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1 Infection control strategy

Key points

- ✦ Because many infectious agents are present in health care settings, patients may be infected while receiving health care, health care workers may be infected during the course of their duties and other people may be infected when working or interacting with patients in a health care establishment.
- ✦ Health care associated infections could occur in any health care setting — for example, hospitals, general practice, day surgery centres, domiciliary nursing services, residential aged care, community services or office practices (dentistry, podiatry and so on).
- ✦ Adopting quality control measures (based on identifying hazards and assessing risks) may minimise health care associated infections.
- ✦ Successful infection control involves five elements, which form the basis for **Parts 1–5** of these guidelines:
 - applying basic infection control strategies (**Part 1**);
 - adopting quality management practices (**Part 2**);
 - developing effective work practices that prevent the transmission of infectious agents (**Part 3**);
 - managing specific infectious agents (**Part 4**); and
 - identifying infection control strategies in specialised health care settings (such as operating rooms, dentistry rooms, residential aged care facilities) (**Part 5**).

1.1 Introduction

Continually improving the quality of care and providing a safe working environment are fundamental activities for Australian health care establishments. An effective infection control strategy for preventing the transmission of infections from person to person within health care establishments is central to these activities.

Infectious agents evolve and constantly present new challenges in the health care setting. Continually modifying and improving procedures is important in meeting these challenges.

Infectious agents evolve and constantly present new challenges.

Many infectious agents are present in health care settings. Patients may become infected while they are receiving health care and health care workers (HCWs) are at risk while they are doing their work. Other people visiting and working in the health care establishment may also be at risk. In some cases, health care associated infections are extremely serious or even life threatening. HCWs should adopt the guidelines in this document to minimise infections.

1.1.1 Scope

This document has a broad scope and aims to establish a nationally accepted minimum standard for infection control. The guidelines provide a basis for HCWs and health care establishments to develop detailed protocols and systems for infection control that apply to their specific health care setting.

The guidelines apply to a wide range of health care establishments, including hospitals, office practices (medical and dental), nursing homes, extended care establishments, community nursing, emergency services and first aid services.

The following general definitions are used throughout these guidelines.

Health care associated infections — infections acquired in health care establishments ('nosocomial' infections) and infections that occur as a result of health care interventions ('iatrogenic' infections), and which may manifest after people leave the health care establishment.

Health care establishment — any facility that delivers health care services. Health care establishments could be hospitals, general practice surgeries, dentistry practices, other community-based office practices, day surgery centres, domiciliary nursing services, residential aged care facilities, alternative health provider facilities and other community service facilities, such as needle exchanges.

Health care workers (HCWs) — all people delivering health care services, including students, trainees and mortuary attendants, who have contact with patients or with blood or body substances.

▷ Definitions of other terms used in these guidelines are given in the **Glossary**.

1.2 Successful infection control

Maintaining a safe environment for people, patients and HCWs in a health care setting is a complex matter.

Maintaining a safe environment for people, patients and HCWs in a health care setting is a complex matter. Identifying hazards and classifying the associated risks is the key to successful infection control management. This task requires unselfish cooperation between management, HCWs and support staff.

Health care establishments should develop detailed protocols and policies that cover the five elements of successful infection control listed in the key points box at the beginning of this section. These elements are addressed in five main parts of these guidelines.

Part 1 Principles of infection control:

- overall strategy;
- basic measures for infection control (standard and additional precautions);
- identifying hazards and minimising risks;
- identifying who is at risk and from what;
- responsibilities of health care establishments, HCWs, patients, carers and other people; and
- routine practices essential for effective infection control, such as aseptic technique, handling of sharps, use of single-use equipment, reprocessing of instruments, antibiotic use and the appropriate use of antiseptics and disinfectants.

Part 2 Quality management:

- administrative arrangements for effective infection control, including
 - implementing an infection control program,
 - appointing an infection control committee and infection control practitioner,
 - compliance and accreditation standards,
 - quality improvement program maintenance,
 - continuum of care responsibilities, and
 - employee health policies;
- educating and training HCWs to improve their awareness and to encourage their compliance with national infection control standards; and
- ethical and legal issues that affect health care service delivery.

Part 3 Effective work practices and procedures:

- design and maintenance of premises;
- handwashing and personal hygiene;
- use of personal protective equipment;
- handling and disposal of sharps;
- management of clinical and related wastes;
- reprocessing of instruments and equipment (including instruments requiring special reprocessing);
- environmental cleaning and spills management;
- health care establishment support services (linen, laundry and food services);
- use of therapeutic devices;
- surveillance and outbreak investigations;

- protection for HCWs, including health status records, immunisation and testing of immune status;
- management of incidents involving blood or body fluid exposure;
- management of infections among HCWs;
- handling and use of blood and blood products; and
- organ and tissue transplants.

Part 4 Managing infectious diseases in the health care setting:

- identification of major risk factors;
- recommendations for management procedures for patients, HCWs, instruments and the health care environment; and
- short descriptions of the viral, bacterial, antibiotic-resistant and other diseases that are important in the health care setting.

Part 5 Infection control in specific health care settings:

- identification of the major risk factors and management procedures for specialised health care settings:
 - operating rooms;
 - office practice (general);
 - dental practice;
 - midwifery and obstetrics;
 - home and community; and
- long-term care.

HCWs should recognise that, although specific settings may have their own requirements, the principles outlined in these guidelines form the basis for infection control procedures in all health care settings.

Overall, successful infection control depends on:

- each health care establishment ensuring that policies and practices are guided by an infection control professional;
- provision of adequate resources (people, equipment and space) to do the work of infection control, consistent with both the establishment's infection control strategic plan and its business plan;
- application of the infection control program across all components in the organisation, including support services as well as direct clinical care;
- integration of a system of quality management into the infection control program;
- appropriate training and management of all staff, fostering commitment to the infection control program;

- ongoing assessment of the infection control program, including incident monitoring, that encourages adjustment to work practices when required; and
- regular evaluation of the infection control program, with feedback to management and HCWs on the program's effectiveness and provision for adjustment as required.

2 Basic infection control measures

Key points

- ✦ *Standard precautions* are standard operating procedures that apply to the care and treatment of all patients, regardless of their perceived infectious risk. These precautions include aseptic technique, handwashing, use of personal protective equipment, appropriate reprocessing of instruments and equipment and implementation of environmental controls. Standard precautions should incorporate safe systems for handling blood (including dried blood), other body fluids, secretions and excretions (excluding sweat), nonintact skin and mucous membranes.
- ✦ *Additional precautions* are required when standard precautions may not be sufficient to prevent the transmission of infectious agents (eg tuberculosis, measles, Creutzfeldt–Jakob disease). Additional precautions are tailored to the specific infectious agent concerned and may include measures to prevent airborne, droplet or contact transmission and health care associated transmission agents.

2.1 Background

The strategies for infection control described in these guidelines are based on current understanding of the aetiology of the infections involved and the most effective ways to control them. Before the advent of human immunodeficiency virus (HIV) in the early 1980s, and the increase in high-throughput, short-stay surgical and medical treatments, the majority of recognised health care associated infections occurred in hospitals.

Before the 1980s, infection control systems were based on identifying at-risk patients in hospitals and applying isolation systems or special treatments. The isolation approach failed to take account of the possibility of transmitting infection from asymptomatic individuals, particularly those with bloodborne viruses or antibiotic-resistant bacteria.

By the mid-1980s, the acquired immune deficiency syndrome (AIDS) epidemic created an urgent need for new strategies to protect health care workers (HCWs) from bloodborne infections in their working environment. In 1985, universal blood and body fluid precautions (universal precautions) were proposed by the United States Centers for Disease Control and Prevention (CDC 1987). This new approach emphasised the universal use of blood and body fluid precautions regardless of a patient's presumed infectious status.

Strategies for infection control are based on the aetiology of the infections involved and the most effective ways to control them.

As initially defined by the CDC, the term ‘universal precautions’ applied to blood and body fluids that were implicated in transmitting bloodborne infections. CDC universal precautions do not apply to faeces, nasal secretions, sputum, sweat, tears, urine or vomit, unless they contain visible blood (CDC 1994a).

State/Territory health departments in Australia adopted a broader approach to universal precautions. They agreed that all blood and body substances should be considered potentially infectious and introduced the principle of ‘standard precautions’. This level of care was applied to all people, regardless of their perceived or confirmed infectious status, as a strategy for minimising health care associated infections from both asymptomatic and symptomatic people. In 1996, the National Health and Medical Research Council (NHMRC)/ Australian National Council on AIDS (ANCA) Infection Control Working Party broadened the scope of this approach and adopted the terms ‘standard precautions’ and ‘additional precautions’ (based on modes of transmission of infectious agents), to define appropriate work practices.

The terms ‘standard precautions’ and ‘additional precautions’ define appropriate work practices.

- **Standard precautions** are work practices required to achieve a basic level of infection control and are recommended for the treatment and care of all patients (see **Section 2.2**).
- **Additional precautions** are recommended for patients known or suspected to be infected or colonised with disease agents that cause infections in health care settings and that may not be contained by standard precautions alone (see **Section 2.3**).

This two-tiered approach should provide high-level protection to patients, HCWs and other people in health care establishments.

2.2 Standard precautions

Standard precautions are work practices required to achieve a basic level of infection control. **Table 2.1** provides a directory of these work practices, which are pivotal to infection control in the health care environment.

Table 2.1 Standard precautions for infection control in health care settings

Work practice	Relevant section(s)
Aseptic technique, including appropriate use of skin disinfectants	6.1, 7
Personal hygiene practices, particularly handwashing before and after all significant patient contacts	12
Use of personal protective equipment, which may include gloves, impermeable gowns, plastic aprons, masks/face-shields and eye protection	13
Appropriate handling and disposal of sharps and other clinical waste	14, 15
Appropriate reprocessing of reusable equipment and instruments, including appropriate use of disinfectants	7, 16, 17
Environmental controls, including design and maintenance of premises, cleaning and spills management	11, 18
Appropriate provision of support services, such as laundry and food services	19

Standard precautions are recommended for the care and treatment of all patients, regardless of their perceived or confirmed infectious status, and in the handling of:

- blood (including dried blood);
- all other body fluids, secretions and excretions (excluding sweat), regardless of whether they contain visible blood;
- nonintact skin; and
- mucous membranes.

