- Environmental cleaning: Emerging environmental cleaning technologies
- Principles of environmental cleaning product selection
- Principles of environmental cleaning auditing
- Benefits of environmental cleaning - infographic
- The process and product selection for routine environmental cleaning - flowchart

Reprocessing of reusable medical devices

Any medical device (instruments or equipment) that is to be reused requires reprocessing.
For the purposes of reprocessing, reusable medical devices are categorised as:

- **Critical:** these devices have a high risk for infection if they are contaminated with microorganisms. These devices must be sterile at the time of use. Examples include surgical instruments, intravascular devices, cystoscopes, and bronchoscopes.
- **Semi-critical:** These devices come into contact with mucous membranes or non-intact skin and should be single use or sterilised after each use. If this is not possible, high-level disinfection is the minimum level of reprocessing that is acceptable. Examples include laryngoscope blades, endoscopes, vaginal ultrasound transducers and breast pump accessories.
- **Non-critical:** These devices 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. Examples include 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.

Further information on environmental cleaning is covered in full detail in the Disinfection and sterilisation learning module and chapter of this workbook.

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. Health service organisations should also refer to Standard AS/NZS 3816: 2018 and the Waste Management Association of Australia's industry code of practice.

When handling waste:

- Use standard precautions to protect against exposure to blood and body fluids
- and perform hand hygiene
- 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 health service organisation's waste management plan
- Ensure healthcare workers are trained in the correct procedures for handling waste.

Further information on waste management is covered in full detail in the Clean and Safe Environment module and chapter of this workbook

Handling of linen

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

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:

- Used linen should be handled with care to avoid dispersal of microorganisms into the environment and contact with HCW clothing
- Appropriate personal protective equipment should be worn to prevent exposure of skin and mucous membranes to blood and body substances
- Ensure it is 'bagged' at the location of use into an appropriate laundry receptacle
- 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 health service 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. Health service organisations should have a schedule in place for the cleaning and maintenance of these machines.

Further information on handling linen is covered in full detail in the Clean and Safe Environment module and chapter of this workbook.

Transmission-based precautions

Transmission-based precautions are precautions, 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.

Key elements of transmission-based precautions include:

- Personal protective equipment
- 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 is available for download here.

There are three categories of transmission-based precautions:

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

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 person without a contaminated intermediate object or person. For example, blood or other body substances from an infectious person may come into contact with a mucous membrane or breaks in the skin of another person.

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* (previously known as *Clostridium difficile*)
- Norovirus and other intestinal tract pathogens
- Hepatitis A
- Respiratory syncytial virus (RSV)
- 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:

- Use of appropriate personal protective equipment, such as aprons, gowns, and gloves
- Patient placement (e.g. single room cohorting)
- Minimising patient movement

Use of appropriate personal protective equipment for contact precautions

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. As part of standard precautions, a surgical mask and protective eyewear or face shield must also be worn 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, personal protective equipment must always be changed, and hand hygiene must always be performed.

Patient placement for contact precautions

A single-patient room is recommended for patients who require contact precautions. If a single room is not available, consultation with local infection prevention and control expertise is recommended to assess the risks associated with other patient placement options (e.g. cohorting). A tool to assist in cohorting patients with known or suspected infectious conditions can be found here. If cohorting is required, it is recommended that patient beds are separated by 1.5 metres.

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

Minimising patient movement for contact precautions

Limiting the movement of a patient on contact precautions reduces the risk of environmental contamination. If transfer within or between health service 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 prior to the transfer.

Droplet precautions

Droplet precautions prevent transmission of infectious agents spread through respiratory droplets (i.e. 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)
- Rubella (German measles)
- Parainfluenza
- Adenovirus
- Rhinovirus
- Group A Streptococcal species.

The key elements of applying droplet precautions are:

- Use of appropriate personal protective equipment (surgical mask always required, apron, gown, gloves, and protective eyewear as appropriate)
- Patient placement
- Minimising patient transfer or transport.

Use of appropriate personal protective equipment for droplet precautions

Surgical masks that meet Australian Standards 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, personal protective equipment must always be changed, and hand hygiene must always be performed.

Patient placement for droplet precautions

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
- Placing masks on coughing patients 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 (e.g. immunocompromised, prolonged lengths of stay, cystic fibrosis, cardiac conditions, or muscular dystrophy)

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

Patient transfer for droplet precautions

Limiting the transfer of a patient on droplet precautions reduces the risk of transmission.
If transfer within, or between health service 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 prior to the transfer.

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
- 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 personal protective equipment, particularly correctly fitted particulate filter respirators (PFRs), such as P2 and N95
- Patient placement (e.g. use of negative pressure rooms)
- Minimising patient movement.

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

Use of appropriate personal protective equipment for airborne precautions

A particulate filter respirator should be worn 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 7 provide information on the characteristics of P2 and N95 respirators.

When moving between patients, personal protective equipment must always be changed, and hand hygiene must always be performed.

Fit testing

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 commencement 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 recommends annual fit testing). Standard AS/NZS 1715: 2009 outlines the method by which fit testing is conducted.

Table 7: Characteristics of P2 and N95 respirators*

	P2 respirator	N95 respirator
Characteristics	• 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 P2 particulate filtering respirators/masks must have a filter efficiency of at least 94% when tested with NaCl aerosol at a flow rate of 95 L/min. Under the EN system, aerosol testing is similar to **Standard AS/NZS 1716: 2012**, but have additional filter efficiency testing with paraffin oil aerosol that must also meet the minimum 94% filter efficiency to be classified as P2. The particle size of this aerosol has a mass median diameter of 0.3 to 0.6 microns with a range of particles in the 0.02 to 2-micron size range.	• 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 NIOSH classified N95 particulate filtering respirators/masks must have a filter efficiency of at least 95% when tested with NaCl aerosol at a flow rate of 85 L/min. N95 respirator masks can only be used for oil free aerosols. The particle size of this aerosol ~0.3micron.

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

Fit checking

Health service organisations should provide healthcare workers with information and training on how to perform a fit check, and the manufacturer's instructions for fit checking of individual brands and types of particulate filter respirators should be referred to at all times

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

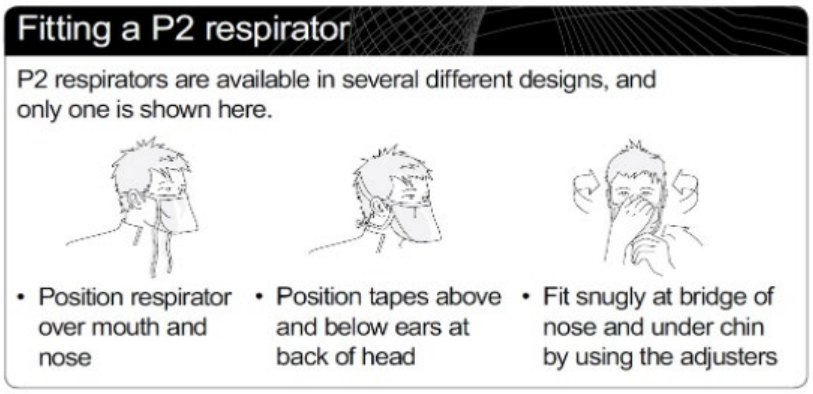
1. Place the particulate filter respirator on the face
2. Place the headband or ties over the head and at the base of the neck

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 wearers face.

HCWs who have facial hair (including a 1–2 day beard growth) must be aware that an adequate seal cannot be guaranteed between the particulate filter respirators and the wearer's face.
Figures 3 and 4 demonstrate the correct way for fit checking and removing a particulate filter respirator.

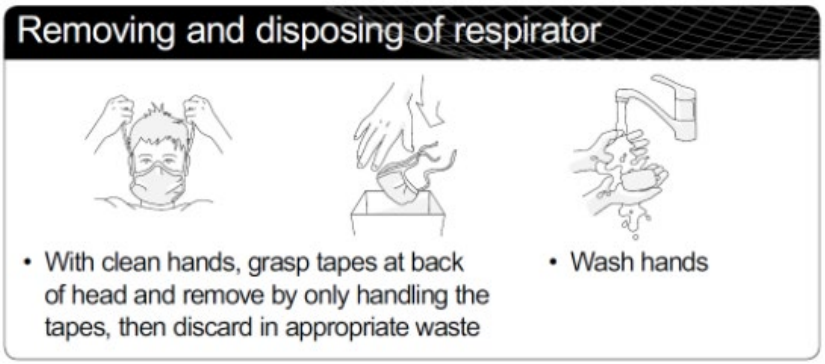
Additional information on suitable masks for airborne precautions and fit testing and checking can be found in The Australian Guidelines for the Prevention and Control of Infection in Healthcare.

Figure 3: Fitting a particulate filter respirator



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

Figure 4: Removing and disposing of a particulate filter respirator



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

Patient placement for airborne precautions

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 cohorted 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, personal protective equipment must always be changed, and hand hygiene must always be performed.

Minimising patient movement for airborne precautions

Limiting movement of a patient on airborne precautions reduces the risk of transmission.
If transfer of 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 (e.g. chickenpox [varicella]). If the patient is a child, their oxygen saturation should be monitored whilst they are wearing a surgical mask.

Both the transferring and receiving organisations must be made aware of the precautions required prior to the transfer.

Other strategies used for infection prevention and control

Invasive medical devices

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

- Catheters inserted for drainage (e.g. urinary catheters)
- Catheters for intravascular access (e.g. peripheral intravenous catheters, peripherally inserted central venous catheters, central venous catheters)
- Devices for mechanical ventilation (e.g. intubation)
- Devices for feeding (e.g. enteral feeding tubes).

Key concepts for managing invasive devices

Health service organisation should have processes in place for:

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

Prior to 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 (e.g. normal saline, chlorhexidine)
- Adherence to the 5 Moments for Hand Hygiene
- The use of appropriate personal protective equipment (e.g. 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. To minimise the dwell time of an invasive medical device:

- Health service 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.

Information on the management of sharps injuries is covered in full detail in the Management of occupational exposure chapter of this workbook

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.

Antimicrobial resistance

Antimicrobial resistance (AMR) is recognised as a significant global health priority. Resistance to antimicrobials is commonly found in Australian hospitals and increasingly so 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 demonstrated through the National Antimicrobial Prescribing Survey.

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 personal protective equipment, single room accommodation, single use patient equipment, and additional cleaning resource
- Extended length of hospital admission, invasive treatments, further antimicrobial use, and potentially long-term health complications for the patient.

Infection prevention and control 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 (e.g. some strains of influenza) as well.

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 could also include:

- Identifying high risk settings and patients for multidrug-resistant organism acquisition (e.g. 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 multidrug-resistant organisms results
- Decolonisation programs, such as whole-body washes (using chlorhexidine) or topically applied antimicrobial agents and/or orally administered antimicrobials
- Multidrug-resistant organism 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. Antimicrobial stewardship is conducted at all levels of the healthcare system, from local hospitals and general practices to national programs, with the intent of improving the safety and appropriateness of use; maximising the benefit of antimicrobials; reducing patient harm; and preventing and containing antimicrobial resistance in Australia.

Actions 3.18 and 3.19 of the National Safety and Quality Health Service *Preventing and Controlling Infections Standard* require all health service organisations to have systems in place for the safe and appropriate prescribing and use of antimicrobials, and describes the elements necessary to support an effective AMS program.

Antimicrobial stewardship programs should include:

- Local antimicrobial stewardship policies and procedures which implement clinical guidelines consistent with Therapeutic Guidelines: Antibiotic
- 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, antimicrobial stewardship 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).

Some key point 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?

The Commission has produced a range of resources to support health service organisations implement antimicrobial stewardship program. These resources can be found on the Antimicrobial Stewardship web page, including:

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

Module 2: Risk management of infectious agents and diseases

This Workbook is designed to complement the learning module you are currently undertaking.
Module 2 has been developed to provide you with an understanding of how to use risk management systems to help minimise the risk of transmission of infectious agents in health service organisations. Many of the infectious agents covered in this module are classified as notifiable diseases. You should refer to your local state or territory guidelines for more information on 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
- Be able to apply risk management strategies to assist in reducing the transmission of infectious diseases
- Understand how the means of transmission of an infectious agent relates to standard and transmission-based precautions, and other infection prevention and control strategies, which can be used to limit the spread of infection.

Health service 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, which sets the framework for infection prevention and control in health service organisations.

Further information on risk assessment can be found in the Australian Guidelines for the Prevention and Control of Infection in Healthcare.

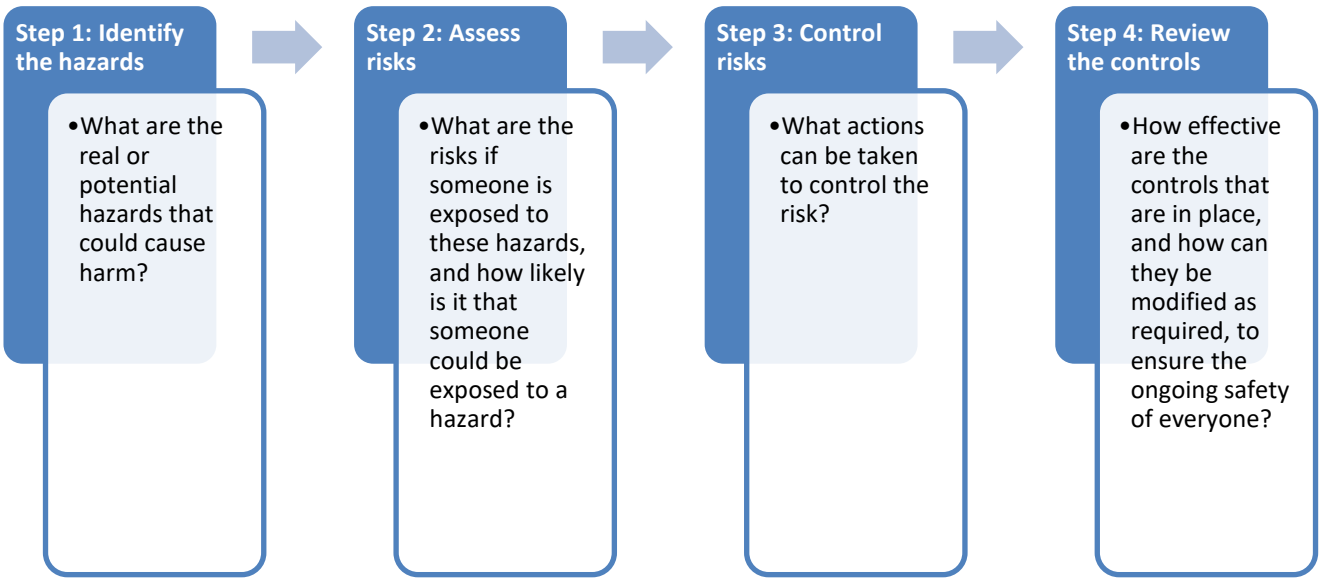
Risk management and the hierarchy of controls

What is risk management?

Risk assessment and management are ongoing and proactive process aimed at identifying and responding to risks which impact on infection prevention and control. The Work Health and Safety Act 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 (i.e. what can be done and what is possible in the circumstances, for ensuring health and safety, and continuity of health service delivery).
The following are key concepts used in risk management:

- **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:



Risk management and infection prevention and control

In the context of infection prevention and control:

- The microorganisms that may colonise or infect patients, healthcare workers or visitors are the **hazards**
- Healthcare-associated infections (HAIs), occupational exposures and sharps injuries are examples of the **risks.**
- The elements of standard and transmission-based precautions are the **controls**.

Risk management is the basis for preventing and reducing harm arising from healthcare- associated infection. A successful approach to risk management occurs on many levels within a healthcare facility, such as:

- 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 (e.g. hand hygiene or respirator fit testing).

All health service 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 health service organisations to regularly conduct infection prevention risk assessments and ensure that all staff understand their responsibility in managing these risks.