The use of standard precautions is essential as the primary strategy for the successful minimisation of transmission of health care associated infection. This is because:

- infectious patients may not show any signs or symptoms of infection that may be detected in a routine history and medical assessment;
- a patient's infectious status is often determined by laboratory tests that may not be completed in time to provide emergency care;
- patients may be infectious before laboratory tests are positive or symptoms of disease are recognised (the window period of disease); or
- people may be placed at risk of infection from those who are asymptomatic but infectious.

The work practices listed in **Table 2.1** should be considered minimum requirements for infection control. Implementing standard precautions minimises the risk of transmission of infection from person to person even in high-risk situations. Standard precautions should be implemented at all times,

Standard precautions are recommended for the care and treatment of all patients.

particularly when patients are undergoing invasive procedures, including catheterisation, cannulation or intubation. Health care establishments that offer these procedures should provide detailed protocols for patient management in their infection control procedures manuals.

DISCUSSION POINT



Routine practices questioned

Over years, many routine practices intended to reduce infection risk have been adopted in the workplace. Examples include wearing masks in operating theatres by all personnel, the use of overshoes, being required to wear a fresh uniform every day, and excluding nasal staphylococcal carriers from designated duties.

There have been no scientific trials to provide evidence to support most of these practices. Nevertheless, some activities, such as washing hands between administering care to successive patients, have a credible history to support their routine application in preventing cross-infection. Other practices, such as some uniform and clothing requirements, have more to do with the ethos of quality care and workplace culture than with a proven reduction of cross-infection.

Today, people are questioning routine practices such as wearing protective masks for routine procedures. This may be appropriate. However, the absence of evidence to support routine practices should not be considered to be a basis for abandoning them. Rather, routine practices should continue until there is sufficient evidence to support alternative procedures.

2.3 Additional precautions

Additional precautions should be applied in a health care setting for patients known or suspected to be infected or colonised with infectious agents that may not be contained with standard precautions alone and that could transmit infection by the following means:

- airborne transmission of respiratory secretions (eg pulmonary tuberculosis, chickenpox, measles);
- droplet transmission of respiratory secretions (eg rubella, pertussis, influenza);
- contact with patients who may be disseminators of infectious agents of special concern (eg faecal contamination from carriers of vancomycin-resistant enterococci); and
- inherent resistance to standard sterilisation procedures, or other disease-specific means of transmission where standard precautions are not sufficient (eg patients with known or suspected Creutzfeldt–Jakob disease — see **Section 31**).¹

¹ Unless otherwise specified, in this document, the term ‘Creutzfeldt–Jakob disease (CJD)’ is used as a general term to cover the classical forms of CJD (including related human transmissible spongiform encephalopathies) and variant CJD. For further details of this group of diseases, see **Section 31**.

Additional precautions should be tailored to the particular infectious agent involved and the mode of transmission, and may include one or any combination of the following:

- allocation of a single room with ensuite facilities;
- a dedicated toilet (to prevent transmission of infections that are transmitted primarily by contact with faecal material, such as for patients with infectious diarrhoea or gastroenteritis caused by enteric bacteria or viruses);
- cohorting (room sharing by people with the same infection) if single rooms are not available;
- special ventilation requirements (eg monitored negative air pressure in relation to surrounding areas);
- additional use of personal protective equipment (eg a well-fitting respiratory protection device for HCWs attending to patients in respiratory isolation; a 0.3- μm particulate filter respiratory protection device² is recommended for tuberculosis);
- rostering of immune HCWs to care for certain classes of infectious patients (eg those with chickenpox);
- dedicated patient equipment; and
- restricted movement both of patients and HCWs.

Table 2.2 shows an outline of the application of additional precautions for infections with respiratory (airborne or droplet) transmission or contact transmission.

Additional precautions are not required for patients with bloodborne viruses, such as HIV, hepatitis B virus or hepatitis C virus, unless there are complicating infections, such as pulmonary tuberculosis.

To minimise the exposure time of other people in office practices or hospital waiting rooms, people identified as at risk of transmitting droplet or airborne diseases (eg a child with suspected chickenpox) should be subject to additional precautions and also be attended to before other people waiting for treatment.

Additional precautions are tailored to the particular infectious agent.

▷ Further information about specific diseases is given in **Part 4** (Managing infectious diseases in the health care setting).

² See **Section 13.4** for definition and description of appropriate masks and personal respiratory protection.

Table 2.2 Outline of requirements for specified categories of additional precautions

Requirement	Additional precautions type		
	Airborne transmission	Droplet transmission	Contact transmission
Gloves	None	None	For all manual contact with patient, associated devices and immediate environmental surfaces
Impermeable apron/gown	None	None	Use when HCWs' clothing is in substantial contact with the patient (includes items in contact with the patient and their immediate environment)
Respirator or mask	Particulate filter personal respiratory device for tuberculosis only All others, surgical mask ^a	Surgical mask ^a	Protect face if splash likely
Goggles/face-shields	Protect face if splash likely	Protect face if splash likely	Protect face if splash likely
Special handling of equipment	None	None	Single use or reprocess before reuse on next patient (includes all equipment in contact with patient)
Single room	Yes (or cohort patients with same infection) Door closed	Yes (or cohort patients with same infection) Door closed	If possible, or cohort with patient with the same infection (eg methicillin-resistant <i>Staphylococcus aureus</i>)
Negative pressure	Essential for pulmonary tuberculosis	None	None
Transport of patients	Surgical mask ^a for patient Notify area receiving patient	Surgical mask ^a for patient Notify area receiving patient	Notify area receiving patient
Other	Encourage patients to cover nose and mouth when coughing or sneezing and to wash their hands after blowing nose Provide one metre of separation between patients in ward accommodation	Provide one metre of separation between patients in ward accommodation	Remove gloves and gown, and wash hands before leaving patient's room

^a Surgical mask refers to a fluid-repellent, paper filter mask used in surgical procedures (see **Section 13.4** and AS 4381).

2.4 Triage policy

Specific triage policies should be developed to minimise transmitting diseases to other patients in outpatient and emergency units or health care waiting rooms. This applies particularly where there is a high risk of transmission (eg respiratory viruses such as respiratory syncytial virus, influenza and chickenpox). Triage staff and clinicians have a pivotal role in instigating an outbreak management plan.

Triage staff and clinicians have a pivotal role in instigating an outbreak management plan.

Before admission to hospital or on presentation at an emergency unit, a detailed medical history should be collected from individuals or their carers to identify conditions that may require additional precautions. Triage staff should use a checklist to assess patients for conditions that require additional precautions, as well as for prioritising those who may require urgent attention, isolation or immediate treatment.

When referring patients (for surgery, dental treatment or hospital admission) the treating doctor should advise the clinician in charge of admission of any known infectious conditions that are relevant to the purpose of the referral. The patient's consent should be sought before the release of any sensitive information.

▷ For further information see **Section 10** (Ethical and legal issues).

2.5 Quarantine

The Australian Government has legislative responsibility for human quarantine. Under the Human Quarantine Program, it develops policy on diseases of quarantine importance and, in collaboration with the chief quarantine officers (CQOs) of each State/Territory health department, coordinates the national response to outbreaks of quarantinable diseases.

Certain diseases are listed as quarantinable under the *Quarantine Act 1908* (Commonwealth) and its proclamations. These include yellow fever, cholera, plague, rabies, Japanese encephalitis and four viral haemorrhagic fevers (Crimean–Congo, Ebola, Lassa and Marburg). The CQO of the relevant State or Territory should be notified immediately, by phone or fax, of any suspected or confirmed case of a quarantinable disease as required by local legislation. Contact may be made through the State/Territory health department.

2.6 Handling and transport of deceased patients

All bodies of deceased patients should be handled using standard precautions, as bloodborne pathogens may remain infective for some time. Any exposures to blood or body fluids should be reported and managed as outlined in **Section 23**. If additional precautions were required before death, people who handle the body after death should continue these precautions.

▷ Any exposures to blood or body fluids should be reported and managed as outlined in **Section 23**.

Viewing of the body by relatives should not be prohibited on infection control grounds. Unless there is likely to be contact with blood or other body fluids of the deceased, relatives should not be discouraged from superficial contact, such as touching or kissing.

When deceased patients need to be transported, appropriate arrangements should be made to contain any potential spillage of blood or body fluids. Generally, an impervious plastic wrap should be used to encase the deceased patient before transport. The Australian Funeral Directors Association (AFDA 1992) suggests the use of polyethylene sheeting of suitable strength and size folded into an 'envelope' and sealed with 40-mm wide waterproof adhesive tape.

HCWs involved in the transport and handling of deceased patients should be aware of the danger from sharps that are still with or in the body. Appropriate personal protective clothing should be worn when handling deceased patients.

3 Identifying hazards and minimising the risks of infection

Key points

- ✚ To successfully control transmission of infectious agents in health care settings it is necessary to:
 - identify hazards;
 - assess, classify and manage risks; and
 - develop risk management protocols and communication strategies to effectively minimise the risks.

3.1 Identifying hazards

A hazard in a health care setting is defined as an agent (biological, chemical or physical) that has the potential to cause harm to people or the environment. In infection control, a hazard is either an infectious agent or a mechanism that allows the transmission of an infectious agent (eg invasive device).

A hazard is an agent that has the potential to cause harm to people or the environment.

Identifying a hazard involves:

- identifying and documenting the activities and tasks that put patients and health care workers (HCWs) at risk of infection (eg sharps injury);
- identifying and documenting the infectious agent involved;
- identifying and documenting the route of infection; and
- obtaining evidence to confirm that the infection may be spread using this route (observational or experimental studies plus expert knowledge).