The hierarchy of controls

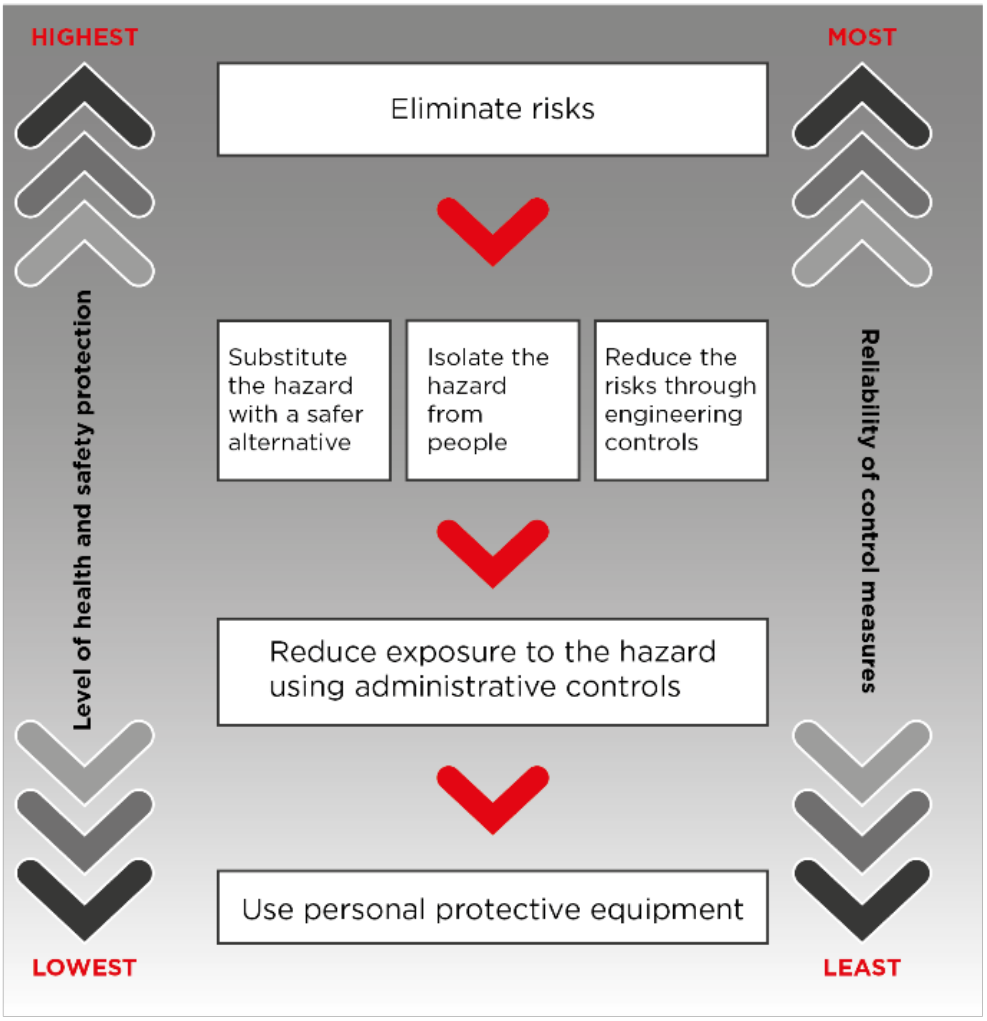
Actions 3.02a and 3.07b of the NSQHS Standards, require all health service organisations to establish multidisciplinary teams to identify and manage risks associated with infections, using the hierarchy of controls, in conjunction with infection prevention and control systems.
The hierarchy of controls (Figure 1) 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 infection prevention and control systems, supports the design of infection prevention and control 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 using one or a combination of controls, such as:

- Substitution
- Isolation
- Engineering controls
- Administrative controls
- Personal protective equipment.

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

Figure 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.

Applying the hierarchy of controls

Some examples relevant to each of the controls for infection prevention and control programs are provided below. More information is available in the Commission's fact sheet *Role of the hierarchy of controls in identification and management of infection risks*.

Specific guidance has also been developed for COVID-19.

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 health service organisation.

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 infection prevention and control strategies
- Organisational compliance with the current version of the Australian Guidelines for the Prevention and Control of Infection.
- Provision of training in infection prevention and control practices to all healthcare workers
- Provision of a risk-based workforce vaccine-preventable diseases screening and immunisation program, consistent with the current edition of the Australian Immunisation Handbook and current jurisdictional requirements. Further information is also provided in the Commission's document NSQHS Standards Workforce Immunisation Risk Matrix.

Use personal protective equipment (PPE)

The effectiveness of personal protective equipment in reducing the risk of infection depends on access to appropriate personal protective equipment, correct use, and complementary substitution, administrative and engineering controls. The use of personal protective equipment includes:

- Access to a sufficient supply of a range of sizes and types of personal protective equipment relevant to the infection risks in the healthcare setting
- Training programs regarding correct use of personal protective equipment (such as putting on, removal and disposal), and competency assessment
- Fit checking and fit testing protocols for particulate filter respirators (e.g. P2/N95).

Risk management in infection prevention and control programs

The NSQHS Standards require health service organisations to use evidence-based systems to mitigate the risk of infection. Infection prevention and control 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 infection prevention and control program need to address risk management in relation to the following.

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.

Points to consider when assessing infection risk in relation to a patient include:

- The patient's history, including underlying health conditions (e.g. recent surgery, overseas travel, immunosuppression)?
- Checking if the patient has symptoms that suggest they may have an infection
- Are other patients, healthcare workers or visitors at risk of infection (e.g. 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)?
- Processes for communicating relevant details of a patients' infectious status if care is transferred between clinicians or health service 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, the design and structure, the ease with which the space can be cleaned, the volume of patient care activity and the type of equipment used for patient care.

Points to consider when assessing infection risk in relation to the clinical environment:

- 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 personal protective equipment, and infection prevention and control?
- What environmental cleaning solutions are available?
- Are their local issues that might increase the risk of infection such as building renovations or outbreaks?

The Australasian Health Facility Guidelines (AusHFG) provide information to assist health service organisations plan the design of health facilities.
The Commission has developed environmental cleaning resources that provide more information on risk management for the clinical environment.
Further information on risk management of the clinical environment is covered in full detail in the *Clean and safe healthcare environment* and the *Renovation, repairs and redevelopment risk management* chapters of this workbook.

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. Healthcare workers may also put patients at risk of infection if they have an infectious condition.
Points to consider when assessing infection risk in relation to healthcare workers:

- 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 infection, during their work? Further information is provided in the Commission's document NSQHS Standards Workforce Immunisation Risk Matrix

- Does the organisation have appropriate training in place?
- Is a range of personal protective equipment available and easily accessible?
- Does the organisation provide suitable personal protective equipment for different tasks and different roles (e.g. 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 in accordance with the Australian National Guidelines for the Management of Health Care Workers known to be infected with blood-borne viruses 2018 and/or 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 for infection risk in the delivery of health care.

Points to consider when assessing infection risk in relation to delivery of health care:

- What type of activity is being performed (e.g. invasive procedure, wound dressing, personal care)?
- Where is the care being delivered (e.g. 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 (e.g. cleaning, emergency responses)?
- What resources are available for the activity (e.g. appropriate PPE, condition of the equipment)?
- What actions can be taken to reduce the risk of infection transmission during the activity (e.g. aseptic technique, patient placement, transmission-based precautions).

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

- Aseptic technique
- NSQHS Standards workforce immunisation risk matrix
- Ensuring appropriate patient placement
- Environmental cleaning.

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 for the development of equipment and medical devices can improve patient care and procedures and create new challenges.

Cleaning solutions currently in use within a health service organisation may not be appropriate for new devices. Some technologies require specialised servicing and maintenance, whilst others require staff to undergo specialised training and accreditation to use the device to perform a procedure. Existing equipment and medical devices may also become damaged over time or be difficult to clean. These factors can potentially increase the risk of infection transmission, if not managed or planned for.
Points to consider when assessing infection risk in relation to clinical equipment include:

- 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 medical and patient care equipment?
- How are equipment, stock and reusable medical devices stored?
- Do current reprocessing practices comply with Australian Standards AS/NZS 4187: 2014 and AS/NZS 4815 for reprocessing?

Visitors and carers

Visitors and carers can also be at risk of infection as well as a potential infection risk to others.
Visitors and carers may be involved in patient care and should be informed about basic infection prevention and control 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.
Points to consider when assessing infection risk in relation to visitors and carers include:

- 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 infection prevention and control 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?

Risk management for specific infectious agents and diseases

This section provides guidance in relation to risk management, infection prevention and control precautions, and patient placement for a series of infectious agents, that align with the content in the module.
Patient placement is an important element of infection prevention and control precautions, along with the use of dedicated equipment, the use of appropriate PPE, and effective environmental cleaning.
The Commission has developed Ensuring Appropriate Patient Placement as a guide to support healthcare workers in the appropriate bed allocation, particularly in circumstances when infection prevention and control advice is not readily available.

Standardised infection control signage (posters) complements appropriate patient placement by increasing the awareness of healthcare workers, patients and visitors to the precautions required to minimise the risk of transmission of infectious agents. Signage is available on the Commission's website. Some states and territories have also developed this type of signage which can be accessed by visiting state and territory health department websites.

The content of the following tables has been collated from:

- The Australian Guidelines for the Prevention and Control of Infection in Healthcare (current edition)
- Australian Government Department of Health
- Centers for Disease Control and Prevention

Communicable Diseases Network Australia (CDNA) has developed the Series of National Guidelines (SoNGs) to provide nationally consistent advice and guidance to public health units, in responding to a notifiable disease event.

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Clostridioides difficile

Disease or infectious agent	Symptoms, diagnosis, and treatment	Means of transmission	infection prevention and control precautions on clinical suspicion	Other strategies
Clostridioides difficile is a toxin and spore forming bacteria, that causes severe gastrointestinal infection and pseudomembranous colitis Approximately 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. Emergence of a hyper-virulent strain has been identified. Infants can carry without having disease.	Symptoms include: • 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 is made by: • Faecal, rectal swab or intestinal contents testing. Treatment consists of: • Appropriate antimicrobial therapy.	**Direct contact** with contaminated surfaces and equipment. Transmitted in faeces.	**Standard and contact precautions,** including isolation in single room with dedicated ensuite, where available. **Contact precautions** for a minimum of 48 hours after the resolution of symptoms	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 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. Further information on the Commission's work on *Clostridioides difficile* can be found here.

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Creutzfeldt-Jacob Disease (CJD)

Disease or infectious agent	Symptoms, diagnosis, and treatment	Means of transmission	Infection prevention and control precautions on clinical suspicion	Other strategies
Caused by protein-based, transmissible agents known as prions, that accumulate in brain and neural cells. Causes rare chronic encephalopathy and associated dementia leading to death. Prions cannot be cultured and do not trigger an immune response. Resistant to heat, chemicals, and irradiation. Long incubation period of many years Once signs appear, deterioration is progressive and rapid.	Symptoms include: • Personality changes • Memory loss • Impaired thinking • Blurred vision or blindness • Insomnia • Incoordination • Difficulty speaking • Dysphagia • Myoclonus. Diagnosis is made by: • Medical and personal history • Neurological exam • Certain diagnostic tests such as, CSF testing for protein markers • Brain biopsy. No treatment available. Death usually occurs within 1 year of onset of symptoms.	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).	**Standard precautions**	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.

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Gastroenteritis

Disease or infectious agent	Symptoms, diagnosis, and treatment	Means of transmission	Infection prevention and control precautions on clinical suspicion	Other strategies
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 include: • Diarrhoea • Nausea and vomiting • Abdominal pain. Diagnosis requires either: • Two or more loose/watery stools more than what is 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 nausea, vomiting, abdominal pain, diarrhoea. Treatment consists of: • Appropriate antimicrobial therapy for bacterial and protozoan infections • No specific treatment for viral infections.	Faecal-oral route from contaminated food, fluid or hands, and contaminated surfaces Transmission can also occur through aerosolisation of droplets of vomit or diarrhoea.	**Contact precautions** for duration of illness in most infections. **Contact precautions** until 24 hours after symptoms have ceased for *Salmonella* spp., Campylobacter, Shigella, Cholera. **Contact precautions** for a minimum of 48 hours after the resolution of symptoms or to control institutional outbreaks for norovirus. In some situations, such as during an outbreak, **droplet precautions** are also required.	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.

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Group A beta-haemolytic *streptococcus* (GAS)

Disease or infectious agent	Symptoms, diagnosis, and treatment	Means of transmission	Infection prevention and control precautions on clinical suspicion	Other strategies
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 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 is made by: • Throat swab • Swab of fluid in blisters • Blood culture. Treatment consists of: • Appropriate antimicrobial therapy.	Person to person by **contact** and **droplet** transmission (saliva and respiratory secretions).	**Contact and droplet precautions** until the first 24 hours of antimicrobial therapy is complete. **Standard precautions** thereafter.	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.

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Hepatitis A

Disease or infectious agent	Symptoms, diagnosis, and treatment	Means of transmission	Infection prevention and control precautions on clinical suspicion	Other strategies
Hepatitis A virus is a non-enveloped RNA virus classified as apicornavirus. 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. Often associated with community outbreaks, e.g. 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.	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 is made by: • Medical history • Blood test. No specific treatment. Treatment consists of: • Rest • Adequate nutrition • Fluids.	Faecal-oral route, either by person-to- person **contact** or ingestion of contaminated food/water.	**Standard precautions** Addition of **contact precautions**, for incontinent persons for the duration of illness.	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

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Hepatitis B

Disease or infectious agent	Symptoms, diagnosis, and treatment	Means of transmission	Infection prevention and control precautions on clinical suspicion	Other strategies
Hepatitis B virus is an enveloped DNA virus belonging to the family Hepadnaviridae. Causes liver inflammation which can be acute or become chronic. Complications include cirrhosis of liver, hepatocellular carcinoma and death. Chronic hepatitis B infection occurs more commonly 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.	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 is made by: • Medical history • Blood test. No specific treatment. Management consists of: • Rest • Adequate nutrition • Fluids • Antiviral medication in some instances.	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.	**Standard precautions**	Transmission can be further reduced by: • Screening and vaccination for all healthcare workers and laboratory staff • An effective occupational exposure protocol for bloodborne viruses • 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.

AUSTRALIAN COMMISSION ON SAFETY AND QUALITY IN HEALTH CARE

Hepatitis C

Disease or infectious agent	Symptoms, diagnosis, and treatment	Means of transmission	Infection prevention and control precautions on clinical suspicion	Other strategies
Hepatitis C virus is a small, enveloped RNA virus belonging to the family Flaviviridae. Causes liver inflammation which can be acute or become chronic. Complications include cirrhosis of liver, hepatocellular carcinoma and death. Incubation period 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.	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 is made by: • Medical history • Blood test. Treatment consists of: • Appropriate antiviral therapy.	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 (e.g. injecting drug users, persons with haemophilia). International reports of transmission via contaminated blood products.	**Standard precautions**	Transmission can be further reduced by: • Screening and vaccination for healthcare workers and laboratory staff • An effective occupational exposure protocol for bloodborne viruses • 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.

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Impetigo

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

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Influenza (seasonal)

Disease or infectious agent	Symptoms, diagnosis, and treatment	Means of transmission	Infection prevention and control precautions on clinical suspicion	Other strategies
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/Territory guidelines for further 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 include: • Fever • Malaise • Headache • Cough • Sore throat • Myalgia • Vomiting and diarrhoea in children. Diagnosis made by: • Nose and/or throat swab. Treatment consists of: • Anti-viral medications should be considered for treatment if identified early.	**Direct and indirect contac**t and **droplet transmission.**	**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 or patients in intensive care. **Standard precautions** thereafter.	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.

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Legionnaires' disease

Disease or infectious agent	Symptoms, diagnosis, and treatment	Means of transmission	Infection prevention and control precautions on clinical suspicion	Other strategies
Severe bacterial lung infection caused by either *Legionella pneumophila or Legionella longbeachae.* *Legionella pneumophila* most often associated with water from water supply (hot, warm or cold) or from cooling towers for air-conditioning units. *Legionella longbeachae* most often associated with potting mixes or soil.	Symptoms include: • 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 is made by: • History of possible exposure • Culture of blood, urine and/or sputum. Treatment consists of: • Appropriate antimicrobial therapy.	Not transmitted from person-to-person. Infection caused by inhaling bacteria from soil or water.	**Standard precautions** for the duration of admission.	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, thermal mixing valves etc. • Avoiding the use of tap water in respiratory therapy devices, such as nebulisers. See Legionellosis - CDNA National Guidelines for Public Health Units.

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Measles (rubeola)

Disease or infectious agent	Symptoms, diagnosis, and treatment	Means of transmission	Infection prevention and control precautions on clinical suspicion	Other strategies
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 includingotitis media, pneumonia and encephalitis. Rarely, subacute sclerosing panencephalitis (SSPE) can occur and can lead to death.	Symptoms include: • Prodrome of malaise, cough, coryza, and conjunctivitis • Maculopapular rash that spreads from the head, to the trunk, to the lower extremities • Fever. Diagnosis made by: • Clinical symptomology • Throat swab • Urine test • Blood test. No specific treatment. Management consists of: • Rest • Adequate nutrition • Fluids. Appropriate antimicrobial therapy may be required if otitis media or bacterial pneumonia develop.	**Airborne transmission** (saliva and respiratory secretions).	**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.	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.

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Meningococcal disease

Disease or infectious agent	Symptoms, diagnosis, and treatment	Means of transmission	Infection prevention and control precautions on clinical suspicion	Other strategies
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 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 made by: • Clinical symptomology • Culturing of blood or cerebral spinal fluid. Treatment consists of: • Urgent appropriate antimicrobial therapy.	**Droplet transmission** (saliva and respiratory secretions).	**Droplet precautions** until the first 24 hours of antimicrobial therapy is complete. **Standard precautions** thereafter.	Transmission can be further reduced by: • Healthcare worker education regarding the identification of disease • Vaccination • Contact tracing and prophylaxis for close contacts • Patient and carer education. Immunisation considered with some healthcare worker groups e.g. 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 prior to droplet precautions being implemented. Colonised individuals usually not treated with antibiotics. See Invasive Meningococcal Disease - CDNA National Guidelines for Public Health Units.

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Mumps

Disease or infectious agent	Symptoms, diagnosis, and treatment	Means of transmission	Infection prevention and control precautions on clinical suspicion	Other strategies
Acute viral infection caused by an enveloped virus which is a member of the Paramyxovirus family. Incubation period is usually12-25 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. Unimmunised people have the highest risk.	Symptoms include: • Fever • Swelling of the parotid glands (usually unilateral) • Headache • Fatigue • Myalgia • Loss of appetite • Pain on chewing or swallowing. Diagnosis made by: • Clinical symptomology • Throat swab • Urine test • Blood test. No specific treatment. Management consists of: • Rest • Adequate nutrition • Fluids.	**Contact and droplet** (respiratory secretions)	**Standard and droplet precautions** until 5 days after onset of parotid gland swelling. Exposed non-immune people should be considered infectious from 12th-25th day after exposure, with or without symptoms.	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.

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Novel respiratory viruses

Disease or infectious agent	Symptoms, diagnosis, and treatment	Means of transmission	Infection prevention and control precautions on clinical suspicion	Other strategies
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.	Early symptoms include: • Runny nose • Low-grade fever (generally minimal throughout the course of the disease) • Mild, occasional cough • Apnoea in infants. Diagnosis made by: • Clinical symptomology • Physical examination • Throat swab culture • Blood test. Treatment consists of: • Antiviral treatment • Symptom support/ hydration, respiratory support	**Contact**, **droplet** and **airborne** transmission.	Combined **contact** and **airborne precautions**, noting that these precautions in combination, provide adequate protection against droplet transmission.	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.

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Pertussis (whooping cough)

Disease or infectious agent	Symptoms, diagnosis, and treatment	Means of transmission	Infection prevention and control precautions on clinical suspicion	Other strategies
Highly infectious respiratory tract infection caused by the bacterium *Bordetella pertussis.* Most at risk population is infants < 6months 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.	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 made by: • Clinical symptomology • Physical examination • Throat swab culture • Blood test. Treatment consists of: • Appropriate antimicrobial therapy.	**Droplet transmission** (saliva and respiratory secretions).	**Droplet precautions until at least 5 days** after commencement of appropriate antimicrobial therapy, or for 21 days after the onset of symptoms if not receiving antimicrobial treatment, or for 14 days after the onset of paroxysmal cough (if the onset is known) **Standard precautions** thereafter.	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.

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Respiratory syncytial virus (RSV), parainfluenza and adenovirus

Disease or infectious agent	Symptoms, diagnosis, and treatment	Means of transmission	Infection prevention and control precautions on clinical suspicion	Other strategies
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.	Early symptoms include: • Runny nose • Fever • Decreased appetite • Cough • Sneezing • Wheezing • Dyspnoea. Diagnosis made by: • Nasal aspirate. No specific treatment. Management consists of: • Rest • Adequate nutrition • Fluids.	**Direct and indirect contact** and **droplet transmission.**	**Contact and droplet precautions,** including placement in a single room if available for the duration of illness.	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.

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Rubella (German measles)

Disease or infectious agent	Symptoms, diagnosis, and treatment	Means of transmission	Infection prevention and control precautions on clinical suspicion	Other strategies
Rubella is caused by an enveloped, positive stranded RNA classified as a Rubivirus in the Matonaviridae family Usually a mild, and 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 include: • Lymphadenopathy • Maculopapular rash that spreads from the head, to the trunk, to the lower extremities • Fever. Diagnosis made by: • Clinical symptomology • Throat swab • Urine test • Blood test. No specific treatment. Management consists of: • Rest • Adequate nutrition • Fluids.	**Contact and droplet transmission** (saliva and respiratory secretions).	**Contact and droplet precautions** for the duration of illness in immunocompromised patients **Standard precautions** thereafter.	Transmission can be further reduced by: • Preventing susceptible healthcare workers from caring for patients (e.g. pregnant women) • Screening and vaccination in line with national, state or territory requirements • Patient and carer education on how to reduce transmission.

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Tuberculosis (TB)

Disease or infectious agent	Symptoms, diagnosis, and treatment	Means of transmission	Infection prevention and control precautions on clinical suspicion	Other strategies
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 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 made by: • Medical history and potential risk of exposure • Chest x-ray for evidence of pulmonary infection • Blood and sputum cultures. Treatment consists of: • Combined multi-drug therapy, usually a combination of four agents administered concurrently over a prolonged period (usually at least six months).	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.	**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.	Transmission can be further reduced by: • Patient education regarding the disease and the application of airborne precautions for themselves and others. See CDNA National Guidelines for Public Health Units - Management of TB.

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Varicella (chickenpox)

Disease or infectious agent	Symptoms, diagnosis, and treatment	Means of transmission	Infection prevention and control precautions on clinical suspicion	Other strategies
Highly contagious infection caused by an enveloped virus known as varicella-zoster virus (VZV), which is a member of the herpes virus family. Highly contagious and can cause severe disease in adults, particularly in pregnant women and those who are immunocompromised. Average incubation period 14 to 16 days after exposure, with a range of 10 to 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 include: • Fever • Headache • Malaise • Vesicular rash. Diagnosis made by: • Clinical symptomology • Blood test • Culture of fluid from lesion. Management consists of: • Antiviral therapy in some cases • Rest • Adequate nutrition • Fluids.	**Airborne** transmission, as well as via **direct contact** with fluid from lesions and nasopharyngeal secretions.	**Airborne and contact precautions,** including placement in a negative pressure room if available, until all lesions are dry and crusted **Standard precautions** thereafter.	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.

Module 3 Basic microbiology and multidrug-resistant organisms (MRO)

The online module provides:

- Description of the normal flora and where they are found
- An understanding of environmental contaminants
- Understanding of how a virus differs from bacteria
- Understand the principles of basic bacterial staining, and
- Information on multidrug-resistant organisms (MROs), specifically Gram-positive bacteria: including MRSA, VRE and *C.difficile*, and Gram- negative bacteria: including ESBL and carbapenem-producing bacteria.

Basic microbiology

Terminology

The following table provides explanation of terms utilised in this module and terms that an ICP should be aware of to ensure they have an understanding of this topic.

Carrier	Person that harbours and has the ability to continuously shed ortransmit an infection without showing any symptoms of the disease, e.g. Methicillin Resistant *Staphylococcus aureus* (MRSA) and Hepatitis B
Colonisation	Microorganisms which normally inhabit and reproduce in or on thehuman body without causing disease. Some of these organisms are also identified as pathogens, such as *S. aureus,* which can be carried on the skin without causing disease, but if it is provided with an entry point or suitable environment can be pathogenic (disease/infection producing). There are many health factors that can provide protection against infection by these colonising pathogens.
Disease	Harmful alteration in the physiological or metabolicstate of the host, e.g. pulmonary tuberculosis
Endemic	Always present in a given population, e.g. *Streptococcus sp.*
Endogenous infection	Infection caused by organisms from the hosts own body, e.g. *Streptococcus sp.*
Epidemic	A sudden rapid rise in a disease in a given population or area, e.g. H1N1 influenza
Erythema	Reddened skin, usually due to inflammation
Exogenous infection	Infection caused by organisms external to the host, e.g. *Pseudomonas aeruginosa*
Host	Human, or other providing a home for the organism
Iatrogenic infection	Infection resulting from medical treatment or procedure, e.g.post-operative wound infection
Immunisation	Exposure to an antigen in order to create an immune responsewhich then develops antibodies to that particular disease
Incubation period	Time between exposure to organism and appearance of symptoms, e.g. food poisoning – 4-24 hrs; tetanus –3-21 days;chicken pox – 2-3 weeks; Hepatitis B – 1-3 months
Infective dose	The number of organisms which must gain entry in order to cause infection, e.g. Shigella - <100 organisms Salmonella - $>10^6$ organisms
Pathogenic	The ability for microorganisms to cause disease
Pathogens	These are microorganisms that are capable of causing disease ina susceptible host. The intact skin and mucous membranes liningthe respiratory, gastrointestinal and genitourinary tract provide a protective barrier against these organisms. If this barrier is damaged or penetrated, the organisms can potentially gain entry to the body, e.g. *Escherichia coli* is normally found as normal floraof the gastrointestinal tract where it usually causes no evidence ofdisease and offers benefits to the host. However, it can also cause bacteraemia, septicaemia and urinarytract infections when it is allowed to enter other body areas/systems, thereby becoming an opportunistic pathogen.

Prodromal (period)	The period that precedes the onset of specific signs orsymptoms that indicate the onset of a disease
Resident (normal)flora	Organisms that live on the host without causing disease
Serotypes	Different antigenic strains of a microorganism
Signs	Measurable changes in the patient as a result of infection, e.g. temperature and vomiting
Subclinical infection	No recognisable signs or symptoms but an immune responseoccurs, e.g. Infectious mononucleosis (glandular fever).
Symptom	Changes felt by the patient, e.g. hot flushes, nausea
Syndrome	Combination of signs and symptoms, e.g. inflammation
Sepsis	Poisoning due to infection by microorganisms
Transient flora	Organisms found on the host for a short time, not causingdisease
Virulence	Degree of pathogenicity of an organism. This varies between microorganisms in the same species, e.g. *Streptococcus sp.*

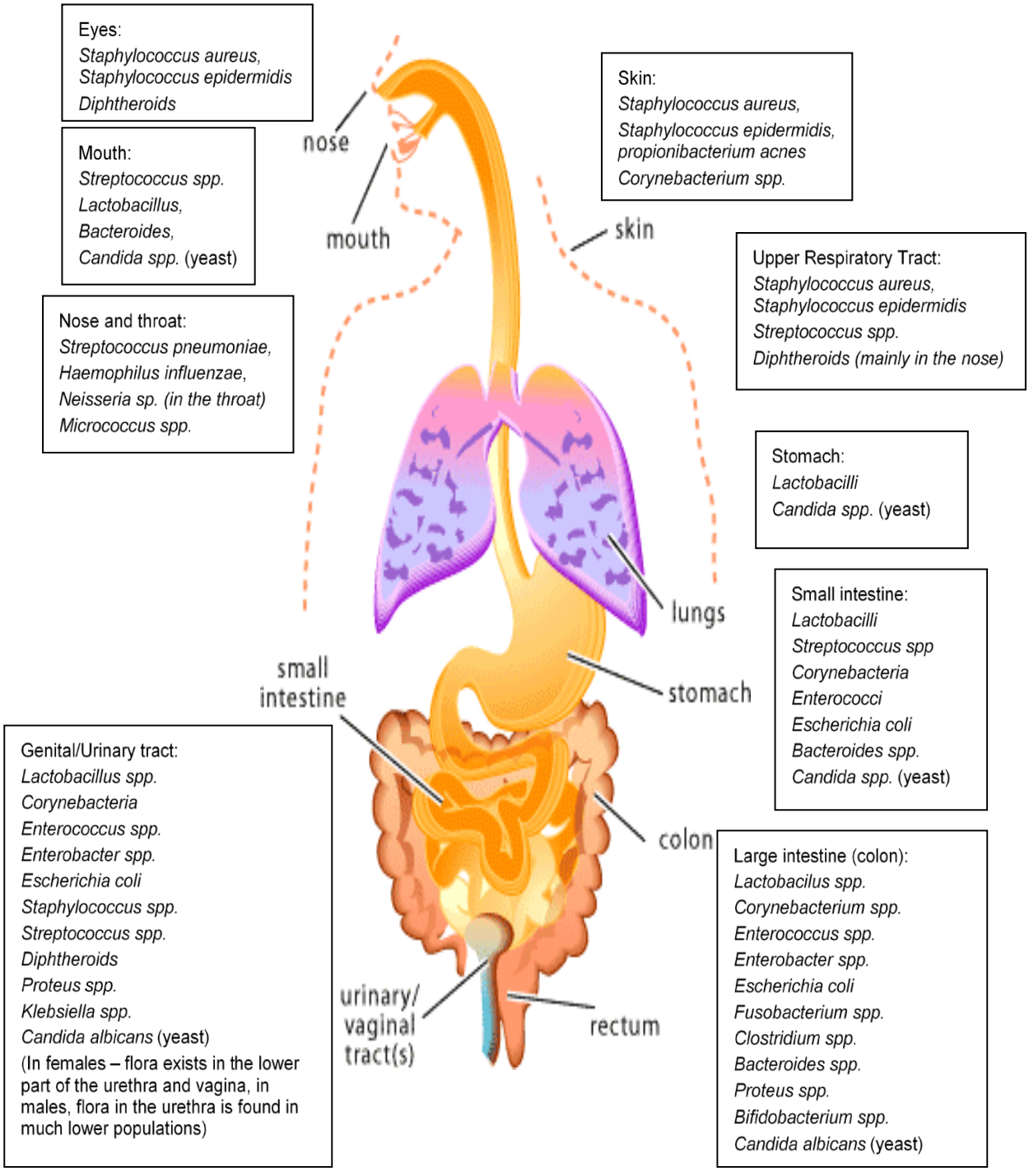

Image 2: Normal body flora. Source: https://www.scq.ubc.ca/microbes-and-you-normal-flora/ (accessed 25 June 2019)

Normal flora of the skin

The normal flora of the skin includes:

- *Staphylococcus epidermidis*, a type of coagulase negative staphylococcus (CoNS). Other examples include *Staphylococcuscapitis* and*Staphylococcus hominis.*
- *Staphylococcus aureus*, found in moist areas, that is, axillae, groin, perineum
- *Propionibacterium acnes*, found in hair follicles and sebaceous glands
- *Corynebacterium* spp, found on the skin surface, and
- *Candida* spp*,* found in the female genital tract.

Normal flora of the respiratory tract

Normal flora of the respiratory tract includes:

- *Streptococcus* spp, including *S. mutans, S. mitis* and *S. salivarius*
- *Neisseria* spp, including *N. sicca* and *N. pharyngitidis*
- *Staphylococcus* spp, including *S. epidermidis*, and
- *Haemophilus* spp, including *H. parainfluenzae*.

Normal human flora also includes some Gram-negative bacilli, such as *E.coli*, *Klebsiella* spp in low numbers in the elderly, and some anaerobicbacteria, such as *Peptostreptococcus* spp.

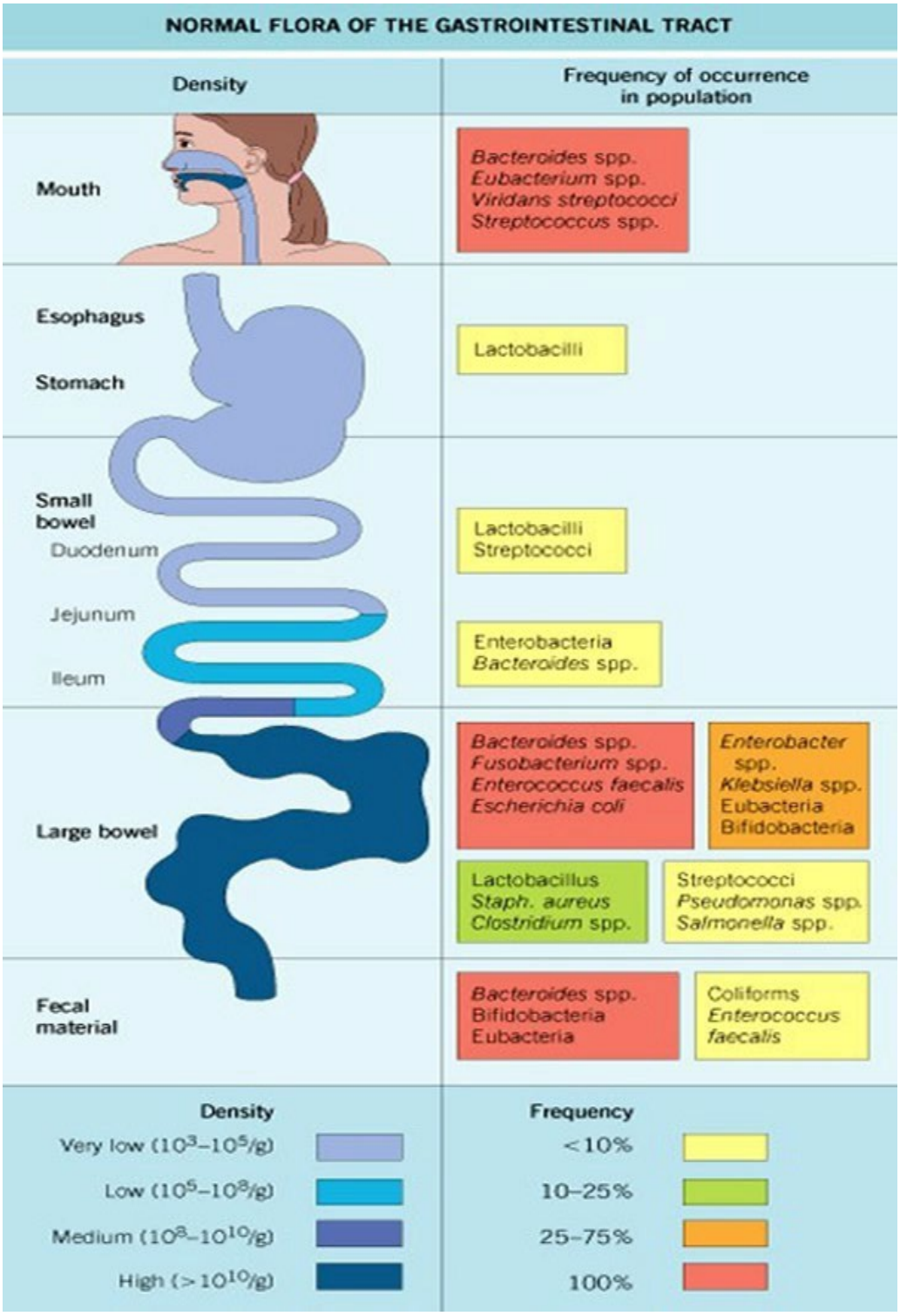

Image 3: The normal flora of the gastrointestinal tract. Source: D. Armstrong and J Cohen. Eds.(1999). Infectious Diseases. Hartcourt International.

Normal flora of the gastrointestinal tract

The normal flora of the gastrointestinal tract includes:

- *Enterococcus* spp, such as *E. faecium* and *E. faecalis*
- Some anaerobic bacteria, such as *Bacteroides* spp
- The anaerobic Gram-positive bacillus *Clostridium perfringens*, and
- Gram-negative bacilli, including *E.coli*, *Serratia* spp, *Klebsiella* spp and *Pseudomonas* spp.