3.2 Assessment of risks

Risk assessment for the transfer of infectious diseases includes:

- **hazard identification** — see **Section 3.1**;
- **hazard characterisation**, which involves evaluating the infective dose of the infectious agent and a relationship between the dose received and the frequency/severity of the infection (dose–response relationship), and
 - knowledge of infectious agents, epidemiology etc;

- assessment of the health care establishment physical environment (layout, facilities and practices);
- assessment of current infection control procedures;
- analysis of records of infection; and
- level of knowledge and/or training of patients and HCWs;
- **exposure assessment**, which involves evaluating factors relating to hazard exposure to determine the dose of infectious agent received, which may be quantitative or qualitative (for example, for a sharps injury this would be the source of infection and the level of contamination); and assessing
 - patient categories;
 - HCW categories;
 - procedures (critical, semicritical, noncritical); and
 - frequency of exposure; and
- **risk characterisation**, which involves integrating hazard and exposure information to give a qualitative estimate of risk (eg low risk) or, if data are available, a quantitative population-based estimate (eg 1 in 1000).

3.3 Risk management

The purpose of risk management/control is to minimise people's exposure to sources of infection, including blood or body fluids, in the health care setting. Depending on the nature of specific risks, risk management may be achieved by:

- eliminating the risk factors;
- modifying procedures, protocols and work practices;
- engineering controls;
- implementing safe work practices;
- monitoring HCW and patient compliance with infection control procedures;
- providing HCWs with information about personal health conditions that may place them or patients at risk;
- providing information/education and training to patients and HCWs; and
- using personal protective equipment appropriately.

In addition to AS/NZS 4360:1995, a framework for identifying hazards, assessing the risks and implementing risk management is provided by the 'hazard analysis critical control points' (HACCP) approach (ANZFA 1996, Mortimore and Wallace 1998), which is based on the following principles:

- determining critical control point plans required to control identified hazards;

- specifying critical limits that determine whether a procedure is under control at a particular control point;
- establishing a monitoring system for critical limits;
- implementing corrective action if critical limits are not met; and
- verifying that the system is operating according to specification.

These principles form a framework to link identifying specific hazards with critical control points. Implementing suitable procedures within this framework should provide effective control over the transmission of infectious agents in the health care setting.

For example, the critical points for ensuring that reprocessed instruments are sterile may include cleaning the instruments before sterilisation, packing the sterilised units and validating the steam sterilisation process. Routine procedures are then required to ensure that each of these identified critical control points is adequately monitored (for example, see AS/NZS 4185¹).

Using this approach, critical control pathways may be mapped for all activities where hazards have been identified. The higher the risk associated with the identified hazard, the more critical control points and/or the more rigorous the monitoring procedures that may be required.

Health care establishments have a legal and ethical responsibility to provide HCWs with:

- risk assessment guidelines;
- a safe working environment;
- effective workplace instruction and ongoing education about infection control procedures;
- appropriate facilities and equipment, including occupational health services; and
- health screening programs.

Ongoing monitoring and evaluation of infection control procedures is also required.

Critical control pathways may be mapped for all activities where hazards have been identified.

▷ Details of the application of HACCP principles for food preparation are given in **Section 19.2**.

3.4 Risk communication

Risk communication is the process of interactive exchange of information and opinion among risk assessors, risk managers and other interested parties. For this to occur, infection control objectives should be established and evaluated regularly. Feedback on the effectiveness of infection control programs should be provided to all the stakeholders of the establishment.

¹ AS/NZS 4815 (2001) *Office-based health care facilities not involved in complex patient procedures and processes — Cleaning, disinfecting and sterilising reusable and surgical instruments and equipment*.

3.4.1 Health care establishment communication strategies

An empowering infrastructure and environment are important factors for increasing the level of compliance with infection control programs. Hence, management should:

- provide direction (eg nominate issues for attention that are relevant to the establishment, such as rotavirus in paediatrics or urinary catheter sepsis in paraplegic care);
- establish goals (ie nominate benchmark rates for performance improvement);
- provide resources; and
- provide information to individuals, self-directed work groups, patients and other stakeholders, with an emphasis on continually improving performance.

Health care establishments should incorporate a communication plan and process that:

- provide timely information necessary to accomplish their objectives;
- facilitate feedback; and
- increase awareness of the infection control program.

3.4.2 Health care worker communication strategies

Strategies for communicating infection control issues among HCWs include:

- developing a set of shared values, behavioural guidelines and quality principles in support of the establishment's infection control strategy that are reflected in job descriptions and duty statements;
- communicating annual infection control objectives to HCWs in simple and measurable terms to form the basis for HCW work plans;
- ensuring that HCWs understand the establishment's infection control objectives and can articulate their contribution as part of regular HCW performance reviews;
- ensuring that all HCWs understand the link between the establishment's infection control program objectives and their personal work objectives;
- undertaking regular reviews to ensure that HCW objectives are translated into work plans that act as
 - a mechanism for ongoing formal feedback on individual and collective behaviours, and
 - a system to build feedback into the process of continuous personal improvement; and
- holding multidisciplinary workshops to
 - devise individual infection control codes of conduct,
 - communicate the interdependent mechanisms of infection control, and
 - build infection control codes into career development.

3.4.3 Patient communication strategies

Health care establishments are responsible for communicating to patients their reasons for infection control policies and procedures. This should encourage the patient cooperation required to minimise cross-infection.

Education

Patient cooperation is vital to an effective infection control program. Health care establishments should inform patients about the risks associated with medical and surgical treatment.

Patient cooperation is vital for effective infection control.

Educational material should be provided in all health care settings, including the home/community setting, using a variety of media, including posters, printed material and educational videos. Patients should be familiarised with the infection control strategies that are employed in health care establishments to protect them, the people caring for them and the health care environment. They should also be provided with information about procedures for dealing with infection control breaches.

Risk disclosure

Health care establishments should inform patients about the risks associated with their medical care and the protocols for protecting their privacy and confidentiality. Patients should be encouraged to disclose their health or risk status, and any lifestyle choices that make them a potential risk or source of infection to HCWs or others within the health care establishment. Informing the patient of the protocols for protecting their privacy and confidentiality should form part of this discussion.

Patients should be informed about, and encouraged to use, feedback procedures to staff/management for any concerns they have about infection control procedures.

3.4.4 Communication with the health care industry

HCWs should liaise with the health care industry and interest groups to improve infection control procedures by providing feedback about equipment design. Risk prevention and optimal maintenance and cleaning by health care establishments should be considered, in conjunction with evidence-based infection control data, to ensure that high standards of design are achieved.

3.5 Tracking and traceability

For surveillance purposes, and in the event of a lookback investigation, health care establishments should implement an effective system to track and trace surgical instruments and devices that have been associated with health care associated infections.

Health care establishments need to track key items of equipment.

▷ See **Section 17** for further information on instruments and equipment that require special processing.

3.5.1 Devices and instruments

Health care establishments should have systems in place that allow key items (for high-risk procedures, see **Table 4.1**) of equipment to be tracked. Those hard-to-clean instruments classified as semicritical items (see **Table 4.2**) that have been known to transmit infectious agents (eg flexible endoscopes) should also be tracked. The system should show individual devices and instruments, details of patient use, details of reprocessing steps, and process validation proof (see **Section 17.1.2** for further information).

Health care establishments should be able to identify the patients on whom individual instruments have been used so that these patients may be traced if potential exposures have occurred (eg after use on patients with Creutzfeldt–Jakob disease or pulmonary tuberculosis).

3.5.2 Prostheses

Due to the potential dangers in the use of prostheses, health care establishments that are involved in the implantation or insertion of prostheses must maintain adequate records. These records must cross-reference patients with the batch and manufacturer code details of all implanted prostheses to allow identification of individual patients in the event of a recall or other event (eg health risk).

3.5.3 Contact tracing

When there are cases of specific infectious diseases (eg tuberculosis, measles), the health care establishment involved may be required to provide details of patients, HCWs and others who may have been exposed to the disease to public health officials responsible for tracing and informing potentially exposed persons. Health care establishments should maintain appropriate systems to enable such tracing.

4 Who is at risk and from what?

Key points

Risk of contracting a health care associated infection

- ✦ Patients may contract infections from themselves (endogenous infection) or from other patients, health care workers (HCWs), instruments and equipment, or the environment (exogenous infection). The level of risk relates to the health care setting (specifically, the presence or absence of infectious agents), the type of health care procedures performed and the susceptibility of the patient to infection.
- ✦ HCWs may contract infections from infected patients, instruments and equipment, or the environment. The level of risk relates to the type of clinical contact HCWs have with potentially infected patient groups, instruments or environments, and the health status of the HCW (eg immunised or previously exposed).

Risk of transmitting a health care associated infection

- ✦ Patients may transmit infections to other patients, HCWs, instruments and equipment, or the environment. The level of risk relates to the transmissibility of the infectious agent, the availability of a route of transmission, the susceptibility of exposed persons, and the success of applied control measures (ie standard and additional precautions).
- ✦ HCWs may transmit infections to patients during clinical contact, or to other HCWs, instruments and equipment, or the environment. The level of risk relates to the procedures undertaken (interviews and noninvasive procedures being the lowest risk and exposure-prone invasive procedures the highest risk) and the efficacy of the aseptic techniques used.
- ✦ Instruments and equipment may transmit infections to patients during clinical procedures. The level of risk relates to the site where the instrument is used — instruments that contact sterile tissue (critical sites) have the highest risk; instruments that contact only intact skin (noncritical sites) have the lowest risk.
- ✦ Infections may be transmitted from the environment when infectious agents are provided with a route of entry into susceptible patients or HCWs (eg airborne bacterial contamination of open wounds). The level of risk relates to the susceptibility of the patient or HCW, the availability of a route of entry from the environment and the level of contamination of the environment.

4.1 Spreading infection

The spread of infection requires three elements:

- a source of infecting microorganisms or other infectious agents (at a sufficient level to cause infection);
- a susceptible host; and
- a path for transmission of the infectious agent to the susceptible host.

Patients and health care workers (HCWs) can be sources and hosts for infectious agents.

In hospitals or other health care establishments, patients and health care workers (HCWs) are both potential sources and potential hosts for infectious agents. Human hosts may be people who are acutely ill, people who have no symptoms but who are in the incubation or window period of a disease (ie the time after infection has occurred but before a diagnosis is possible), or people who are chronic carriers of an infectious agent. Other sources of infectious agents are the normal endogenous microbial flora of patients or HCWs, or environmental sources, such as air, water, medications or medical equipment and devices that have become contaminated.

People have variable resistance to infection, depending on their age, underlying disease and other factors that may compromise their immune status, such as medical treatment with immunosuppressive drugs or irradiation. The risk of transmission of infection is higher for patients undergoing invasive procedures, and for patients who stay in hospital for a long time. ‘Indwelling’ devices (eg catheters) may increase the risk of infection, particularly when used over long periods. These risk factors are discussed further in this section by considering four main elements:

- patients
- HCWs
- instruments and equipment
- the health care environment.

▷ The risks associated with specific routes of infection are described in more detail in **Part 4** (Managing infectious diseases in the health care setting).

Infections may pass between any of these elements in either direction, as shown in **Figure 4.1**. The risks associated with specific routes of infection are described in more detail in **Part 4** (Managing infectious diseases in the health care setting).

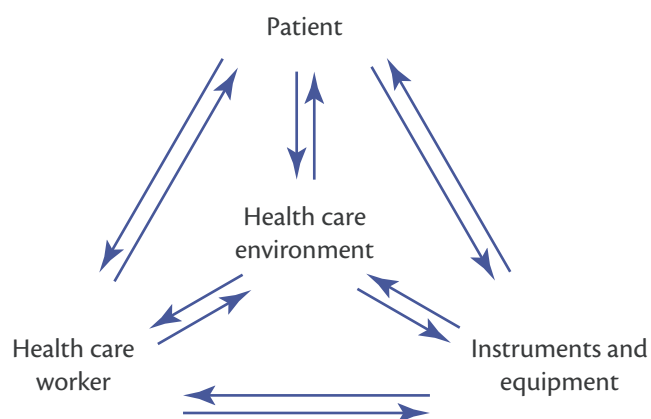


Figure 4.1 Spread of infection in health care settings

4.2 Patients

4.2.1 Risk of contracting a health care associated infection

Patients may contract infection from:

- their own (endogenous) flora;
- exogenous sources, including:
 - contact with other patients or with HCWs;
 - cross-contamination of equipment by either infected patients or HCWs;
 - procedures (eg inadequately reprocessed instruments); and/or
 - the health care environment (eg ventilation, food).

Infection from within

The most common source of health care associated infection is the patient's own flora. Some infections of this type may even be considered 'inevitable' (eg fungal infections in immunocompromised patients). Infection control practices should minimise the risk from the patient's own normal (endogenous) flora (eg the use of skin antisepsis before invasive procedures), as well as from exogenous sources (eg appropriate reprocessing of instruments).

DISCUSSION POINT



The risk of a patient contracting a health care associated infection is related to:

- the presence or absence and the burden of infectious agents (either endogenous or exogenous);
- the susceptibility of the individual patient to infection; and
- the type and quantity of health care procedures performed on the patient.

The burden of infectious agents is related to:

- the number of infectious agents present (dose); and
- their virulence (the ability to cause disease).

Susceptibility to infection is related to:

- disease immunity and/or immunisation status;
- systemic immune deficiency (inherent or acquired, including treatment-mediated);
- physical breaches of body defence mechanisms (eg invasive devices, surgical wounds);
- skin/mucosal conditions (eg psoriasis, excoriation); and
- other physical/health factors (eg age, pregnancy).

Immunocompromised patients are generally at increased risk from both endogenous and exogenous sources of infection. They may vary in their susceptibility to health care associated infections, depending on the severity and duration of immunosuppression. These patients may be particularly susceptible to environmental contaminants, such as *Legionella* spp or *Aspergillus* spp.

Children and confused adults who have not learnt, or are unable, to control their personal hygiene pose an additional challenge to maintaining infection control standards in health care establishments because they may be incontinent and use their hands and mouths to explore the environment. Very young children or babies may also be at increased risk of health care associated infection due to their general lack of exposure to common diseases in the community, and due to their current immunisation status.

The type and quantity of health care procedures relates to factors such as:

- whether the procedure is invasive or exposure prone;
- the duration of the procedure or use of the device;
- the number of procedures performed (eg multiple procedures on one patient); and
- whether the instruments have been appropriately reprocessed.

4.2.2 Risk of transmitting a health care associated infection

Patients may transmit infection to other patients, HCWs or visitors when:

- they have an active symptomatic infection;
- they are infectious with detectable markers for a particular disease but asymptomatic (ie asymptomatic carriers); and/or
- they are infectious but have no detectable markers (ie 'window period').

Infected or not?

The chances of patients being infectious but asymptomatic may vary among different population groups and this may be used to determine risk status. For example, intravenous drug users demonstrate a higher prevalence of, and a higher risk of contracting, bloodborne viral diseases (eg hepatitis C) than nonusers.

However, such 'lifestyle' information may not be volunteered by the patient, and the right to privacy must be respected. All patients should therefore be considered potential infectious risks.

DISCUSSION POINT

The risk of transmission of infection to others is also related to factors such as the susceptibility of others to infection and the availability of a route of transmission (see **Section 4.2.1**).

4.3 Health care workers

4.3.1 Risk of contracting a health care associated infection

The main risk to HCWs is that they may contract an infection from contact with patients, instruments or the health care environment. The risk of an HCW contracting a health care associated infection is related to the presence or absence and the burden of infectious agents (number and virulence), the susceptibility of the individual HCW to infection and the type of infectious hazard encountered (see **Section 4.2.1**).

HCWs may contract an infection from patients, instruments or the environment.

The infectious hazards encountered by particular types of workers vary between and within health care establishments. For example, clerical staff in a paediatric outpatient clinic may encounter viral infections more frequently than clerical staff in a pay office.

HCWs can be placed in three main categories in relation to infectious hazards:

- clinical contact
- nonclinical contact
- laboratory and mortuary staff.

The categories are useful for targeting education programs and establishing immunisation protocols. However, they are not comprehensive and do not necessarily represent the category that should be assigned to HCWs in similar positions in all health care establishments.

Clinical contact

This category includes all HCWs who have clinical contact with patients. Some clinical contact HCWs have physical contact with, or potential exposure to, blood and body substances. This group includes:

- dentists, medical practitioners, nurses, student HCWs and allied health practitioners;
- emergency HCWs (fire, police, ambulance and volunteer first aid workers);
- maintenance personnel who service clinical equipment;
- sterilisation services personnel;
- mortuary technicians; and
- cleaning staff and waste management personnel.

The clinical contact category also includes HCWs in patient areas who have less direct contact with patients or with blood or body substances. These HCWs may be exposed to droplet-spread infections, such as rubella, but are unlikely to be at risk from bloodborne diseases. Examples include:

- catering staff
- primary care reception staff and ward clerks
- maintenance personnel.

Nonclinical contact

In many health care establishments, clerical staff, gardening staff and many other occupational groups have no greater exposure to infectious diseases than does the general public. These employees do not need to be included in vaccination programs or other programs aimed at protecting clinical contact staff.

Laboratory and mortuary staff

Laboratories contain special risk factors because of the equipment used (eg centrifuges) and the possibility of exposure to high concentrations of infectious agents generated by culture procedures. The major risk to laboratory staff occurs in the handling of blood and blood products.

The strategies for controlling infectious hazards in laboratories to create a safe working environment should be covered in laboratory manuals prepared inhouse in individual establishments to address the specific disease agents likely to be encountered, based on AS/NZS 2243.3.¹

¹ AS/NZS 2243.3 (2002) *Safety in laboratories — Part 3: Microbiological aspects and containment facilities*.

Mortuary staff may be at risk of exposure to infectious agents through contact with body substances, or through procedures such as autopsies or embalming. These risks may be minimised by appropriate handling of deceased patients (see **Section 2.6**) and the use of standard precautions. Further information about safe work practices in mortuaries may be found in AFDA (1992, 1995).

4.3.2 Risk of transmitting a health care associated infection

The risks of an HCW transmitting an infection to a patient in their care, another HCW or a visitor are the same as those described in **Section 4.2.2** for patients.

Transmission from HCW to patient

The risk of an infected HCW transmitting an infection to patients is of particular concern. The possibility of this happening is related to the types of procedures the HCW is involved in, their infection status and the types of patients they provide care for. **Table 4.1** shows the level of risk to patients from HCWs infected with bloodborne viruses associated with various clinical procedures, from low-risk procedures (such as an interview or noninvasive examination), to high-risk, exposure-prone procedures (see below).

Invasive procedures carry a risk of infection and include any situation where an HCW enters the tissue, body cavity or organs of a patient, or surgically repairs traumatic injury to a patient. Operator factors may also increase the likelihood of transmission. These include technical competency (which may relate to skills training and education) and infectious status (eg a high hepatitis B virus DNA titre).

Exposure-prone procedures are invasive procedures where there is potential for direct contact between the skin (usually finger or thumb) of the HCW and sharp surgical instruments, needles or sharp tissues (spicules of bone or teeth) in body cavities or in poorly visualised or confined body sites, including the mouth (NSW Health 1995a) of a patient. An exposure-prone procedure is one in which there is potentially a high risk of transmitting a bloodborne disease between an HCW and a patient during a medical or dental procedure.

The risk of an infected HCW transmitting an infection to patients is of particular concern.

An exposure-prone procedure is one in which there is potentially a high risk of transmitting a bloodborne disease.