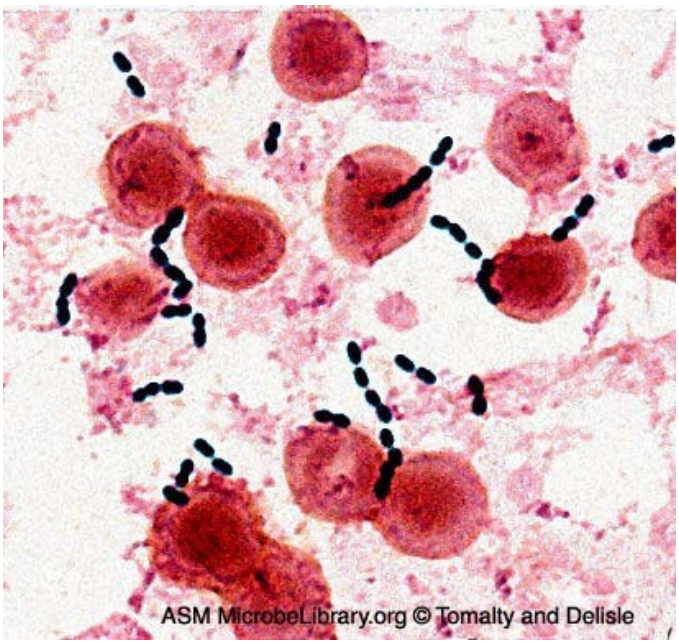

Image 4: Gram-positive cocci: *Enterococcus faecalis*. Source: ASM Microbe Library http://chiefmedicalresident.blogspot.com/2009/05/day-299-enterococcal-prosthetic-valve.html (Accessed 25 June 2019)

Environmental organisms

There are several significant microorganisms that are linked to transient flora andenvironmental origins, including:

- Animals
- Soil
- Buildings and air conditioning units
- Vegetation
- Foods, and
- Water.

Healthcare facility areas that pose a risk of being contaminated by environmentalmicroorganisms include:

- Food preparation areas
- Air handling systems
- Warm water systems
- Inanimate surfaces and objects, like curtains, shelving or storage units
- Equipment, like ventilators and humidicribs, and
- Wet areas.

Examples of common environmental microorganisms are: *S. aureus, P. aeruginosa, L. longbeachiae, L. pneumophilia, L. monocytogenes, Pasteurella* spp*.,* and *Enterococcus*spp*. Aspergillus fumigatus.*

Fungi

Aspergillus is a fungal organism found on plants and in soil, dust and building materials.They have also been linked to air-conditioning ducts. While *A.fumigatus* is the most common species of Aspergillus, others include *A.flavus*, *A.niger* and *A.terreus.*

Aspergillus spp causes a disease known as Aspergillosis. This is a disease that has been linked to redevelopment and renovations especially in healthcare facilities. For additional information refer to the Renovation, Repairs and Redevelopment Risk Management on- line module.

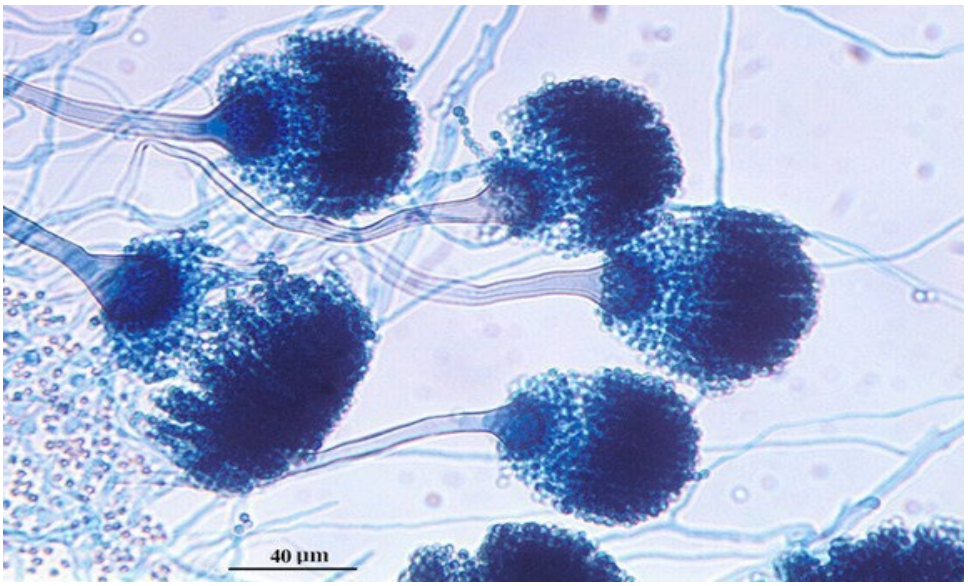

Image 5: *Aspergillus fumigatus.* Source: http://bioweb.uwlax.edu/bio203/s2008/miller_melo/ (accessed 25 June 2019).

Aspergillosis symptoms and transmission

Aspergillosis symptoms range from allergic reactions, like wheezing and coughing, to invasive symptoms resulting from infected bodily organs and compromised immune systems. The disease commonly affects the lungs, and can spread throughout the body,

including the brain.

Aspergillus is transmitted via spores which are breathed in from the environment. There isno harm for healthy people as the immune system can get rid of the spores. However, inhalation by compromised people from a dusty environment can lead to infection.

This means the risk is greatest for immunocompromised patients, including bone marrowor solid organ transplant patients, leukemia patients, or cystic fibrosis patients.

Invasive aspergillosis is very serious and requires early treatment with antifungals.Risk factors associated with aspergillosis include:

- Transplantation
- Corticosteroids, and
- Chemotherapy.

Viruses

Viruses are small obligate intracellular parasites, which by definition contain either a RNAor DNA genome surrounded by a protective, virus-coded protein coat. The main purpose of a virus is to deliver its genome into the host cell to allow its expression by the host cell.Some examples of important viruses include:

- Respiratory viruses, such as respiratory syncytial virus (RSV), influenza A andB,measles, rubella, herpes, and varicella zoster
- Faecal viruses, such as rotavirus or norovirus, and
- Blood borne viruses, such as hepatitis B and C, and HIV.

Bacteria

Gram-positive bacteria

Gram-positive organisms are characterised by having a thick cell wall made ofpeptidoglycan, and stain blue when challenged with the Gram stain technique.

Examples of Gram-positive bacteria include *Staphylococcus aureus, S. epidermidis, Enterococcus* spp*, Streptococcus pyogenes, S. pneumoniae, Clostridioides difficile,Lactobacillus* spp and *Listeria* spp.

Gram-negative bacteria

Gram-negative organisms have a thinner cell wall and an additional outer layer made upof polysaccharides that stain red when challenged with the Gram stain.

Examples of Gram-negative organisms include *Neisseria meningitidis, N.gonorrhoeae, E. coli, Klebsiella pneumoniae, Pseudomonas aeruginosa*, *Acinetobacter* spp, *Serratia* spp and *Bacteroides* spp.

Staphylococcus aureus treatment:

Treatment depends on the type of *S.aureus*.
Terminology used for the types of *S. aureus* will vary between laboratories and clinicians.It includes:

- Penicillin sensitive *S.aureus* (PSSA)
- Methicillin (flucloxacillin) sensitive *S. aureus* (MSSA)
- Methicillin (flucloxacillin) resistant *S. aureus* (MRSA)
- Healthcare associated (HA-MRSA)
- Community associated (CA-MRSA)
- Vancomycin-intermediate/resistant *S.aureus* (VISA/ VRSA)
- Epidemic methicillin-resistant *S.aureus* (EMRSA)
- Multi-resistant methicillin-resistant *S.aureus* (mMRSA/ mrMRSA),
- Non multi-resistant methicillin-resistant *S.aureus* (nmrMRSA), and
- Heterogeneous vancomycin-intermediate *S.aureus* (hVISA)

Examples of *S. aureus* susceptibility patterns

	PSSA	MSSA	CA-MRSA	HA-MRSA	VISA/VRSA
Penicillin	S	R	R	R	R
Methicillin	S	S	R	R	R
Gentamicin	S	S	S	R	R
Cephazolin	S	S	R	R	R
Erythromycin	S	S	S	R	R
Clindamycin	S	S	S	R	R
Ciprofloxacin	S	S	S	R	R
Vancomycin	S	S	S	S	I/R
Rifampicin	S	S	S	S	S
Fusidic acid	S	S	S	S	S

S=Susceptible, I=Intermediate, R=Resistant

Please note that if recommended, rifampicin and fusidic acid should **always** be used in combination therapy for the treatment of MROs. This reduces the risk of resistance to oneor both of these agents

Clostridioides difficile

The *Clostridioides difficile* organism grows anaerobically and is capable of causing:

- Diarrhoea, referred to as *Clostrioides difficile*-associated diarrhoea (CDAD)
- Pseudo membranous colitis

- Toxic megacolon
- Colonic perforation
- Peritonitis, and
- Death.

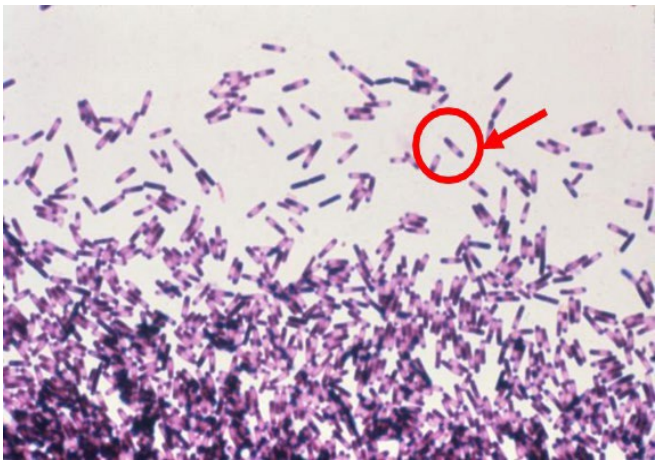

Image 6: *Clostridium difficile* and spores. Source: CDC/Dr. Gilda Jones https://www.forbes.com/sites/judystone/2015/07/23/stool-transplants-save-lives-why-dont-we-use- them-early-for-deadly-c-diff/#64361d6d3bf0 (accessed 25 June 2019)

Multi-resistant Gram-negative bacteria (MRGN)

Many of the common Gram-negative bacteria can develop resistance.Examples that have developed multi-drug resistance include:

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

Extended spectrum beta-lactamases (ESBL)

The major classes hydrolysed by these enzymes are:

- Penicillins, including benzyl penicillin, cloxacillin, flucloxacillin, amoxicillin andpiperacillin, and
- Cephalosporins, including cephalexin, cefaclor, cefazolin, cefotaxime, ceftazidimeand ceftriaxone.

Beta lactam antibiotics

Beta lactam groups	Examples
Penicillins	*Penicillinase sensitive*: penicillin G, penicillin
	Penicillinase resistant: methicillin, oxacillin, cloxacillin
	ampicillin, amoxycillin
	ticarcillin
	piperacillin
Cephalosporins	*First generation*: cefazolin, cephalothin, cephalexin
	Second generation: cefaclor, cefamycin, cefotetan,cefoxitin
	Third generation: cefotaxime, ceftriaxone, ceftazidime
	Fourth generation: cefepime, cefpirome
Carbapenems	imipenem, meropenem, ertapenem
Monobactams	aztreonam

Module 4 Cleaning, Disinfection and Sterilisation

The online module provides:

- Information to differentiate between methods of cleaning, disinfection and sterilisation
- Information on the quality management processes for reprocessing reusablemedical equipment
- Information on the general principles for storing and handling of processed items,
- Overview of education that personnel responsible for the delivery of health care are educated about the safe use of medical equipment and associated products to minimise the risk of disease transmission.

Spaulding classification

The Spaulding classification is a system that provides a general framework for HCWs to classify the level of reprocessing required for individual items.
This classification system should be risk based and consistent with relevant national and international standards for reprocessing reusable medical devices, instruments and equipment (Rutala, & Weber, 2008).

Classification	Item use	Goal	Appropriate Process
Critical items	Items entering sterile tissue, the body cavity, the vascular system and non-intactmucous membranes, e.g. surgical instruments.	Clean as soon as possible after use Objects will be sterile (free of all microorganisms including bacterial spores)	Sterilisation (or use of single use sterile product) • steam sterilisation • low temperature methods (ethylene oxide, peracetic acid, hydrogen peroxide plasma) Store appropriately to maintain sterility and prevent environmental contamination
Semi-critical items	Items that make contact, directly or indirectly, with intact mucous membranes or non-intact skin, e.g. endoscopes, diagnostic probes (vaginal/rectal), anaesthetic equipment	Clean as soon as possible after use Objects will be free of all microorganisms, with the exception of high numbers of bacterial spores	High level disinfection • thermal disinfection • chemical disinfection (glutaraldehyde, OPA) • Store to prevent environmental contamination in a designed storage environment. **NOTE: It is always preferable to sterilise semi- critical items whenever they are compatible with available sterilisation processes**
Non-critical items	Objects that come into contact with intact skin but not mucous membranes, e.g. crutches, BP cuffs and bench tops.	Clean as necessary with detergent solution Objects will be clean	Low level disinfection • cleaning (manual or mechanical) • store clean and dry to minimise environmental contamination

Cleaning and reprocessing of reusable medical devices

Cleaning is the removal of soil and reduction of the number of microorganisms acquiredduring use and is accomplished using water with detergents and mechanical action or enzymatic products.

Cleaning agents

Agents suitable for instrument cleaning must be:

- Biodegradable
- Mild alkaline or neutral pH
- Low foaming
- Non toxic
- Non corrosive
- Free rinsing and not leave any residue, and
- Compatible with the instrument.

Respiratory equipment

An example of reprocessing reusable medical equipment is the cleaning and disinfection ofanaesthetic and respiratory equipment. This equipment does not need to be sterilised as it classified as a semi-critical item as described by the Spaulding classification. The processrequired to clean and disinfect this equipment is shown in the table below.

Cycle temperaturesrequired	
Rinsing	40° C to 50° C
Washing	50° C to 60° C
Disinfecting	70° C to 95° C
Final rinsing	80° C to 90° C

Disinfection

Disinfection is the process that inactivates non-spore forming infectious agents, using eitherthermal or chemical means. Disinfection is not a sterilisation process and must not be used on critical items as described by the Spaulding classification.

Thermal disinfection

High level disinfection is achieved when surfaces are in contact with hot water in an automated thermal washer/disinfector by choosing a cycle that achieves the appropriate timeand temperature relationships as listed in the table below

Surface Temperature	**Min. Disinfection Time**
≥ 90º C	1 minute
80º C	10 minutes
75º C	30 minutes
70º C	100 minutes

Chemical disinfection

High-level disinfection is achieved from the application of a liquid chemical agent and is dependent on the biocidal action to ensure the disinfection process eliminates pathogenicmicroorganisms. An example of Chemical disinfection is ortho-phtaladehyde (OPA)

Ortho-phtaladehyde:

- Demonstrates excellent broad spectrum microbiocidal activity
- Is non corrosive

- Is stable over a wide pH range
- Has a relatively short acting cycle time
- Does not require activation
- Does not fix proteinaceous material to instruments
- Is compatible with a wide range of endoscopic instrument models
- Personnel using OPA must use appropriate PPE when handling this chemical
- Be used in a room fit for purpose and should
- Refer to the Material Safety Data Sheet

Endoscopes

Endoscopes are another example of semi-critical items that require high-level disinfection. Significantly different process are used for the disinfection of flexible and rigid scopes, and accessories used for invasive endoscopic procedures must be treated separately as critical items as described in the Spaulding classification.

Further information on endoscopes

For more detailed information on care and reprocessing of endoscopes youcan refer to the following as helpful sources of information:

- State or territory guidelines
- Australian and New Zealand Standards
- The Gastroenterological Society of Australia (GESA), and
- The Gastroenterological Nurses College of Australia (GENCA).

Sterilisation

Sterilisation is a process used to render an item free from all forms of viable microorganismsCritical items require preparation prior to sterilisation including cleaning and drying, a visual inspection for damage, an inspection to ensure the item is functioning correctly and prepackaging.
The most widely used methods of sterilisation used in healthcare facilities are steam sterilisation, dry heat sterilisation and peracetic acid.

Monitoring

Physical monitoring of any method of sterilisation requires certain parametersare met as per the following table.

Steam porous loads	134° C	203-206 KPa	3-3 ½ mins
Steam flash	134° C	203 KPa	3 ½ minutes
Ethylene oxide	45-60° C	78-168.9 KPa	3-4 hrs
Dry heat	160-180° C	Ambient	½ -1r
Gamma radiation	Ambient	Ambient	Dose – 25 kGy

Peracetic acid	50 – 56° C	Concentration	12 minutes
Low temperature gas plasma (hydrogen peroxide)	50 -55°C	Varies according to cycle stage	35-40 or 55-75 minutes Varies according to machine type

Bowie Dick type test

The Bowie Dick type test is done daily at 134°C for 3-3 ½ min. It detects air entrapment and evaluates the removal of residual air from the chamber andload.

Using biological/enzymatic monitoring indicators

The table shown here is a guide showing test organisms appropriate to themethod of sterilisation.