Table 4.1 Level of risk to patients from HCWs infected with bloodborne viruses, associated with particular procedures

Risk category	Procedure
High risk (exposure-prone procedures; NSW Health 1995 ^a)	Any submucosal invasion with sharp, hand-held instruments, or procedure dealing with sharp pathology/ bone spicules, usually in a poorly visualised or confined space (eg orthopaedic surgery, trauma, internal cavity surgery, oral surgery)
Variable risk ^{a,b}	Minor dental procedures (excluding examination), routine dental extractions Internal/instrument examination/biopsy (eg endoscopy, vaginal examination, laparoscopy) Minor skin surgery
Low risk	Interview consultation, dental examination Noninvasive examinations or procedures (aural testing, electrocardiograph, abdominal ultrasound) Intact skin palpation (gloves not required, no pathology) Injections/venepuncture (gloves required)

^a 'Variable risk' refers to procedures where the risk may depend on training, experience, competence or other operator-specific factors related to the status of infection (eg HbeAg, high levels of HBV DNA).

^b Where the risk to patients from HCWs infected with bloodborne viruses during specific procedures is unclear, consult with State/Territory and/or professional advisory boards for further advice.

Risk assessment for transmission from infected HCWs

▷ HCWs who are infected with a bloodborne viral disease should not perform high-risk procedures. See **Section 24** for further discussion of this issue.

For HCWs who perform high-risk procedures (see **Table 4.1**), the rate of exposures is sufficiently high to recommend that they should ascertain their status with respect to bloodborne viral diseases. HCWs who are infected with a bloodborne viral disease should not perform high-risk procedures. In the case of hepatitis B virus (HBV), hepatitis C virus (HCV) and possibly HIV infection, treatments may alter the infectious status. Thus, the determination about whether or not to participate in high-risk exposure-prone procedures requires consultation with State/Territory and/or professional advisory boards.

Low-risk procedures may be safely performed by infected HCWs, provided standard precautions are strictly observed.

Variable-risk procedures (see **Table 4.1**) are those in which there is usually a low incidence of exposure. It is likely that the infected HCW may safely perform such procedures, provided strategies are used to minimise risk (see below). However, if the HCW is more prone to exposures than others (eg an HCW in training, or HCWs with a previous history of exposures during procedures) or if the assessment of the infected HCW indicates a highly infectious status (eg high HBV DNA), the situation should be reviewed in consultation with State/Territory and/or professional advisory boards.

Risk minimisation

Risk minimisation strategies include altering clinical procedures (eg using staple devices instead of hand-held suture needles) or, if this is not possible, preventing the infected HCW from carrying out the procedure (see above). Where there is uncertainty about whether certain procedures are exposure prone or about the level of risk associated with those procedures, the matter should be referred to State/Territory and/or professional advisory boards for individual assessment.

HCWs who engage in exposure-prone procedures and who have positive or indeterminate test results for potentially serious bloodborne viral infections, such as HBV, HCV or HIV, must be individually assessed by their State/Territory and/or professional advisory boards or in accordance with local legislation or regulations (see **Section 24**).

4.4 Instruments and equipment

The risk of transferring infections on instruments and equipment is related to the presence or absence and burden of infectious agents (number and virulence), the type of procedure (eg invasive versus noninvasive) and the body site where the instrument is used (eg submucosal invasion versus intact skin).

The risk of transmission of infection by instruments and equipment may be classified according to the site where they are to be used. The Spaulding classification system (Spaulding 1968) suggests that contact sites for instruments may be classified as critical, semicritical or noncritical as shown in **Table 4.2**, and that instruments should be processed accordingly (see **Section 16**).

Table 4.2 Spaulding classification system for possible contact sites of instruments

Application	Classification	Examples
Entry or penetration into sterile tissue cavity or bloodstream	Critical	Surgical procedure with entry into sterile tissue, intravascular cannulation
Contact with intact nonsterile mucosa (or nonintact skin)	Semicritical	Respiratory therapy, gastrointestinal endoscopy
Contact with intact skin	Noncritical	Noninvasive procedures (eg palpation, abdominal ultrasound)

All instruments and equipment contaminated with blood or body substances must be cleaned as soon as practicable. Instruments that come into contact with sterile tissue must be sterile (see **Section 16.2.2**).

Instruments and equipment should be designed to minimise the potential for injury in routine use. Wherever possible, instruments or equipment that incorporate sharps should be minimised or guarded to reduce the likelihood of sharps injury.

4.5 Environment

Most environmental microorganisms are nonpathogenic (ie they do not cause disease in humans) but a small number are capable of causing disease in certain situations (eg *Legionella* spp). Some infectious agents may be shed by patients and/or HCWs into the environment (eg *Staphylococcus aureus*).

Reusable instruments and equipment should be reprocessed in the way described in **Sections 16** and **17**.

The risk of contracting an infection via the environment is related to the presence or absence and the burden (number and virulence) of infectious agents in the environment and their ability to gain entry to a susceptible host.

Only a small proportion of all health care associated infections are transmitted from the environment. The environment is usually contaminated with bacteria, but they are not likely to cause infection unless there is an opportunity for them to access open wounds or other potential sites of entry in sufficient numbers.

Reducing the number of infectious agents in the environment — for instance by appropriate management of blood spills (see **Section 18.2**), use of aseptic technique (see **Section 6.1**) and effective engineering maintenance programs (see **Section 11.8**) — will minimise the likelihood of contracting an infection from the environment.

HCWs must use procedures to reduce the likelihood of environmental contamination during invasive procedures.

The major environmental infection risk occurs with invasive procedures and devices. HCWs must use procedures to reduce the likelihood of environmental contamination during invasive procedures or in the use of invasive devices. Such procedures may include use of aseptic technique (see **Section 6.1**), specific ventilation requirements (eg during orthopaedic implant procedures; see **Section 11.5**) or procedures for the handling and use of invasive devices (eg keeping drainage bags off the floor; see **Section 20.1.3**). Contaminated environmental surfaces may be a potential source of infection for more than one patient. Effective environmental cleaning is essential to minimise these risks.

▷ Further information on environmental controls is given in **Section 11**.

There may also be a risk of infection from the environment to specific patient groups, such as the potential for fungal infections in immunocompromised patients. Environmental or engineering controls may be required to reduce these risks (eg minimising dust that may contain *Aspergillus* spores, controlling legionellae in water supplies).

5 Responsibilities

Key points

- ✦ The management of each health care establishment has a number of responsibilities in relation to infection control. These include:
 - use of appropriate measures to prevent transmission of infection between health care workers (HCWs) and patients;
 - development and/or maintenance of surveillance procedures, equipment and facilities, and education and training programs;
 - the provision of options for the protection of HCWs;
 - communication and protection of patients' rights; and
 - prevention of unwarranted discrimination against patients or HCWs with infections.
- ✦ HCWs who undertake exposure-prone procedures have a responsibility to know their infectious status with regard to bloodborne viruses. Infected HCWs should seek appropriate medical care and advice.
- ✦ Patients have a responsibility to declare their infectious status to the health care establishment. Patients should be informed of their rights to privacy and records as well as their responsibilities. Health care establishments should encourage a spirit of cooperation.

5.1 Health care establishments

The management of each health care establishment has a responsibility to prevent transmission of infections in the clinical environment. This requires coordination of clinical and nonclinical services to identify the hazards and to minimise the risk of the spread of infection. Specific aspects of this general responsibility are as follows.

General

- Use recommended measures to prevent the transmission of infection between health care workers (HCWs) and patients.
- Maintain surveillance for infections that may spread amongst patients and HCWs.

The management of each health care establishment has a responsibility to prevent transmission of infections in the clinical environment.

- Establish and practise infection control procedures that take account of the relevant pathogens for the particular clinical situation and pay due regard to the psychosocial welfare of the patient, thus enlisting their support and cooperation.
- Take good medical histories, which explore known risk factors for infectious diseases (eg tuberculosis, immunodeficiency), of all patients entering the establishment.

Equipment and facilities

- Maintain adequate physical facilities to control the spread of infectious agents.
- Ensure that all equipment is maintained in sound working order and is subject to regular quality checks.

Education and training

- Provide education in hygiene, including specific advice about handwashing and special requirements for specific areas where HCWs are working.
- Inform and educate HCWs about the infectious hazards they will face during their employment. This information should be provided when they are first appointed and before rostering to hazardous areas. If patients present special or unusual hazards (eg tuberculosis in a general medical ward), HCWs at risk in the area should be informed and appropriate control measures should be taken.

Protection of health care workers

- Maintain awareness of new vaccines becoming available to protect HCWs and initiate procedures to ensure that those at risk are fully immunised. An appropriate immunisation strategy is one that identifies the infectious agents likely to be encountered by HCWs at risk and offers immunisation programs that encourage compliance by providing full information about the vaccines (see also **Section 22**).
- Take positive measures (eg immunisation) to implement appropriate infection control. Health care establishments should advise HCWs of the potential consequences if they refuse reasonable requests for immunisation. Such advice and refusal to comply should be documented. Should such HCWs subsequently develop work-related infections, it is most likely that the health care establishment would not be found to be in breach of its duty of care. Nevertheless, HCWs may be entitled to workers compensation under present legislation.
- Testing should be offered following occupational exposure to blood or body substances, for example by needlestick injury (see **Section 23**).
- Ensure that there is access to appropriately experienced counselling services for HCWs who become anxious about their health as a result of exposure to a potential hazard, whether actual or perceived.

Awareness of patients' rights

- Ensure that HCWs are adequately informed of the rights and responsibilities of patients.
- Maintain procedures to ensure that knowledge of patient risk status can be handled in a calm and confidential fashion.

5.2 Health care workers

HCWs have an obligation to follow specific establishment infection control policies as part of their contract of employment. This includes reporting any known potential exposures to blood and/or body substances. Failure to follow infection control policies and procedures may be grounds for disciplinary action. Some States/Territories have statutory infection control requirements for HCWs.

HCWs have an obligation to follow specific establishment infection control policies as part of their contract of employment.

All HCWs should be aware of their requirements for immunisation against infectious diseases and maintain personal immunisation records.