Type of test organism	**Methods of sterilisation**
Geobacillus stearothemophilus(*Bacillus stearothermophilus*)	Steam under pressure peraceticacid Hydrogen peroxide plasma
Bacillus atrophaeus (Bacillus subtilis)	Ethylene oxideDry heat

Bibliography and other resources

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Module 5 Infectious agent screening and immunisation of HCWs

The online module provides:

- An understanding of the steps involved with providing an occupational screening andimmunisation program for HCWs
- An overview of the organisation's responsibilities for health screening and immunisationof HCWs
- Employee responsibilities in relation to certain infectious agents and preventative actions
- An outline of safe work practices to be considered if exposed to these infectious agents
- The requirement for accurate and confidential record keeping in relation to HCW healthcare records.

Some organisational and jurisdictional policies and procedures determine a HCW's risk based on a classification or category that is determined by their occupational risk of exposure to patients, blood and body substances or infectious agents. In addition, some jurisdictions and organisations have included an additional sub-category to reflect a high risk for certain vaccine preventable infections i.e. seasonal influenza may be referred toas Category A mandatory.
The following example gives two category examples.
Category A – direct contact with patients or blood/body substances or infectious agents
Category B – no direct contact with patients, no greater risk of exposure to infectious agentsthan a member of the general public.

There are clinical areas where an organisation may determine that the risk is considered too high to allow HCWs to work clinically without this evidence of immunisation until all evidence is complete. These include:

- Emergency department
- Operating theatres and post anaesethic care units
- Paediatrics
- Maternity
- Adult and neonatal ICU and special care units
- Respiratory wards/units
- Transplant and oncology units with immunocompromised patients

Recommend vaccinations for HCWs

Occupation	Vaccine
Healthcare workers (HCW)	
All HCW Includes all workers and students directly involved in patient care or the handling of human tissues	Hepatitis B Influenza MMR (if non-immune)[‡] Pertussis (dTpa) Varicella (if non-immune)
HCW who work in remote Indigenous communities or with Indigenous children in NT, Qld, SA and WA, and other specified healthcare workers in some jurisdictions	Vaccines listed for 'All HCW', plus hepatitis A
HCW who may be at high risk of exposure to drug-resistant cases of tuberculosis (dependent on state or territory guidelines)	Vaccines listed for 'All HCW', plus consider BCG
Persons who work with children	
All persons working with children, including: • staff and students working in early childhood education and care • correctional staff working where infants/children cohabitate with mothers • school teachers (including student teachers) • outside school hours carers • child counselling services workers • youth services workers	Influenza MMR (if non-immune)[‡] Pertussis (dTpa) Varicella (if non-immune)
Staff working in early childhood education and care	Vaccines listed for 'Persons who work with children', plus hepatitis A
Carers	
Carers of persons with developmental disabilities[§]	Hepatitis A Hepatitis B Influenza
Staff of nursing homes and long-term care facilities for persons of any age[§]	Influenza MMR (if non-immune)[‡] Varicella (if non-immune)
Providers of home care to persons at risk of high influenza morbidity	Influenza
Emergency and essential service workers	
Police and emergency workers	Hepatitis B Influenza Tetanus (dT or dTpa)
Armed forces personnel	Hepatitis B Influenza MMR (if non-immune)[‡] Tetanus (dT or dTpa) Other vaccines relevant to deployment

Table 4: Recommended vaccinations for persons at increased risk of certain occupationally acquiredvacine-preventable diseases.Source: Australian Technical Advisory Group on Immunisation: The Australian Immunisation handbook. 10th.ed. Canberra: Australian Government Department of Health and Ageing: 2013

Risk assessment and health screening for HCWs

An example of risk assessment table for health screening and immunisation of HCWs is presented below.

Infectious agent or disease	HCW category A	HCW category B	Examples of evidence that may be required aspart of the recruitment process for new staff
Diphtheria, Tetanus and Pertussis (Adult dTpa)	Yes	Recommended	One documented dose of adult dTpa vaccine This dose must identify that the vaccine contained aPertussis component in addition to Diphtheria and Tetanus. **Note: This is not the same as a 'Tet Tox' or ADTvaccine.**
Tuberculosis(TB)	Yes	No	Assessment of status within 4 weeks of commencement of employment
Hepatitis A	Selected	Selected	Offer to selected staff only, for example: • laboratory services • plumbers, and • community, primary and mental HCWs working with developmentally disabled or indigenous people.
Hepatitis B	Yes	No	Documented evidence* of completed, age appropriate, course of vaccine AND documentedevidence of antiHBs>10mIU/ml' OR documented evidence of past infection (HBcAb)
Measles, Mumps, Rubella (MMR)	Yes	Recommended	Born before 1966;OR documented evidence of 2doses of MMR at least 1month apart; OR documented evidence of immune response (IgG) toMeasles, Mumps, Rubella.
Chickenpox	Yes	Recommended	Personal history of chicken pox;OR physician diagnosis of shingles;OR documented evidence of IgG varicella serology;OR documented evidence of age appropriatevaccination for Varicella.
Influenza	Recommended for most HCWs but mandatory for identified highrisk HCW	Recommended	Offer annually in autumn Identified high risk HCWs are HCWs who work in emergency departments, ICU (adult, paediatric and NICU), haematology/oncology units, transplant units or other high risk areas as identified by the organisation orjurisdiction

Hepatitis B immunity

If documented evidence is not available but the HCW has serological evidence of >10mU/L Hepatitis B surface antibody serology (antiHBs or HBs Ab) then the following items will assist in determining risk for the HCW:

1. The assessor should document the person's reported hepatitis B vaccinationhistory and determine the validity of the information, taking into consideration:
    - Who provided the vaccines, the number of doses and the timing of the doses
    - The person's age at the time each dose was received (NB. two adult doses of hepatitis B vaccine administered 4-6 months apart are adequate when given to persons aged 11-15 years)
    - The time between the last vaccine dose course and serology provided, and
    - The reasons stated for the inability to provide documented evidence of hepatitis B vaccination.
2. Review a recent serology result (antiHBs).
3. Assess the risk to both the person and clients based on the type of clinicalarea/procedures involved.
4. Advise the person of the importance of a completed age-appropriate course of immunisation to establish long-term protection and the risks associated with incomplete vaccination, even though sufficient antiHBs levels have been documented.
5. The person should be offered an additional dose(s) of vaccine if the person believes that the antiHBs levels could have resulted from an incomplete course.

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Module 6 Outbreak management

The online module provides:

- Information on how to define the steps of an outbreak
- Increased awareness of the need to have effective management and notification systems in place to address relevant state and territory notifiable infectious agentsand conditions
- Improved understanding of the role of the state and territory health authorities inoutbreak management
- Awareness of the requirements relating to data collection and reporting systems
- Awareness of the main stakeholders required to form an Outbreak Control Team,and
- The ability to recognise the importance of investigating outbreaks as early as possible to utilise the maximum effect of the risk management principles, for example, identification, control and containment, and acquiring and utilising the bestepidemiological data and microbiological results to minimise impact upon the population.

An outbreak can be defined as: **"when there are more cases of infection with the sameorganism than would normally be expected in one area or period of time".**
https://www.nhmrc.gov.au/health-advice/public-health/preventing-infection

Factors that can affect the response to an outbreak include

- The virulence of the infectious agent, and
- The vulnerability of the

populationKey steps in responding

to an outbreak:

Many steps are taken more or less simultaneously, while the results of investigations andimplementation of strategies to contain and control will vary with the availability and timeliness of information and the seriousness of the outbreak

1. Implement and reinforce infection control strategies to contain/ prevent further cases
2. Investigate and identify epidemiological links,
3. Communication to key stakeholders and the development of an outbreak controlteam
4. Develop a case definition
5. Identify and monitor existing and new cases, contact tracing and data collection
6. Possible treatment and prophylaxis
7. Develop and test the hypothesis (source, type and mode of transmission)

Chemical agents for environmental cleaning during an outbreak situation

A major factor in the control of an outbreak involves enhanced environmental cleaning. Appropriate selection and use of chemical agents for environmental cleaning and disinfection should be risk assessed for correct and safe use. PPE, especially gloves are tobe changed between and on completion of any cleaning and disinfection activities. Ensure that solutions used for environmental cleaning are compatible with items or surfaces, receive adequate contact time with surfaces and are prepared correctly.

Disinfectants to be used in healthcare settings for environmental cleaning may vary according to national/state/territory recommendations and also between acute and non-acute patient care areas. A risk assessment should be completed.

If using separate cleaning agents and disinfectants, surfaces should be cleaned first with a detergent solution, then a disinfectant is used in accordance with the manufacturer's instructions for use. This is a two-step process, cleaning and then disinfection

If using a combined detergent /disinfectant product for environmental cleaning and followthe manufacturer's instructions for use.

When using disinfectants, ensure staff, patients and items are not harmed by exposure to the disinfectant agents. Follow manufacturer's instructions for use.

The selection of a disinfectant must include confirmation that its characteristics will ensure it is effective against infectious agent(s) involved.

When using disinfectants, ensure staff, patients and items are not harmed by exposure to the disinfectant agents.

Monitoring of cases and the resolution of the outbreak

The development of surveillance lists, case lists, checklists and reporting formats should include appropriate data required by the outbreak management team and state/territory health authorities. Most public health authorities will have protocols to utilise.

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Sample organisational gastro outbreak case list

Name	Patient MRN/ UR number	DOB	Symptom duration		Symptom description (tick & describe)				
			Onset date & time	End date	Abdominal Pain	Fever	Diarrhoea	Vomiting	Naus

Bibliography and further reading

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Module 7 Management of occupational exposures

The online module provides:

- An understanding of the types of occupational exposures likely to be encounteredin the healthcare setting
- An understanding of the ways to prevent occupational exposures in the healthcare setting
- Information on the body fluids that pose a risk for blood borne viruses transmission
- Awareness of the estimated transmission risks of the blood borne viruses hepatitisB (HBV), hepatitis C (HCV) and human immunodeficiency virus (HIV)
- The ability to outline the management of an occupational exposure, including first aid, informed consent, pre and post-test counselling, risk stratification and assessment, blood tests required and follow up
- An understanding of the processes involved in managing an occupational exposure within a healthcare facility.

Transmission risk

Type of Exposure	Estimated Risk ofHIV Transmission	Estimated Risk of HBV Transmission	Estimated Risk of HCV Transmission
Use of contaminated injecting equipment	0.8%		
Needlestick injury of HCW	**0.3 – 0.8 %** If source is HIV positive and/or not receiving antiretroviral treatment	**1-6%** if source is HBeAg negativeand health care worker is non-immume or unvaccinated **22-31%** if source is HbeAg positiveor HBV DNA positive and health care worker is non- immume or unvaccinated	Approx **1.8%** if the source is HCVab positive but PCR negative **10%** if the exposure isa result of a deep needlestick injury with a hollow bore needle froma HCV – RNA positive source(tested using Polymerase Chain Reaction PCR)
Mucous membrane exposure	0.09%		

Table 5: Risk of transmission following exposure to HIV, HBV, HCV infected person who is NOT on antiretroviral treatment**.** Source**:** NSW Health Policy Directive 2017-101 HIV, Hepatitis B and Hepatitis C – Management of Health Care Workers Potentially Exposed, Health Protection NSW, NSW Health, May 2017

Factors affecting transmission risk

The following factors may increase the risk of transmission of blood borne viruses following an occupational exposure.

- If first aid is delayed
- The nature of the injury such as:
  1. Hollow bore needles verses solid sharp
  2. Penetrating injury verses mucosal splash
  3. Deep versus superficial
  4. Visible blood on instrument/ body fluid verses no visible blood or body fluid
  5. No gloves verses wearing gloves
- Hepatitis B immune status of the recipient
- Types and stages of viral infection of the source
  1. High viral load in the source
  2. Early post exposure prophylaxis (PEP) may significantly reduce the risk of transmission of blood born viruses

Factors to consider in assessing the need for follow-up of occupational exposures

Type of Exposure
- Percutaneous injury
- Mucous membrane exposure
- Non-intact skin exposure
- Bites resulting in blood exposure to either person involved
- Other – environmental, zoonotic

Type and Amount of Fluid/Tissue
- Blood
- Fluids containing blood
- Potentially infectious fluid or tissue (semen, vaginal secretions, and cerebrospinal, synovial, pleural, peritoneal, pericardial, and amniotic fluids or wound exudate)
- Direct contact with concentrated virus or bacteria

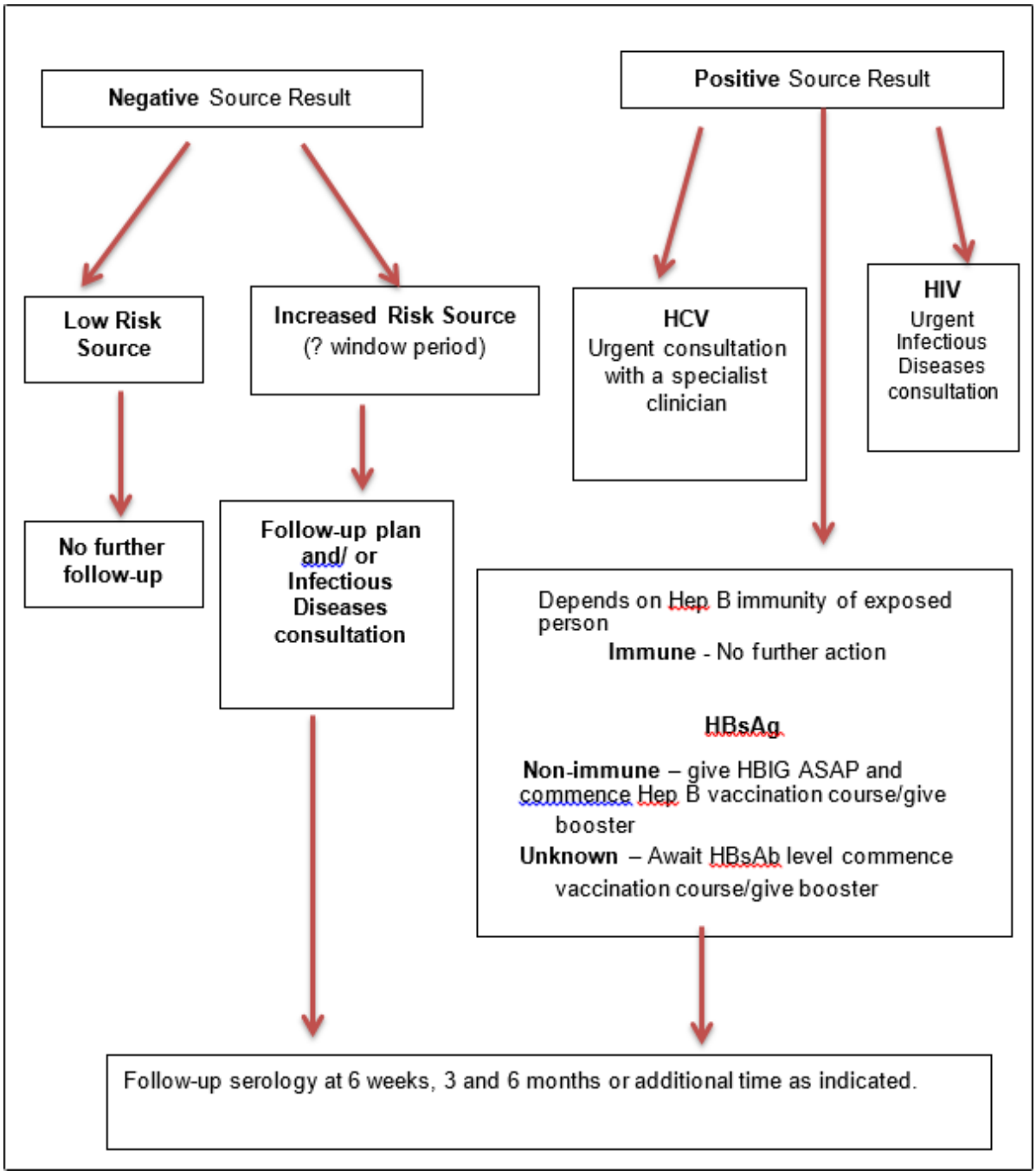
Infectious Status of Source
- Can source be identified
- Presence of HBsAg
- Presence of HCV antibody
- Presence of HIV antibody

Source status	**Serological tests for HCWs**				
	Baseline		6 weeks	3 months	6 months
HIV+ve or ina window period	HIVab		HIVab	HIVab	HIVab (if PEP is used)
HB+ve or ina window period	HBsAb HBsAg HBeAg HBV DNA		HBsAb HbsAg HBeAg HBV DNA	HbsAg	HBsAg
HC+ve or ina window period	LFT's HCVab	*HCV PCR at 3 weeks	HCVab HCV – PCR LFT's	HCVab HCV – PCR LFT's	HCVab HCV – PCR LFT's

Table 6: Serological testing timeframe for HCWs. Source: NSW Health Policy Directive2017-101 HIV, Hepatitis B and Hepatitis C – Management of Health Care Workers Potentially Exposed, Health Protection NSW, NSW Health, May 2017.

Note: In high risk exposures consideration should be given to checking Hep C PCR at 3 weeks post exposure if earlier diagnosis is desired.

Immediate management flow chart – source identity known – SAMPLE ONLY



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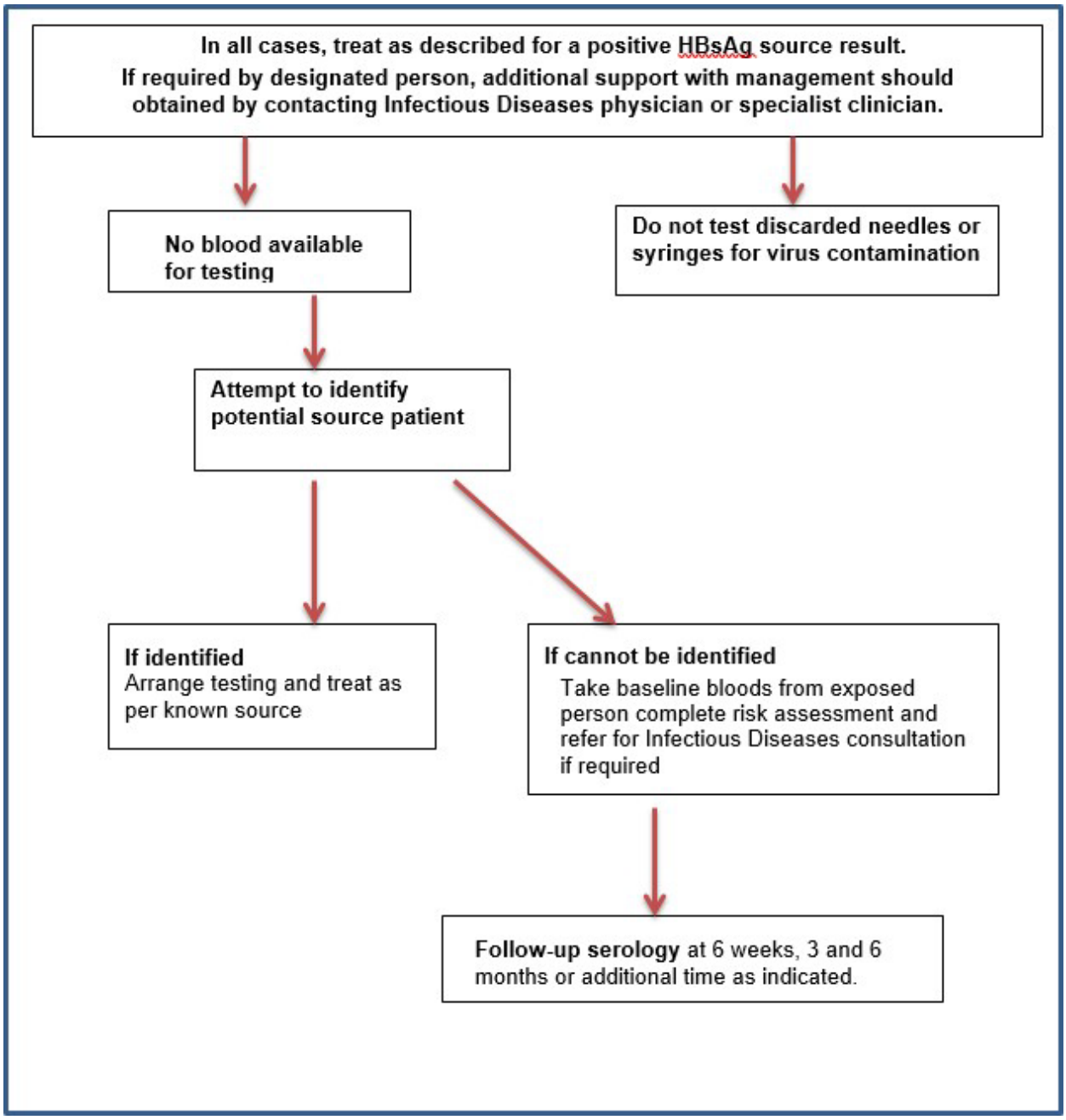

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Module 8 Renovation, repairs and redevelopment risk management

The online module provides:

- An overview of basic risk minimisation strategies
- An example of how to demonstrate the method of risk assessment
- Methods to recognise the appropriate infection prevention measures for each classification
- Methods to demonstrate an understanding of monitoring options to be used during projects in the healthcare setting, and
- A description of significant infectious agents that are associated with renovationand redevelopment in healthcare facilities.

Etiologic agent	Underlying medical condition	Number of patients infected or colonised	Number of patients who died	Circumstances	Year
Scedosporium sp., Rhizopus sp., Phoma sp., Exoserohilum sp., Bipolaris sp., Fusarium sp., Aspergillus sp., Candida sp	Children with acute leukaemia	50	10	Major renovation with excavation of grounds for construction of a tower connecting buildings	Pokala, et al., 2014
A. fumigatus *A. flavus* *A. terreus*	Acute leukaemia	25	6	Construction and renovation work	Charbrol et al., 2010
A. fumigatus	Haematology unit/acute leukaemia	4	0	Renovation work	Pini, et al., 2008
A. fumigatus	Haematology patients	6	2	Major hospital construction work	Chang et al., 2008
A. fumigatus *A. flavus* *A. terreus*	Lung transplant recipients	8	1	Building construction work	Raviv et al., 2007
A. ustus	Ophthalmology patients	3	0 (3 enucleations)	Renovations ophthalmology dept and operating suite	Saracli et al., 2007

Table 7: Summary of documented significant outbreaks of construction related infection

Etiologic agent	Underlying medical condition	Number of patients infected or colonised	Number of patients who died	Circumstances	Year
A. fumigatus	Renal transplant patients	4	4	Building construction work	Panackal et al., 2003
A. fumigatus *A. flavus*	Surgical inpatients	6	2	Deterioration of insulating material in airflow units	Lutz et al., 2003
Aspergillus	Oncology patients (Bone Marrow Transplant, Acute Myeloid Leukaemia, Acute and Chronic Lymphatic Leukaemia)	36 (over 69 months)	17	28 cases occurred during construction and 4 cases after control measures initiated	Loo et al., 1996
A. fumigatus	Respiratory failure, Crohns disease, chronic bronchitis	6	3 (related to underlying disease)	Spores in fibrous insulation above perforated ceiling were dispersed during minor building in adjacent offices and stores areas	Humphreys et al., 1991
A. fumigatus	Renal disease – chronic renal failure	3	2	Outbreak coincided with hospital renovation in an area near the renal unit where the patients were being accommodated.	Sessa et al., 1996
Aspergillus	Patients on haematology unit	5	5	Large-scale evacuation work while hospital being rebuilt. The isolation rooms that housed the patients overlooked the building site.	Shields et al., 1990

Outbreak papers are included in further resources at the end of the section.

Risk rating	Area/Department
Lowest risk	Office areas Public areas Workshops Unoccupied wards areas not accommodating patients
Potential risk	Nuclear medicine Non-invasive radiology including Magnetic Resonance Imaging (MRI) andComputerised Tomography (CT) Preadmission units and discharge clinics Research laboratories General outpatient areas except surgery and oncology Psychiatric services Allied health, e.g. physiotherapy, occupational therapy, social work, dieteticsand so on General wards All other patient care areas unless stated in moderate or highest risk
Moderate risk	Emergency Department Pharmacy Pathology laboratory Respiratory units Physiotherapy respiratory function units Coronary care unit Cardiology clinics Outpatients unit (surgery and oncology) Invasiveradiology Paediatrics wards Obstetrics wards including labour ward and delivery suites Surgicalwards Geriatric and long term care wards
Highest risk	Units accommodating immunocompromised patients (e.g. HIV/ AIDS units)Intensive care units and high dependency units Sterilising services unit Sterile stock store rooms All operating suites Day surgery units Haematology/oncology inpatient and day units Solid organ transplant units (e.g. renal transplant unit) Bonemarrow 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

Table 8: Patient and geographic risk areas in a HSO for redevelopment **adapted from**: Australasian Health Facility Guidelines: Part D- IPC,Accessed June 2019.

This table describes the level of risk for the transmission of pathogens relating to the level of construction activity.

Classification	Type of 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 inspectiononly • Painting (not sanding) • Electrical trim work • Minor plumbing (in a localised area, e.g. patient bathroom), and • 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 minimaldust. 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 (1 patient room), e.g. disruption to water supply.
Type 3 - Moderate/major	Work that generates a moderate to high level of dust or work that cannot becompleted 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, e.g. interruption of sewerage pipes, and • Removal of fixed building items, e.g. countertops, sinks.
Type 4 - Major	Major maintenance, demolition/ excavation/ construction projects that requireconsecutive work shifts to complete. These include but are not limited to: • Removal of ceiling tiles and/or ceilings • Major plumbing work in clinical common areas or affecting more than 2 patient rooms • Removal of plaster walls, block works, bricks, or mortar, and • New construction involving large areas of open soil.

Table 9: Activities and classification for risk rating. **Adapted from**: Australasian Health Facility Guidelines: Part D- IPC, Accessed June 2019

AREAS OF VULNERABILITY	*PROBABILITY OF CONTAMINATION*			
	Insignificant	**Minor**	**Moderate**	**Major**
Lowest risk	Class I	Class II	Class II	Class III
Potential risk	Class I	Class II	Class III	Class IV
Moderate risk	Class I	Class II	Class III	Class IV
Highest risk	Class II	Class III	Class IV	Class IV

Table 10: Risk rating matrix. **Adapted from**: Australasian Health Facility Guidelines: Part D-IPC, Accessed June 2019

Baseline air sampling should be considered prior to the commencement of any activities, especially where there is a disruption of possible contaminants. There are several methods used to determine baseline levels of dust and microorganisms.
Further information can be obtained from the Australian Institute of OccupationalHygienists.

Description of activities and classification by class

This table describes the level IPC intervention required to minimise the risk of transmission of organisms that could be harmful to patients and othersduring the project works.

Class	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 • Minimize 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 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 withwet mop with hot water and detergent and /or vacuum with HEPA filtered vacuum.

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 (e.g. 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 atraffic 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 toensure preventative measures are effective, and • Utilise dust monitors in adjacent areas that have been calibrated to the environment.

Table 11: Description of activities and classification by class. Adapted from: **Adapted from**: Australasian Health Facility Guidelines: Part D- IPC, Accessed June2019

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.

Barriers Patient doors adjacent to area closed	☐ Yes	☐ No	☐ N/A
Dust proof plastic sheeting barriers in placeand 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 necessarystaff 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

This table is an example of the infection prevention roles and responsibilities that need tobe considered during construction and renovation, responsibilities may vary in different facilities.

Planning and consultation	**Responsibility**
Infection prevention staff must be consulted and involvement should be sought at the planning stageto 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**
Project design	**Responsibility**
The ICP in collaboration with facility administration and nursing staff must identify patient population(s)that may be at risk and the appropriate preventativemeasures to ensure their safety. This include providing construction/ renovation workers sole access to ensure they avoid patient care areas	**IPCFacility administration**
Patients who are at increased risk or immunocompromised should be moved to an area away from the work area/ construction zone if the airquality cannot be assured during construction.	**IPCFacility administration**
Traffic patterns for construction workers should be established that avoid patient care areas and traffic areas for patient services, e.g. food delivery.	**Architects/ builders Engineering services** **IPC**
Management must identify whose responsibility it is to stop construction projects if breaches in preventative measures arise.	**Facility administration**
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	Responsibility
Isolation/ventilation	
A dust barrier should be created from the floor to the true ceiling and edges sealed. Plastic sheeting can beused 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 bere-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/ constructionzone from being drawn back into patient care areas orreleased to outdoor streets around the healthcare facility.	**Architects/ builders Engineering services**
All windows, doors, vents and other sources of potentialair 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 beto 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 vacuumedwith 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 cleaningshould 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/ constructionzone access corridor and/ or lift.	**Architects/ builders Engineering services**
Monitoring	**Responsibility**
Daily inspection	
The ICP 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 levelof demolition work or during periods of high dust generation.	**IPC**
Laboratory surveillance	**Responsibility**
A baseline rate of clinical isolates of *Aspergillus spp.* and other significant infectious agents should be established prior to the commencement of 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 shouldbe undertaken immediately.	**IPC**
Air sampling	**Responsibility**
Air sampling aims to detect *Aspergillus spp.* coloniesin association with the building works. Sabouraud's Dextrose Agar (SABG). Sabouraud's agar, a selective inhibitory mold agar (IMA) media for fungi is used for this test to monitorfor *Aspergillus spp*.	**IPC**

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Module 9 Basic epidemiology and statistics

The online module provides:

- Information on the occurrence of infection transmission
- How bias and confounding affect results
- The common units of measurement; mean, median and percentiles
- The measure of variability; range and standard deviation,
- The different statistical analysis that can be performed; p value, confidence intervals, odds ratio and risk ratio
- How infection is measured and describe the different epidemiologyinvestigations that are conducted
- The scales of measurement in statistics

Incidence

A measure of the frequency with which new cases of illness, injury, or other health condition occurs among a population during a specified period (CDC).

5 newly colonised patients with MRSA were detected on a weekly screening in Ward C.A total of 30 patients were screened on this day:

- 23 did not have MRSA
- 2 were known to have MRSA from last week's screening, and
- 5 were the newly detected cases.

Therefore: Incidence ratio = 5/30 =0.17
Incidence percentage = 17%

Incidence rate

A measure of the frequency with which new cases of illness, injury, or other health condition occur, expressed explicitly per a time frame. Incidence rate is calculated as the number of new cases over a specified period divided either by the average population (usually mid-period) or by the cumulative person-time the population was atrisk (CDC).

In the following example, 5 patients were identified with *S.aureus* bloodstream infections from Ward A in a 30 day period. Ward A had another 16 patients coming inand out of the ward during these 30 days with a total of 257 patient-days of bed occupation in the ward.

Therefore: Incidence ratio = 5/257 = 0.019
Incidence rate = 19 per 1,000 patient-days

The incidence rate was 19 patients with *S.aureus* bloodstream infections per 1,000 patient-days.

This rate can then be compared to the rates:

- In other wards within the same hospital
- In other similar sized hospitals for the same specialty units, and
- Before and after infection control intervention.

When comparing rates, consideration should be given to *variable risk* as patients mayhave different risk factors or be undergoing procedures that change their risk factors. The risk affecting the rates can be used to identify higher or lower rates and how theyimpact upon patient safety.

Prevalence

The number or proportion of cases or events or attributes among a given population (CDC).

In the following example, 5 newly colonised patients with MRSA were detected on screening in Ward B on one day. A total of 30 patients were screened on this day:

- 23 patients did not have MRSA
- 2 were known to have MRSA from last week's screening, and
- 5 were the newly detected cases.

Therefore: Prevalence ratio = 7/30 =
0.23 Prevalence percentage = 23%

Types of studies used in epidemiology

Various studies can be conducted on a sample population by collecting data over a defined time period. Epidemiological data can be used to record disease or infections,to identify modes of transmission and identify risk factors.
There are two types of studies used in epidemiology; observational and experimental studies.

Examples of observational studies

Ecological study

An example of an ecological study would be a comparison of hospital-wide use of vancomycin with prevalence of VRE in the hospital. Additional studies would be required to further explore the data.

Cross sectional study

A cross-sectional study is a study in which a sample of persons from a population are enrolled and their exposures and health outcomes are measured simultaneously. Thistype of study can be either prospective or retrospective (CDC).
An example of a cross sectional study would be an investigation of all patients

currently in hospital with VRE and whether they have received vancomycin. This study then can lead to analysis of the population as either a case control or cohortstudy.

Case control study

A case-controlled study is a retrospective observational analytic study that enrolls one groupof persons with a certain disease, chronic condition, or type of injury (cases) and a group of persons without the health problem (controls) and compares differences in exposures, behaviors, and other characteristics to identify and quantify associations, test hypotheses, and identify causes(CDC). An example of a case control study would be an investigation of patients with central venous catheters who had BSI (cases) and those that did not (controls)in the intensive care unit over the same time period to identify the risk factors relating to central venous catheters and acquisition of BSI.

Cohort study

A cohort study is a prospective observational analytic study in which enrollment is based on status of exposure to a certain factor or membership in a certain group. Populations are followed, and disease, death, or other health-related outcomes are documented and compared. Cohort studies can be either prospective or retrospective.

A cohort is a well-defined group of persons who have had a common experience or exposure and are then followed up, as in a cohort study or prospective study, to determinethe incidence of new diseases or health events (CDC).

An example of a cohort study would be an investigation of risk factors in patients with central venous catheters who had BSI and those that did not in the intensive care unit over the sametime period.

	Cohort studies	Case control studies
Suited for rare diseases	No	Yes since starting with a set of cases
Suited for rare exposures	Yes since starting with exposure status	No
Allows for studying several exposures	Difficult but examples exists (Framingham study)	Yes
Allows for studying several outcomes	Yes	No
Disease status easy to ascertain	Sometimes difficult	Easier since starting point of the study
Exposure status easier to ascertain	Yes since starting point of the study. Except for retrospective cohorts	Sometimes difficult. Information biases.
Allows computation of risk and rates	Yes	No
Allows computation of effect	Computation of risk ratio and rate ratio	Estimation of risk ratio, rate ratio from odds ratio
Allows studying natural history of disease	Yes Easier to show that cause precedes effect.	More difficult Temporality between cause and effect difficult to establish
Based on existing data sources	Difficult	Yes but access to information sometimes difficult
Easiness to find a reference group	Usually not difficult to identify an unexposed population	No Major potential biases when selecting a control group
Sample size	Large	Small
Cost	Elevated except if retrospective cohorts	Smaller
Time required	Long, sometimes very long except if retrospective cohorts	Shorter
Follow up	Difficult, loss to follow up	No follow up
Logistics	Heavy Many staff, large data sets Long duration	Easier
Concept	Easy to understand	Difficult to understand particularly if case cohort or density case control study
Ethical issues	Major if studying risk factors. Interruption of study if exposure shown to be harmful. Need for intermediate analysis.	None since outcome already happened.