HCWs who undertake exposure-prone procedures have a responsibility to know their infectious status with regard to bloodborne viruses such as hepatitis B virus, hepatitis C virus and human immunodeficiency virus, and should be given relevant information about the tests available and encouraged to have voluntary testing.

HCWs with infections should seek appropriate medical care from a doctor qualified to manage infectious diseases. Where there is a risk of an HCW transmitting infection to a patient or other HCW (ie if the HCW is infected with a bloodborne virus, other transmissible infection or predisposing skin condition), the HCW should be counselled about their work options and either rostered appropriately or provided with information and facilities to enable them to continue to provide safe care.

▷ See **Section 24** for further discussion on the management of HCWs, including students, who may be infected with a bloodborne virus.

5.3 Patients

Although there is no legal requirement for people who know they are infectious to declare their infectious status to health care establishments, patients have an ethical responsibility to do so if there is a known risk to others associated with their treatment. In addition, as is the case with any other members of the community, patients who know or have reason to believe that they are infectious may be exposed to both civil and criminal liability if they knowingly transmit infections.

If a situation arises where there is a need to know the infectious status of a patient (such as a sharps/blood accident), the patient has a responsibility to provide information or consent for testing that enables the health care establishment or responsible health professional to ensure the safe

management of the injured HCW. When obtaining consent, the patient should be offered pretest counselling to advise them of the types of tests that may be needed and to outline the consequences to the patient of doing such tests. Post-test counselling may also be required, particularly if the test is positive.

Patients should have their responsibility explained and be encouraged to acknowledge it. When a patient is admitted to hospital or arrives at an accident and emergency unit, they should be encouraged to provide all relevant information about their infectious status to assist in triage management (see **Section 2.4**). Admission forms should be designed to ensure that this information is collected.

Patients are more likely to provide the relevant information if the risk of transmission of infection is explained in simple terms. They are also more likely to provide information if confidentiality is assured and if they are informed about the establishment's policy and procedures for maintaining confidentiality. Health care establishments should promote a spirit of cooperation and participation among affected communities and seek to identify procedures or practices that encourage this spirit of cooperation.

5.4 Responsibilities relating to specific diseases

▷ Particular responsibilities relating to bloodborne viruses are described in more detail in **Sections 23** and **24**.

Health care establishments should fulfil their legal responsibilities in relation to infection control by adopting standard and additional precautions for specific infections as directed in these guidelines.

Infections that require additional precautions (eg tuberculosis, Creutzfeldt–Jakob disease, antibiotic-resistant bacteria) and other infections requiring special consideration are described in their respective sections in **Part 4** (Managing infectious diseases in the health care setting).

6 Other key issues for infection control

Key points

- ✦ All health care workers should be aware of the concepts of aseptic technique, the handling of sharps, the use of single-use equipment and reprocessing procedures.
- ✦ Restraint in prescribing and adherence to the principles of prudent antibiotic use are essential to avoid the danger of emerging antibiotic resistance.

6.1 Aseptic technique

Asepsis is defined as the absence of infectious agents that may produce disease. Aseptic technique refers to practices used by health care workers (HCWs) to:

- reduce the number of infectious agents;
- prevent or reduce the likelihood of transmission of infectious agents from one person or place to another; and
- render and maintain objects and areas as free as possible from infectious agents.

Techniques to maintain asepsis may be categorised into 'clean' and 'sterile' techniques.

6.1.1 Clean technique

Clean technique refers to routine work practices that reduce the numbers of infectious agents. Routine practices include:

- personal hygiene, particularly handwashing, to reduce the numbers of infectious agents on the skin;
- use of barriers to reduce transmission of infectious agents;
- use of environmental controls to reduce transmission of infectious agents; and
- reprocessing of instruments and equipment between patient use.

Asepsis is defined as the absence of infectious agents that may produce disease.

▷ Basic work practices associated with standard precautions and clean technique are described in more detail in **Part 3** (Effective work practices and procedures).

These practices include most of the same elements as standard precautions. Before the emergence of human immunodeficiency virus/acquired immunodeficiency syndrome (HIV/AIDS) and other bloodborne diseases, clean technique was conventionally seen as primarily protecting patients from infections carried by HCWs or by the health care environment. This concept has now been expanded to include protection for HCWs and patients, mainly from bloodborne infections but also from other infections, through standard precautions (see **Section 2.2**).

6.1.2 Sterile technique

Sterile technique refers to practices designed to render and maintain objects and areas as free from microorganisms as possible.

The concept of the 'sterile operating field', which has been practised for many years by operating room personnel, should be adopted by all practitioners undertaking invasive medical procedures. Everything within a defined radius must be clean and sterile (or, as a minimum, subject to high-level chemical or thermal disinfection). HCWs who come into contact with the sterile operating field must be appropriately trained and prepared (see **Section 33.2**).

In dental practice, the operating field includes anywhere that the patient's blood (or other body substances, including saliva) may transfer to during a procedure (see **Section 35**).

Building design must provide for a sterile operating field, particularly with regard to ventilation systems and working surfaces (see **Section 11**).

6.2 Handling of sharps

Sharps are a major cause of incidents involving potential exposure to bloodborne diseases, and must be handled with care at all times. People involved in medical or dental procedures should devise and discuss methods of handling sharps that will minimise the risk of injury.

Important



▷ Details on the disposal of sharps are given in **Section 14.2**.

IMPORTANT NOTE

Handling of sharps

Sharp instruments must not be passed by hand between HCWs. Specified puncture-resistant sharps trays should be used for transfer of all sharp items (RACS 1998). Where possible, alternatives should be considered, including needleless intravenous systems, the use of blunt needles for drawing up sterile solutions from ampoules, or the use of retractable needle and syringe systems.

6.3 Single-use medications, injectables and instruments

To avoid cross-contamination between patients, single-use equipment should be used wherever this is practical.

6.3.1 Medications, solutions and injectables

Single-dose vials

Medications or solutions that come into contact with normally sterile tissue should be sterile. The most effective way to avoid cross-infection via injection of medication is through the use of single-dose vials or ampoules and single-use sterile injecting equipment. Single-dose vials or ampoules, or prefilled syringes, should be used wherever these are available.

Multidose vials and multiuse products

The Australian Drug Evaluation Committee (ADEC) has advised that injectable products packaged in multidose vials should not be used except where products such as insulin are intended solely for the exclusive use of an individual patient.^{1,2} In these particular cases, specific protocols should be in place to ensure that the products are used for those individuals only. Every precaution should be taken to ensure that the unused portion of the vial is not contaminated, including using a clean needle and syringe to draw up the remaining contents of the vial on every occasion.

Medical and dental practitioners and paramedical HCWs should be aware of situations where cross-contamination from products might occur during routine medical or dental procedures. Protocols to prevent multiple-patient use in these circumstances should be developed. Examples include the use of topical lubricants in proctoscopy and/or vaginal examination, and local anaesthetics in throat procedures. When single-dose vials or ampoules are not available, the risk of cross-contamination is high if injectable products are used on multiple patients. The risk may be controlled by:

- drawing up all the contents of the container into individual syringes before administering to patients;
- establishing a separate area designated for the placement of these medications away from any work area;
- covering the medications to prevent environmental contamination;
- having only the current patient's medication in the immediate working environment;
- using a clean needle and syringe to draw up the remaining contents of the vial or ampoule on every occasion; and

¹ ADEC 1995 *Resolution No 5914*.

² ADEC 2001 *Resolution No 7813*.

- discarding any open ampoule(s) at the end of each procedure.

6.3.2 Instruments and equipment

Instruments or equipment intended for single use and labelled ‘single-use’ by the manufacturer should be disposed of after use.

The Therapeutic Goods Administration (TGA) provides the following advice about reprocessing ‘single-use’ instruments:

Devices listed on the Australian Register of Therapeutic Goods (ARTG) as ‘single use’ should be used only once. In July 2001, the Australian Health Ministers Advisory Council (AHMAC) agreed that any reprocessing of single use devices for reuse is a manufacturing activity and this should be regulated by the TGA. AHMAC also agreed that the regulation of the re-manufacture of single use devices for reuse should meet the same regulatory requirements and standards as apply to the original manufacturer. Any reprocessing would therefore only occur in a Good Manufacturing Practices (GMP) licensed facility that includes a monitoring system to ensure microbiological safety and product integrity. The TGA is developing a regulatory proposal for reprocessing of single use devices but is not in the position to license reprocessing facilities until this regulatory proposal has been fully considered by all relevant stakeholders and finalised.

This option only applies to instruments and equipment that are capable of withstanding reprocessing that involves additional heat or chemical sterilisation methods as detailed in **Table 31.9**, without compromising product safety and integrity.

▷ There is further discussion on single-use instruments and equipment in **Section 16.2.4**.

6.3.3 Implantable items

Devices or items intended for implantation must not be reprocessed or reused after use. Implantables that have had their sterile packaging opened but have not had contact with human tissue may be reprocessed and repackaged according to methods outlined by the manufacturer and approved by the TGA.

▷ See **Section 16.2.4** for further information on implantable items.

6.4 Reprocessing procedures

Any infectious agents introduced into sterile body sites may establish infection or colonise mucosal surfaces. Infectious agents are always present on skin and are likely to be carried through the air on dust particles. Infectious agents may contaminate instruments, medications and solutions that are intended to be sterile. Instruments and equipment used in critical sites must be sterile; instruments and equipment used in semicritical sites should be sterile or have been subjected to a minimum of high-level disinfection.

▷ See **Table 4.2** for definitions of critical and semicritical sites.

In order to achieve sterile conditions during procedures, all potential sources of contamination should be identified and minimised.

Effective reprocessing involves:

- cleaning to remove organic residue and chemicals immediately after use;
- disinfection by
 - heat and water (thermal) or
 - chemical disinfectants; and/or
- sterilisation.

Reprocessing procedures are described in more detail in **Section 16**.