Table 12: Advantages and disadvantages of cohort and case control studies. Source: European Centre for Disease Prevention and Control (ECDC) Field Epidemiology Manual, Access June 2019,access here

Examples of experimental studies

An experimental study is a study in which the investigator specifies the type of exposure for each person (clinical trial) or community (community trial) then follows the person's or community's health status to determine the effects of the exposure (CDC). An experimental study may look at the effectiveness of an antibiotic by whicha group of people are given the new antibiotic while the others receive the current treatment. All other factors are kept constant while the antibiotic is the only experimental factor (variable) that will or will not show an effect.

Randomised controlled trials (RCT)

An RCT is a study in which a number of similar people are randomly assigned to two (or more) groups to test a specific drug, treatment or other intervention. One group (the experimental group) has the intervention being tested, the other (the comparison or control group) has an alternative intervention, a dummy intervention (placebo) or no intervention at all. The groups are followed up to see how effective the experimental intervention was. Outcomes are measured at specific times and any difference in response between the groups is assessed statistically. This method is also used to reduce bias (NICE).

An example of a randomised controlled trial would be where patients in the intensive care unit are randomly assigned to either a new antibiotic or the current antibiotic treatment for MRSA bacteraemia and then compared for mortality and length of hospital stay outcomes.

Bias

Bias is defined as any systematic error in the design, conduct or analysis of a studythat results in a mistake of the estimate between the exposure and risk of infection.

Bias

examples

Selection

bias

Selection bias is a systematic difference in the enrollment of participants in a study that leads to an incorrect result (e.g., risk ratio or odds ratio) or inference (CDC).

Selection bias occurs where volunteers may not be representative of a true population as these are patients who want free treatment and they may differ to non-volunteers.

Information bias

Information bias is a systematic difference in the collection of data regarding the participants in a study (e.g., about exposures in a case-control study, or about health outcomes in a cohort study) that leads to an incorrect result (e.g., risk ratio or odds ratio) orinference (CDC).

Information bias can occur if patients are aware of their infection status as they may try to identify possible reasons for obtaining a resistant infection. This group would be more likelyto remember recent antibiotics that they have been given

Confounding

Confounding is the distortion of the association between an exposure and a health outcomeby a third variable ('confounder') that is related to both (CDC).

For example, in assessing the association between VRE infection and mortality in a gastro-surgical unit, we need to consider complexity of surgery as a potential confounder. Complex

surgical patients are more likely to be on vancomycin and develop VRE but these patients are also more likely to die. As complexity of surgery is associated with both exposure and outcome it is a potential confounder.

Basic statistics

Statistics allow clinicians to have an understanding of the significance of the epidemiologicaldata and to determine if it is statistically significant or not in the applied setting. An understanding of the terminology and how it is applied in research will also assist with the interpretation of scientific journal articles and research findings.

Mean (μ)

Mean is the measure of central location, commonly called the average, calculated by addingall the values in a group of measurements and dividing by the number of values in the group(CDC).

To calculate the mean for the set of 10 numbers displayed here:10.5,

10.8, 10.9, 11.9, 12.4, 12.8, 15.2, 11.1, 11.7, 10.1

Total sum X = 117.4 and number of observations n = 10.

Therefore: 117.4/10 = mean **11.7**.

Median

Median is the measure of central location that divides a set of data into two equal parts (CDC).

To calculate the median for the following set of numbers: 10.5, 10.8, 10.9, 11.9, 12.4, 12.8,

15.2, 11.1, 11.7, 10.1

Arrange them in numerical order:

10.1, 10.5, 10.8, 10.9, 11.1, 11.7, 11.9, 12.4, 12.8, 15.2

The median is between 11.1 and 11.7. The median is the middle number. If there is two middle numbers, the median is halfway between the two middle numbers.

Median =**11.4**

Percentiles

Percentiles are a set of cut points used to divide a distribution or a set of ranked data into 100 parts of equal area with each interval between the points containing 1/100 or 1% of the observations (CDC).

If we use our previous set of numbers:
10.5, 10.8, 10.9, 11.9, 12.4, 12.8, 15.2, 11.1, 11.7, 10.1

10.1, 10.5, 10.8, 10.9, 11.1, 11.7, 11.9, 12.4, 12.8, 15.2

Therefore:

- 25th percentile = (10.5, 10.8) = **10.6**
- 50th percentile = (11.1-11.7) = **11.4**
- 75th percentile = (12.4-12.8) = **12.6**.

Normal distribution

Normal distribution is a distribution represented as a bell shape, symmetrical on both sidesof the peak, which is simultaneously the mean, median, and mode, and with both tails extending to infinity (CDC).

The height of adults in Australia follows a normal distribution with a mean (μ) of 174 cm and a standard deviation (σ) of 6 cm.

Therefore:

- 68.2% of observations will be between ± 1 standard deviation (168-180cm)
- 95.4% of observations will be between ± 2 standard deviations(162-186cm), and
- 99.6% of observations will be between ± 3 standard deviations (156-192cm).

Range

Range is the difference between the largest and smallest values in a distribution; in common use, the span of values from smallest to largest (CDC).

Using the set of numbers from our previous

sample: 10.5, 10.8, 10.9, 11.9, 12.4, 12.8, 15.2,

11.1, 11.7, 10.1

We would rearrange them in numerical order:

10.1, 10.5, 10.8, 10.9, 11.1, 11.7, 11.9, 12.4, 12.8, 15.2

Therefore, the **range** is (**10.1 – 15.2**).

Standard Deviation (σ)

Standard deviation is a statistical summary of how dispersed the values of a variable are around its mean, calculated as the square root of the variance (CDC).

To use the set of numbers from our previous

example: 10.5, 10.8, 10.9, 11.9, 12.4, 12.8, 15.2,

11.1, 11.7, 10.1

We would again arrange them into numerical

order. 10.1, 10.5, 10.8, 10.9, 11.1, 11.7, 11.9,

12.4, 12.8, 15.2

Therefore:

- Mean = 11.7, and
- Calculated SD = **1.5**.

This means that 95% of results will be between (11.7-1.5) to (11.7+1.5), thatis, 10.2 to 13.2.

If the distribution is "normal", 95% of all observed results will be located between the mean +/- 1.96 SD.

Confidence intervals

Confidence intervals are a way of expressing how certain we are about the findings from a study, using statistics. It gives a range of results that is likely to include the 'true' value for the population. A wide confidence interval indicates a lack of certainty about the true effectof the test or treatment - often because a small group of patients has been studied. A narrow confidence interval indicates a more precise estimate (for example, if a large number of patients have been studied). The confidence interval is usually stated as '95% CI', which means that the range of values has a 95 in a 100 chance of including the 'true' value (NICE).

Confidence intervals are a range of values for a measure (e.g. rate or odds ratio) constructed so that the range has a specified probability (often, but not necessarily, 95%) ofincluding the true value of the measure (CDC).

p value

The p value is a statistical measure that indicates whether or not an effect is statistically significant. For example, if a study comparing two treatments found that one seems to be more effective than the other, the p value is the probability of obtaining these results by chance.
By convention, if the p value is below 0.05 (that is, there is less than a 5% probability that the results occurred by chance) it is considered that there probably is a real difference between treatments. If the p value is less than 0.001 (less than a 1% probability that the results occurred by chance), the result is seen as highly significant. However, a statistically significant difference is not necessarily clinically significant. The following provides an example of the difference between statistical significance and clinical significance.

Example, drug A might relieve pain and stiffness statistically significantly more than drug B.But, if the difference in average time taken is only a few minutes, it may not be clinically significant (adapted from NICE).

The incidence rate for acquiring VRE from another patient in a four bed room has a Relative Risk of 2.9 [95% CI, 1.3-4.4], p = 0.01.

This means that the risk of acquiring VRE from another patient sharing the four bed room is 2.9 times increased with the true value 95% of the time being as low as 1.3 or as high as 4.4. As it does not cross 1, the p value of 0.01 is supported as significant.

Other common statistical tests

Anova: Tests for statistical significance between means of several subgroups (multiple testing).

Chi-square: Tests the relationship between the frequencies of two factors.

Correlation coefficient: A measure of association that indicates the degreeto which two variables have a linear relationship. Results can be between -1and +1.

Fisher's exact: Used to test association of 2X2 frequency table for sparsedata or small numbers (<20).

Kruskall-Wallis: Extension of Wilcoxon for comparing more than 2 groups

Mann-Whitney: Used when sample data are not normally distributed. Test compares two independent groups of ordinal scores.

McNemar's Test: A form of Chi- square test for matched pair's data.

Multivariate Analysis: Involves the observation and analysis of more than one statistical variable at a time.

Pearson Correlation: Used to determine if the values of two normally distributed variables are linearly associated.

Regression: Determines the relationship between one dependent (response) variable and one or more independent variables.

T-test: Used to test the hypothesis involving numerical data that is normally distributed. It determines whether the mean observations differ significantly from a test value.

Univariate Analysis: Explores each variable in a dataset separately.

Wilcoxon: Used instead of the T-Test, when sample data are not normally distributed. It is

similar to a Mann-Whitney test but used for dependent data, for example, matched or repeated samples.

Bibliography and further resources

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Module 10 Surveillance and quality improvement

The online module provides:

- An introduction to the principles of surveillance and quality improvement,
- An overview of why surveillance and quality improvement is important to patient safety and quality of care
- Examples of the Plan-Do-Study-Act (PDSA) cycle
- An understanding of the different types of surveillance
- Information on the importance of regular evaluation of all programs
- Information on available resources to support facilities and individuals undertaking surveillance activities, and
- Information on surveillance principles and how to improve quality and safety in healthcare.

Resources for further information on IPC, surveillance definitions and activities

Australian Commission on Safety and Quality in Health Care (ACSQHC) For NSQHS Standards 2nd edition use the microsite link available here	The National Safety and Quality Health Service (NSQHS) Standards were developed by the Commission with the Australian Government, state and territory partners, consumers and the private sector. The primary aim of the NSQHS Standards is to protect the public from harm and improve the quality of health care. They describe the level of care that should be provided by HSOs and the systems that are needed to deliver such care. The second edition of the NSQHS Standards wasreleased in November 2017. Health service organisations will be assessed to the secondedition from January 2019.
Australian Commission on Safety and Quality in Health Care (ACSQHC) Antimicrobial Use and Resistance in Australia (AURA) National Alert System for Critical Antimicrobial Resistances - CARAlert	Comprehensive, coordinated and effective surveillance of antimicrobial resistance and antimicrobial use is a national priority and a critical component of the *Australia's First National Antimicrobial Resistance Strategy 2015–2019*. The Commission has developed the AURA Surveillance System to support strategies to prevent and contain AMR. AURA coordinates data from a range of sources to provide a comprehensive and integrated picture of patterns and trends of AMR and antimicrobial use across Australia. The National Alert System for Critical Antimicrobial Resistances (CARAlert) was established by the Australian Commission onSafety and Quality in Health Care (the Commission) in March 2016 as part of the Antimicrobial Use and Resistance in Australia (AURA) Surveillance System. CARAlert collects surveillance data on nationally agreed priority organisms with critical resistance to last-line antimicrobial agents.

Australian Commission on Safety and Quality in Health Care (ACSQHC) Hospital-acquired complications (HACs)	A hospital-acquired complication (HAC) refers toa complication for which clinical risk mitigation strategies may reduce (but not necessarily eliminate) the risk of that complication occurring. The national list of 16 HACs that includes healthcare associated infections was developed through a comprehensive process that included reviews of the literature, clinical engagement andtesting of the concept with public and private hospitals.
Australian Commission on Safety and Quality in Health Care (ACSQHC) Australian Atlas of Healthcare Variation Series. Link accessed here	The Commission has led development of the Atlas series. The first Atlas was developed in collaboration with the National Health Performance Authority and the second Atlas with the Australian Institute of Healthand Welfare. The Commission has consulted widely with the Australian government, state and territory governments, colleges and specialist societies, clinicians and consumer representatives to developeach Atlas. Over 150 stakeholders were consulted in the development of the second Atlas; this consultation addressed the topic selection, data specification development, data interpretation and development of the clinical commentary. Enhancements made to the second Atlas have included: • Greater involvement of clinicians during all stagesof development • Analysis of data by Aboriginal and Torres Strait Islander status • Analysis of data by patient funding status (public or private).

Australian Commission on Safety and Quality in Health Care (ACSQHC) Clinical Care Standards. Link accessedhere	The Commission established the Clinical Care Standards program to develop Clinical Care Standards on health conditions that would benefitfrom a national coordinated approach.
Australian Commission on Safety and Quality in Health Care (ACSQHC) NHHI (NHHI).Link accessed here.	The NHHI was establishedto develop a national hand hygiene culture-change program that standardised hand hygiene practice andplacement of alcohol-based hand rub in every Australian hospital. Hand hygiene is a high priority for the prevention of healthcare associated infection (HAI) worldwide, as itis the single most effective intervention for preventingHAI.
Queensland Health	Resources for IPC in Queensland Health. Provides policies, procedures, guidance and support for Queensland healthcare facilities in communicable diseases, surveillance activities aggregating and analysing data.
New South Wales Health, Clinical Excellence Commission (CEC)	Incorporates knowledge and resources for NSW Health, including quality improvement, patientsafety, and IPC.
South Australia - SA Health - Healthcare Associated Infections	Provides resource information, publications and data on IPC activitiesincluding HAI and surveillance activities, reprocessing of reusable medical devices and AMS
Tasmanian Government – Infection Prevention and Control Service	Provides resource information and education resources, publications and data on IPC activities including HAI and surveillance activities
Victoria Health – Infection Control guidelines	IPC resources in Victoria

Safer Care Victoria	Victoria's quality and safety improvement agency. Workto monitor and improve the quality and safety of care
Department of Health and Human Services	Manages health data collections by suppling standards, specifications and quality processes and analysing data to assist health services develop services, policies and procedures.
Victorian Hospital Acquired Infection Surveillance System (VICNISS) https://www.vicniss.org.au/	Resources for surveillance activities in Victoria that collects and analyses data from acute care facilities. Provides data on results and resources for these activities.
Western Australia – Department of Health – IPC policies	Provides links to WA health policies and resources onIPC.
Western Australia – Department of Health – Infectious Disease Guidelines	Provides generic and specific advice for specific diseases and outbreak settings.
Australian Council for Healthcare Standards (ACHS)	Provides member organisations with risk management tools and clinical indicators.
Australian Aged Care Quality Agency http://www.accreditation.org.au/ Department of Health, Aging in Aged Care https://agedcare.health.gov.au/ensuring-quality	Provides aged care information relating to accreditationand regulatory requirements. Revised Aged Care Standards will be implemented in2019. Aging in Aged Care is linked to the Australian Aged Care Quality Agency and provides information on qualityand reporting of quality activities in aged care. This includes risk management and infection prevention control in this specialised area of healthcare.

Australasian College for IPC (ACIPC)	The College is the peak body for IPC professionals in the Australasian region with the vision of the prevention and control of infection in ourcommunities. The College commenced in January 2012 bringing together the various State and Territory infection control associations to support and encourage collaboration across Australasia.
Gastroenterological Society of Australia (GESA)	GESA is the peak membership organization for healthcare professionals and researchers working in gastroenterology and hepatology. GESA sets and promotes clinical practice standards, training and research. Infection Control in endoscopy resources can be located on their website.
Gastroenterological Nurses College of Australia (GENCA)	Professional organisation for nurses working in endoscopy. GENCA provide • The development of national standards and guidelines • Providing educational courses and supporting the COGEN credentialing program • Providing representation at state, national and international forums.
Healthcare Infection Control Special Interest Group (HICSIG)https://www.asid.net.au/groups/hicsig	HICSIG provides resources and education on IPC and antimicrobialstewardship
Institute of Healthcare Improvement	An independent resource centre that provides information and resources on improvement of health care world-wide.

Surveillance is the ongoing and systematic collection, analysis, interpretation and dissemination of data regarding a healthcare-related event. Surveillance can be used to measure performance in key areas such as:

- Assessing patient safety
- Measuring the effectiveness of an intervention strategy
- Benchmarking, and
- Contribution to other programs.

The surveillance of HAIs assists in identifying:

- Whether there is an infection problem
- The magnitude of the problem, and
- The factors that contribute to the infections

Surveillance programs should incorporate the principles of quality improvement.
In order to achieve this one approach would be to use **Plan - Do - Study - Act (PDSA)**. This method enables early identification of issues and opportunities for improvement through careful planning of what is going to be measured, ongoing analysis of data and action on results received as part of the broader facility quality improvement program.