Section 17 gives further information on reprocessing of special instruments and equipment. General information on chemical disinfectants is given in **Section 7**.

▷ Special reprocessing requirements apply to Creutzfeldt–Jakob disease (see **Section 31.14**).

6.5 Antibiotic use

Adherence to the principles of prudent antibiotic use is essential to avoid the danger of emerging drug resistance and provide best practice and quality care for patients.

Prudent antibiotic use reduces the danger of emerging drug resistance.

The acquisition and spread of resistance to antimicrobial agents is more common in hospitals than in the community. This is due to:

- the selective pressure exerted by high levels of drug use, which allows the amplification of resistant infectious agents; and
- increased opportunities for transfer of infectious agents between HCWs and patients.

However, the same principles apply for both hospital and community or office practice settings. In all settings, antibiotics should be used according to the principles outlined in the Australian *Therapeutic Guidelines: Antibiotic* (Therapeutic Guidelines Ltd 2000). In addition, all prescribers of antibiotics should adopt the 'prudent use principles' shown below.

Prudent use principles for antibiotics

General

- Antibiotics should be used only where the benefits are scientifically demonstrable and substantial.
- In general, the antibiotic spectrum of the drug selected should be the narrowest to cover the known or likely pathogen(s).
- Single agents should be used unless it is proven that combination therapy is required to ensure efficacy or reduce the selection of clinically significant resistance.
- The dosage should be high enough to ensure efficacy and minimise the risk of resistance selection, and low enough to minimise the risk of dose-related toxicity.

Therapy

- Choice should be based on either culture and susceptibility test results (directed therapy) or known common pathogens in the condition and their current resistance patterns (empirical therapy).
- Duration should be as short as possible, and should never exceed seven (7) days unless there is proof that this duration is inadequate.

Prophylaxis

- Choice should be based on known or likely target pathogen(s).
- Duration should be as short as possible. A single dose delivered in a timely fashion to achieve adequate levels at the time of surgery is recommended. Longer-term prophylaxis should be administered only when it has been demonstrated that the benefits outweigh the risk of resistance selection or propagation.

Modified from *The Use of Antibiotics in Food-Producing Animals* (JETACAR 1999).

Successful implementation of antibiotic policies requires that the clinical administrations of health care establishments:

- formulate prescribing strategies appropriate for their establishment or practice;
- audit antibiotic use;
- participate in appropriate educational measures; and
- recognise the forces influencing doctors' prescribing habits and practices.

Particular attention should be given to effective prescribing of antibiotics that are considered critical to human medicine (ie where there are no or few alternative antibiotics available for treatment of infections); for example, third-generation cephalosporins (eg cefotaxime, ceftriaxone, ceftazidime, ceftiofime and ceftiofime) and glycopeptides (eg teicoplanin and vancomycin).

Important antibiotic-resistant pathogens, including methicillin-resistant *Staphylococcus aureus* (MRSA), vancomycin-resistant enterococci (VRE), multiresistant gram-negative bacilli and multidrug-resistant tuberculosis (MDR-TB), are discussed further in **Part 4** (Managing infectious diseases in the health care setting), **Section 30**.

7 Disinfectants and sterilants

Key points

Surface disinfectants/sterilants

- ✦ Surface disinfectants and sterilants are regulated by the Therapeutic Goods Administration (TGA) under Therapeutic Goods Order No 54 (TGO 54) as sterilants, instrument-grade disinfectants, hospital-grade disinfectants or household/commercial-grade disinfectants.
- ✦ Sterilants are chemical agents that may be used to sterilise instruments or devices for use in critical sites (entry or penetration into a sterile tissue cavity or the bloodstream).
- ✦ Instrument-grade disinfectants are further classified as high, low or intermediate level, where the level of activity is defined by the risk associated with specific in-use situations (see **Section 16.4.1**).
- ✦ High-level instrument-grade disinfectants provide the minimum level of processing for instruments used in semicritical sites (contact with nonsterile mucosa or nonintact skin).
- ✦ The performance of chemical disinfectants and sterilants is affected by temperature, contact time, concentration, pH, presence of organic and inorganic material, and numbers and resistance of microorganisms present.
- ✦ Chemical disinfectants and sterilants should always be used with care according to the manufacturer's instructions and material safety data sheets.

Skin disinfectants (antiseptics)

- ✦ Skin disinfectants, or antiseptics, are substances used for dermal or mucous membrane application to kill or prevent the growth of microorganisms. They are regulated by the TGA as either registered medicines (AUST R), or listable medicines or medical devices (AUST L). Label claims must be followed.

7.1 Introduction

Chemical disinfectants and sterilants act by damaging the structure or impairing the metabolism of infectious agents. The biocidal (inactivation) range of a disinfectant or sterilant varies according to its active chemical structure and the general properties of the group to which it belongs (see

Table 7.1). All solutions labelled as disinfectants inactivate a range of vegetative bacteria, such as gram-positive and gram-negative bacteria, but may not inactivate more resistant bacteria, bacterial endospores, viruses or other microorganisms such as fungi (eg *Candida* spp) or protozoa (eg *Giardia* spp).

Sterilants and higher-level disinfectants also inactivate bacterial endospores, mycobacteria, viruses (both the more sensitive lipid-coated viruses, such as human immunodeficiency virus, and relatively resistant viruses, such as polio virus) and other microorganisms (see **Section 7.2.1**). However, the sporicidal activity during the usual shorter exposure time for high-level disinfection may not be optimal.

Most chemical disinfectants and sterilants are only partially effective against the agents of Creutzfeldt–Jakob disease. See **Table 7.1** and **Section 31.14** for details of inactivation methods for these agents.

Chemical substances may be formulated for use on inanimate surfaces (ie surface disinfectants) or for use on skin (ie skin disinfectants, or antiseptics).

Table 7.1 identifies the categories of active chemical substances used to formulate disinfectants/sterilants and antiseptics, and their ranges of activity. Classification of a product using any of these active ingredients as household grade, hospital grade, instrument grade, sterilant or antiseptic depends on the formulation used.

7.2 Chemical disinfectants and sterilants

Disinfectants and sterilants are regulated by the Therapeutic Goods Administration (TGA).

Disinfectants and sterilants intended for use in the health care setting are regulated by the Therapeutic Goods Administration (TGA) under Therapeutic Goods Order No 54 (TGO 54) and are classified in the following broad categories:

- sterilants
- instrument-grade disinfectants (three subclasses)
 - low grade
 - intermediate grade
 - high grade
- hospital-grade disinfectants (two subclasses)
 - dirty conditions
 - clean conditions
- household/commercial-grade disinfectants.

Critical factors that may affect the performance of disinfectants or sterilants include temperature, contact time, concentration, pH, presence of residual organic and inorganic material, and numbers and resistance of the initial bioburden on a surface.

It is essential that disinfectants and sterilants are always used in accordance with the manufacturer's directions to ensure that the product meets its label claims for efficacy in accordance with the requirements of TGO 54.

Always use disinfectants and sterilants in accordance with the manufacturer's directions.

Disinfectants and sterilants should not harm instruments or equipment and the compatibility of instruments and equipment should be a consideration when choosing products. Products should not be mixed and 'use by' dates should be checked for currency. Products should be used at the recommended strength for soaking or exposure times. The required amount of product should be decanted as required to avoid contamination of the stock solution. Unused product should be discarded after use.

7.2.1 Sterilants and instrument-grade disinfectants

The TGA assesses products as instrument-grade (high, intermediate or low level) disinfectants or sterilants on the basis of stringent conditions outlined in TGO 54. The manufacturer is required to provide data to the TGA that demonstrates in-use efficacy and compatibility with a range of instruments. Those chemical disinfectants intended for use in automated washer-disinfectors should perform effectively as claimed on the label. Any disinfectant or sterilant used to reprocess medical instruments must be registered on the Australian Register of Therapeutic Goods (ARTG).

▷ See **Sections 16 and 17** for a detailed discussion of reprocessing instruments and equipment.

Sterilants

A sterilant is a liquid chemical agent that may be used to sterilise critical medical devices that will not withstand steam sterilisation (see **Section 16.5**). Sterilants inactivate all microorganisms, giving a sterility assurance level of less than 10^{-6} (see **Glossary**), which is the sterility level required for medical equipment that will contact critical body sites.

Sterilants inactivate all microorganisms.

All chemical sterilants should be used in accordance with the manufacturer's approved label conditions for sterilisation. For products that may be classified as both a sterilant and a high-level disinfectant (multiuse), the sterilisation time is the longer of the two times that appear on the label.

Automated chemical processing systems based on peracetic acid or high-concentration hydrogen peroxide (plasma) sterilants achieve sterilisation within 30–80 minutes, depending on the model and the system.

There are TGA-approved sterilant products for both manual and automated systems. If users of sterilants and/or high-level disinfectants are unsure of the TGA-approved status of a product, they should ask the manufacturer to supply the product's AUST R code number before they take any further action.

Instrument-grade disinfectants are classified as high, intermediate or low level.

Instrument-grade disinfectants

Instrument-grade disinfectants are classified as high, intermediate or low level. Careful selection of an appropriate level of disinfectant is required to achieve the desired level of disinfection. The definitions given in TGO 54 state that, when used as recommended by the manufacturer:

- high-level chemical disinfectants inactivate all microbial pathogens, except large numbers of bacterial endospores;
- intermediate-level disinfectants inactivate all microbial pathogens except bacterial endospores; they are bactericidal (including mycobactericidal), fungicidal against asexual spores (but not necessarily dried chlamydo spores or sexual spores) and virucidal; and
- low-level disinfectants rapidly inactivate most vegetative bacteria as well as medium-sized lipid-containing viruses; they may not be relied upon to destroy, within a practical length of time, bacterial endospores, mycobacteria, fungi or any small nonlipid virus.

The level of activity (high, intermediate or low) is defined by the risk associated with a specific in-use situation (see **Section 16.4.1**). The minimum level of processing required for specific items in use is shown in **Table 16.1**.