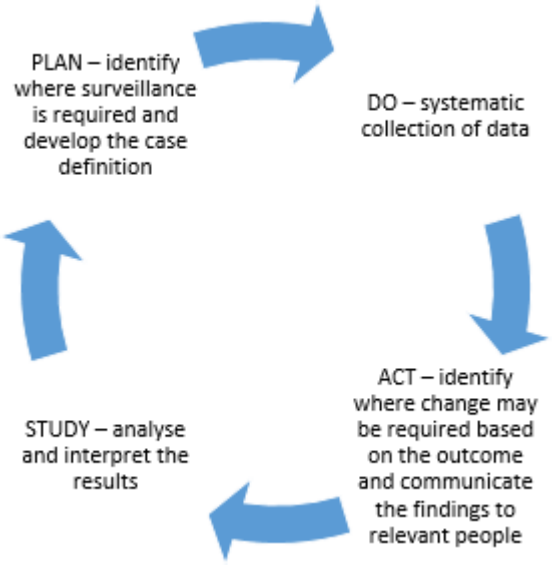
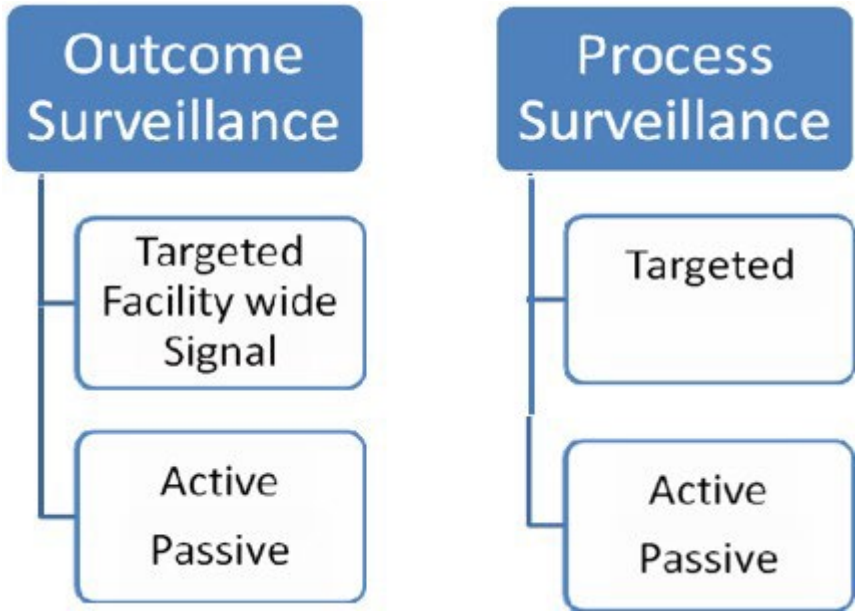


Image 7: An example of a PDSA cycle for surveillance. Source: NSW Health, Plan, Do, Study, Act Cycle https://www.health.nsw.gov.au/pfs/Pages/pdsa.aspx

Types of surveillance are outlined in the following diagram.



Specific high risk clinical areas such as Intensive Care Units (ICU) and High DependencyUnits, including neonatal and pediatric intensive care units, may perform routine HAI surveillance. Both process and outcome surveillance methods are used for surveillance inthese areas and focus on identified risk areas or sites. Examples of HAIs surveillance include:

- Central line associated blood stream infections, which account for approximately87% of primary blood stream infections
- Ventilator associated pneumonia, which accounts for up to 86% of pneumoniacases associated with mechanical ventilation
- Catheter related urinary tract infections, which account for up to 97% of ICU cases of urinary tract infections associated with indwelling urinary catheters
- Antimicrobial use and antimicrobial resistance in infectious agents, which create morbidity and mortality issues, especially in ICU [refer to module 4], and
- Surgical site infections (SSI) following an invasive surgical procedure, which are associated with significant morbidity, mortality and cost to the organisation and patient.

The following examples are scenarios that have been developed as additional material toassist with understanding surveillance activities.

Facility-wide ongoing surveillance

Scenario 1: The Infection Control Preventionist (ICP) at a rural aged care facility decidedto undertake targeted facility-wide surveillance to monitor the incidence of urinary tract infections associated with indwelling urinary catheters. This is an example of outcome

surveillance as the ICP is measuring the rate of infection. The ICP is able to perform this surveillance because the facility has only 12 residents and all are cared for by the local GP. Close liaison with the GP allows the capture all infections and identify possible trends.After twelve months of data collection and analysis, the data indicates that patients with indwelling urinary catheters have a higher infection rate than those patients without an indwelling urinary catheter. The ICP consulted similar facilities that collect data and confirms that the presence of an indwelling urinary catheter is a higher risk for infection. A reassessment of the surveillance plan and available time for the activity indicated that surveillance needed to be refined to concentrate on reducing urinary catheter related infections. The facility's surveillance program now focuses on clinical practices such as reviewing need for urinary catheters, hand hygiene, aseptic technique, and urinary catheter maintenance until infection rates have decreased significantly. The findings from the surveillance program are reported monthly to the facility management, medical officer,and clinical staff.

Point prevalence surveillance:

Scenario 2: The ICP at a small rural hospital undertakes a point prevalence survey of patients colonised with MRSA because several patients have had MRSA isolated from infected surgical wounds over the last month. Nose and groin swabs were collected fromevery patient on a particular day, but MRSA was not detected in any specimens.

To conclude that MRSA was no longer a problem based only on these results, may not be an accurate assessment. In this case, it would be more beneficial to undertake surgical site infection surveillance for a period of time (e.g. 3 to 6 months) to determine if a link betweenthe infections was identifiable, e.g. all patients with MRSA infected wounds had the same surgeon or were operated on in the same theatre etc.

How long should surgical site infection (SSI) surveillance continue?

The following examples provide some suggestions you may want to consider for surveillance activities and effective use of resources.

Example 1: Hospital A has conducted SSI surveillance on elective coronary artery bypass (CABG) surgery for twelve months. Eighty procedures were performed and the infection rate was 1 or less cases of SSI per 100 patient bed days each month. Based on these data the ICP decides that CABG surgery in this facility may not be a high risk for SSI and decides to focus surveillance resources on another surgical specialty for thenext 12 months.

Example 2: Hospital B has conducted surveillance on Lower Segment Caesarean Section(LSCS) for the last 12 months. LSCS procedures were the most commonly performed surgical procedure at this facility. The hospital also performed about 10 hip replacements (arthroplasty) per year. The LSCS infection rate after twelve months was 6%, half of whichwere deep wound infections (non-risk adjusted). The ICP contacted several similar sized facilities in other regions to compare rates and communicated the findings of the surveillance program to the surgical teams, clinical staff and quality manager of the facility. The ICP did not want to cease surveillance of LSCS due to the deep wound infection rate but also wanted to conduct sentinel surveillance on a second surgical

specialty such as hip arthroplasty (replacements), and in particular, adherence to the surgical antibiotic prophylaxis protocol. The ICP continued to monitor the SSI rate for LSCS surgery, reviewed contributing factors that lead to the development of deep wound infections for these patients and introduced interventions to reduce the risk of SSI for future LSCS patients for 12 months. After 12 months the ICP reviewed and evaluated the outcomes of the interventions and the SSI rate. The need for surveillance of hip arthroplasty (replacements) could be assessed by reviewing readmission rates of patientswith SSI for the facility over a specific time frame and identifying if and how many patientswere readmitted with SSI post hip arthroplasty (replacements).

Example 3: SSI surveillance has been conducted at Hospital C, a regional hospital, for the last three years. Data has been collected on three different procedures which are mostcommonly performed. One procedure was targeted each year. After three years, the infection rate for all procedures remained less than the jurisdiction's benchmark. The surgical procedures performed did not require the patients to remain in hospital for longer than a few days, so detecting infections unless readmitted to the hospital was not possible. The ICP considers the jurisdictional requirements for surveillance in the organisation and decides that sentinel events will be targeted for SSI surveillance and added aseptic technique, hand hygiene activities and staff education to the quality monitoring and surveillance activities undertaken. A three month surveillance snapshot of one of the surgical procedures each year for the next three years would also be undertaken. If infection rates increased in any of these procedure groups, the ICP would adjust the surveillance program accordingly.

Process surveillance

Monitoring
In the ICU of a large hospital, the ICP has been providing feedback on high infection ratesfor central line associated bacteraemia to the clinical staff and quality and safety manager.The rate has not decreased, despite introducing a "bundle" of interventions to prevent infection. The ICP decides to monitor/audit adherence to the "bundle protocol" by staff andprovide feedback on these results. In this case, the monitoring of the bundle protocol has a twofold effect. The staff are aware that they are being observed and they usually correctbad habits, or if they are unaware of the correct protocol they can be advised accordingly. Providing feedback on the results of the bundle protocol can assist in highlighting the bundle approach, correcting suboptimal practices or technique, or the need for additional resources in the ICU.

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NSW Health, Plan, Do, Study, Act Cycle https://www.health.nsw.gov.au/pfs/Pages/pdsa.aspx

Glossary

Acid fast stain: A differential stain use to identify Mycobacteria.

Aerobe: An organism that requires oxygen to grow.

Airborne precautions: Utilised to prevent transmission of aerosoled infectious agents (small airborne droplets less than 5 microns in size) that can remain infective over time and distance.

Anaerobe: An organism that does not requires oxygen to grow.

Aseptic technique: Method used to protect patients during an invasive procedure which employs infection control measures that minimise, as far as practicably possible, the presence of pathogenic organisms. (https://www.nhmrc.gov.au/health-advice/public-health/preventing-infection)

Association: In statistics, this refers to any dependence between two or more events, characteristics or other variables.

Bacilli: Bacteria with a rod-like shape.

Beta lactamase: An enzyme produced by bacteria that are resistant to antibiotics containing a Beta (β) -lactam ring such as penicillin and cephalosporins.

Bias: Any trend in the collection, analysis, interpretation, publication, or review of data thatcan lead to conclusions that are systematically different from the truth.

Bioburden: The number and the types of microorganisms present on an item prior to sterilisation.

Box plot: A graphical method of presenting the distribution of a variable measured on a numerical scale. Values are divided into quartiles.

Case: In epidemiology, a person in the population or study group identified as having a particular disease, health disorder, or condition under investigation.

Case control studies: An observational study of people with the disease (or other outcome variable) of interest and a suitable control (comparison, reference) group of persons withoutthe disease.

Cell wall: Outer layer of bacteria, plant and fungal cells that provides shape and structural support for the cell.

Cocci: Bacteria with a spherical or oval shape.

Cohort studies: Observation of a large number of people over a long period of time (commonly years) who have been or in the future may be exposed to factors hypothesisedand the occurrence of a given disease or outcome.

Colonising: Microorganisms which normally inhabit and reproduce in or on the human body without causing disease.

Contact precautions: Utilised to prevent transmission of blood, body substances or infectious agents by hand or via direct or indirect contact with contaminated surfaces or items.

Confidence interval: The probability, e.g. 95%, that the true value of a variable such asmean, proportion, or rate is contained within the interval.

Confounding: A situation which distorts the effect of an exposure on risk due to its association with other factors that can influence the outcome.

Control: In epidemiology, these are subjects with whom comparison is made in case control studies and Random Control Trials (RCTs).

Cross-sectional studies: Examines the relationship between disease and other variablesof interest as they exist in a defined population at one particular time.

Cytotoxin: A toxin that kills mammalian cells.

Denominator: In a fraction, it is the number below the line that indicates the number ofequal parts into which one whole is divided, e.g., 2/3 - 3 is the denominator.

Dependent variable: Variable of interest which should change in response to intervention.

Disinfectant: A chemical agent used on inanimate objects and surfaces (e.g. floors, wallsand sinks) to destroy most recognised pathogenic infectious agents but not necessarily all(e.g. bacterial spores).

Disinfection: Destruction of pathogenic and other kinds of infectious agents by physicaland chemical means.

Droplet precautions: Utilised to prevent direct transmission of infectious agents (larger than 5 microns in size) from the respiratory tract of the infected person to susceptible mucosal surfaces of another person. Transmission requires close contact as the dropletsdo not remain suspended in the air and generally only travel short distances, usually onemetre or less.

Ecological studies: Studies where the unit of analysis are populations or groups of people,rather than individuals.

Endemic: Sporadic infections that occur at a background rate.

Enzymatic cleaner: Enzymatic cleaning solutions contain enzymes which are capable of breaking down biological soils (containing proteins, lipids, carbohydrates and

mucopolysaccharides).

Epidemic: Occurrence of infection at a higher rate than the background rate.

Exposure Prone Procedure (EPP): EPPs are invasive procedures where there is the potential for direct contact between skin, usually a finger or thumb of the HCW,and sharp surgical instruments, needles, sharp tissues (e.g. fractured bones) spicules of bone or teeth in body cavities or in poorly visualised or confined body sites, including the mouth of the patient.

HAI: Healthcare-associated infection.

Hepatitis B surface antibody (anti-HBs/HBsAb): Indicates previous exposure or vaccination to Hepatitis B virus. The antibody protects the body from future Hepatitis B virusinfection.

Hepatitis B surface antigen (HBsAg): Is a protein antigen produced by Hepatitis B virus.This antigen is the earliest indicator of acute hepatitis B and frequently identifies infected people before symptoms appear.

Hepatitis C PCR: Detects the genetic material (RNA) of the virus in the blood using a special molecular technique. The amount of RNA can help determine how severe the infection is andhow easily hepatitis C infection can be spread.

Incidence: Number of new cases of infection during a specified period of time.

Independent variable: Variable in the intervention which is being manipulated.

Interquartile range (IQR): a measure of spread representing the middle 50% of the observations, calculated as the difference between the third quartile (75th percentile) andthe first quartile (25th percentile) CDC.

Liver function tests (LFTs or IQR): LFTS detect abnormal levels of enzyme production inthe liver, and the enzyme most commonly monitored using this test is alanine aminotransferase (ALT). When elevated above normal values, the ALT and aspartate aminotransferase (AST) tests indicate liver damage**.**

Mean: A measure of central tendency calculated by adding all individual values in the groupand dividing by the number of values in the group.

Median: A measure of central tendency calculated by dividing the lower and upper half of the measurements. The point on the scale that divides the group in this way is called the median.

Mould: A type of fungus, in contrast to a yeast, that forms multicellular hyphae that growson various kinds of damp or decaying matter.

MRSA: A strain of *S.aureus* that is resistant to methicillin as well as a number of other antibiotics.

Normal distribution: A graph of continuous measurement whose properties include

continuous symmetrical distribution with both ends extending to infinity, identical arithmetic mean, median and mode and whose shape is determined by mean and standard deviation.

Normal flora: A collection of microorganisms that live on or in a normal healthy individual without causing infection or disease.

Normal body flora: A collection of microorganisms that live on or in a normal healthy individual without causing infection or disease.

Numerator: In a fraction, it is the number above the line that indicates the number of partsof a whole, e.g., 2/3 - 2 is the numerator.

Odds Ratio: The ratio of two odds used to compare two groups in case control studies.

Occurrence: In epidemiology, this describes the frequency of a disease in a population without distinguishing between incidence and prevalence.

Opportunistic: An organism capable of infecting only when host defenses are compromised.

Organelle: A structure bound by a membrane and found in eukaryotic cells.

P value: A statistical measure calculated from various statistical tests ranging from 0-1 that assesses the degree of belief in a hypothesis or statement.

P2 or N95 particulate masks: Also called respirators, are PPE worn by HCW to protectthem from inhalation exposure to airborne infectious agents that are <5 microns in size.

Pandemic: An epidemic occurring over a very wide area, crossing international boundariesand affecting a large number of people.

Percentage: Proportion multiplied by 100.

Percentiles: The set of divisions that produce exactly 100 equal parts in a series ofcontinuous variables.

Plasmid: A small, circular, double extra-chromosomal DNA molecule which replicates independently of chromosomal DNA and can carry several genes that control plasmid or parent cell activity.

Population: In statistics, this refers to all inhabitants of a given country or area considered together.

Prevalence: The number of new and existing cases with infection over a given period oftime.

Prodromal Period: The period that precedes the onset of specific signs or symptoms that indicate the onset of a disease

Proportion: The number of patients with a given disease divided by the total number of patients included in the study.

Prospective: Studies that collect data by looking forward in time.

Quartiles: Division of a distribution into equal quarters.

Randomised controlled trails: An epidemiological experiment in which subjects in a population are randomly allocated into groups called *study* and *control* groups.

Range: The difference between the largest and smallest values in a distribution.

Rates: Rates are based on the number of infections that have occurred divided by the number of patients at risk over a fixed period of time. Similar to proportion but a multiplier isused (for example 1000, 10000 and 100000)

Ratio: The number of patients in a given group with a given disease divided by the numberof patients without the disease.

Relative Risk: The ratio of the risk of disease among the exposed to the risk among the unexposed and used in cohort and randomized controlled trials.

Retrospective: Studies that collect data by looking back in time.

Risk factor: Any aspect of behaviour, environment, or inherited characteristic, which on thebasis of epidemiological evidence is known to be associated with health related conditions considered important to prevent.

Sample population: These are measurements made on a subset of the population. The sample is intended to give results that are representative of the whole population.

Sensitivity: The proportion of individuals in a population that will be correctly identified when tested to detect a particular disease/ infection, calculated as the number of true positive results divided by the number of true positive and false negative results.

Single use item: Single use means the medical device or item is intended to be used on an individual patient during a single procedure and then discarded. It is not intended to be reprocessed and used on another patient. If a single use devices or item is marketed as non-sterile, then it will require processing to make it sterile and ready for use. The manufacturer of the device or item will include appropriate processing instructions to make it ready for use.

Specificity: The statistical probability that an individual who does not have the particular disease/ infection will be correctly identified as negative, expressed as the proportion of true negative results to the total of true negative and false positive results.

Spores: A reproductive structure formed by some Gram positive bacteria and fungi whichare highly resistant to heat and chemicals.

Standard deviation: A measure of dispersion or variation of values around the centre of a frequency distribution.

Standard precautions: Work practices to ensure basic IPC

apply to everyone regardless of perceived or confirmed infectious status. They are a firstline approach to reduce risk relating to potential transmission of infectious agents.

Transmissibility: Infectious microorganisms capable of being transmitted to another patient or host.

Transmission: Any mechanism by which an infectious agent is spread from a source or reservoir to another person.

Variable: Any quantity that varies and can have different values.

Virulence: The degree of pathogenicity of a microorganism.

Virus: An infectious particle consisting of nucleic acid and a protein coat. **Window**

period: The time from infection to development of detectable antibodies.**Yeast**: A

unicellular fungus

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