Halogens (such as chlorine and iodine) may perform as high-level disinfectants at high concentrations, but none are currently registered in Australia. Quaternary ammonium compounds usually perform as low-level disinfectants, which are ineffective against many microorganisms (eg bacterial spores, mycobacteria and many viruses). However, when coformulated with other active chemical substances, the final formulation may deliver the increased activity required of an intermediate or high-level disinfectant. Depending on the formulation, alcohols may be good intermediate-level disinfectants (see **Table 7.1**).

7.2.2 Hospital-grade disinfectants

Hospital-grade disinfectants are regulated by the TGA. These disinfectants must not be used to disinfect medical instruments. This should be stated on the product label.

The use of hospital-grade disinfectants is not necessary in health care establishments. The recommended procedure is the manual removal of visible soil and dirt, followed by cleaning with water and detergent (see **Section 18.1**). However, hospital-grade disinfectants may be used on environmental surfaces such as walls, floors, furniture and equipment that do not come into direct contact with the patient.

The activity of hospital-grade disinfectants is usually restricted to a range of vegetative bacteria of the type usually encountered in a health care setting, unless the TGA approves additional specific label claims, such as tuberculocidal or virucidal activities.

IMPORTANT NOTE**Do not use hospital-grade disinfectants to reprocess medical instruments and equipment**

The term 'hospital grade' in the *Therapeutic Goods Act 1989* may be misleading, as it implies suitability for all purposes in health care establishments. This is not true. 'Hospital grade' should be regarded as general purpose (non-instrument grade) disinfectant and is only so labelled to distinguish it from other commercial and household disinfectants.

Disinfectants labelled 'hospital grade' should not be used to disinfect medical instruments and equipment. Instrument-grade disinfectants or sterilants are the only compounds that are suitable for such use.

IMPORTANT

7.2.3 Household/commercial-grade disinfectants

Household/commercial-grade disinfectants are also regulated by the TGA. These disinfectants have limited use, as their efficacy has not been tested under conditions likely to be encountered in health care settings.

7.3 Skin disinfectants (antiseptics)

An antiseptic is a substance that is recommended by its manufacturer for application to the skin or mucous membranes of a person or animal to deactivate microorganisms or to prevent the growth of microorganisms to a level that may cause clinical infection. An antiseptic is not represented to be suitable for internal use (TGO 54).

Skin disinfectants/antiseptics are regulated by the TGA. Most antiseptic products marketed in Australia are either registered medicines or listable medicines (eg tea tree oil) on the ARTG and therefore require an AUST R or AUST L number, respectively, on the label. Other products contained in sachets are currently classified as listable medical devices, for which the display of an AUST L number is optional. The label claims of such products are important and should be followed.

Skin disinfectants/antiseptics should always be used according to the manufacturer's directions, which are designed to ensure that a product, when used as directed, meets its label claims for efficacy in accordance with TGA requirements.

Always follow the manufacturer's directions when using skin disinfectants/antiseptics.

Hygienic handwash/scrub products are formulated to reduce transient bacteria on the hands. Surgical scrubs reduce the level of both transient and resident bacterial flora. Handwashing disinfectants chosen for health care workers (HCWs) should demonstrate residual as well as immediate activity.

HCWs should use skin disinfectants on their hands before participating in any surgical procedures, including cannulation, catheterisation and intubation. Skin disinfection before surgery should reduce the number of resident bacteria and thus the infectivity of skin or mucosal tissue in the patient and on the hands of the HCW. Each skin disinfectant should be labelled with the date when first opened and discarded after its designated ‘use by’ date as indicated on the manufacturer’s label.

Before use, sufficient skin disinfectant for an individual patient’s use should be decanted into a sterile container. Any fluid remaining in this container should be discarded at the end of each procedure (see **Section 6.3**).

HCWs should check the label for the specific contact time of each antiseptic used and should use the antiseptic strictly in accordance with the manufacturer’s instructions. There is a wide range of antiseptics available. The formulations and concentrations chosen should be appropriate to the tissues to which the antiseptic is applied. Particular note should be taken of the flammability of the product in relation to the setting in which it is to be used.

The following preparations may be used, but the choice should be appropriate for the nature and site of the procedure:

- 70–80% w/w ethanol;
- 60–70% v/v isopropanol;
- chlorhexidine in aqueous formulations (0.5–4% w/v) or in alcoholic formulations with chlorhexidine (0.5–1% w/v) in 60–70% isopropanol or ethanol;
- 10% w/v aqueous or alcoholic povidone–iodine (1% w/v available iodine); and
- solutions containing 1% w/v diphenyl ether (triclosan) (Gardner and Peel 1998).

Note that particular preparations are contraindicated for use at particular sites. For example, 4% w/v chlorhexidine is widely used as a bacterial skin cleaner for hygienic and surgical handwashing. An aqueous solution of 0.5% w/v chlorhexidine is recommended for use on facial skin. Weaker solutions (0.02–0.05% w/v) may be used for application to mucous membranes — for example during bladder irrigation (Gardner and Peel 1998). Where disinfectant is used during dental procedures, oral membranes should be dried/isolated to prevent dilution of the disinfectant with saliva.

Studies have indicated that 2% aqueous chlorhexidine is more effective than 10% povidone–iodine or 70% alcohol for cutaneous disinfection before insertion of an intravascular device and for post-insertion care, and may substantially reduce the incidence of device-related transmission of infection (Maki et al 1991, cited in Gardner and Peel 1998). However, 2% aqueous chlorhexidine is not currently marketed in Australia.

Chlorhexidine should never be used in surgery on the middle ear because it may cause sensorineural deafness (Bicknell 1971). Corneal toxicity — including transient epithelial defects, chronic corneal ulceration and corneal oedema — has been observed following ocular exposure to a proprietary product in which chlorhexidine was the active ingredient (Tabor et al 1989, Varley et al 1990).

An alcohol wipe (70% w/w ethanol or 60% v/v isopropanol) may be used before venous blood collection, injection, or insertion of acupuncture needles to reduce the bacterial load on the skin and thus lessen the risk of infection. Currently, there is no evidence to suggest a minimum drying time to effect skin disinfection before venous blood collection, injection or acupuncture. However, to reduce discomfort in the patient, the alcohol should be allowed to dry before proceeding. Alcohols are flammable and should be used with caution. Therefore, they should not be used for skin disinfection before electric cautery or laser treatment. Alcoholic solutions are inappropriate for use on mucous membranes.

7.4 Occupational health and safety issues for using chemical disinfectants

Chemical disinfectants should be used with caution and in accordance with the manufacturer's directions. Information on the safe handling of chemicals in laboratories is given in AS/NZS 2243.1¹ and AS/NZS 2243.2.² Health care establishments should provide comprehensive induction and training programs for HCWs about the safe handling of chemicals.

Use chemical disinfectants with caution and follow the manufacturer's directions.

Material safety data sheets for disinfectants should be consulted before use. Personal protective equipment must be worn when working with disinfectant/sterilant solutions. Ventilation should be adequate when using concentrated or volatile chemicals as defined by the National Occupational Health and Safety Commission (NOHSC 1994). Fume extraction systems should comply with AS 1668.2.³

The use of hazardous substances is regulated under workplace health and safety legislation in each State/Territory. All chemical disinfectants should be discarded in accordance with State/Territory and local government regulations (see AS/ANZ 3816⁴).

¹ AS/ANZ 2243.1 (1997) and Amendment 1 (2000) *Safety in laboratories — General*.

² AS/ANZ 2243.2 (1997) *Safety in laboratories — Chemical aspects*.

³ AS 1668.2 (1991) and Supplement 1 (1991) *The use of mechanical ventilation and air-conditioning in buildings — Mechanical ventilation for acceptable indoor air quality*.

⁴ AS 3816 (1998) *Management of clinical and related wastes*.

Important**IMPORTANT NOTE****Using chemical disinfectants and sterilants**

Use chemical disinfectants with caution and follow the manufacturer's directions. Consult material safety data sheets for disinfectants before use. Wear personal protective equipment and ensure adequate ventilation.

Table 7.1 Categories and ranges of activity of the active chemical substances used to formulate disinfectants and antiseptics

Activity range	Other properties/comments ^a
Alcohols <ul style="list-style-type: none"> Effective: <ul style="list-style-type: none"> bactericidal fungicidal mycobactericidal Variable: <ul style="list-style-type: none"> virucidal Poor: <ul style="list-style-type: none"> not sporicidal Ineffective: <ul style="list-style-type: none"> CJD 	Ethanol: <ul style="list-style-type: none"> 70% w/w ethanol acts rapidly and dries quickly 90% w/w ethanol is useful as a virucide 100% ethanol is not an effective disinfectant Less effective against nonenveloped viruses (eg HAV) than against enveloped viruses (eg HIV) Isopropanol: <ul style="list-style-type: none"> Most effective at 60–70% v/v Variable mycobactericidal activity Not an effective virucide General properties of alcohols: <ul style="list-style-type: none"> Do not penetrate organic matter well, so prior cleaning is required as alcohol acts as fixative Flammable May be combined with other bactericidal compounds for skin disinfection May only be used as an instrument-grade disinfectant if labelled accordingly by manufacturer
Aldehydes <ul style="list-style-type: none"> Effective: <ul style="list-style-type: none"> bactericidal fungicidal virucidal sporicidal (slow) Variable: <ul style="list-style-type: none"> mycobactericidal Ineffective: <ul style="list-style-type: none"> CJD 	Highly irritant Act as fixatives: prior cleaning required Penetrate organic material slowly and usually not inactivated by inorganic materials Usually noncorrosive to metals Buffered alkaline solutions must be activated immediately before use and have a limited shelf life Acidic solutions are more stable but are slower acting; glycolated (mildly acidic) solutions have shorter inactivation times Instrument-grade disinfectant when used for a short period (usually <60 minutes) according to label: specific to each formulation Instrument sterilant when used for a prolonged period (usually >5 hours) depending on formulation/labelling Slow acting against atypical mycobacteria

Table 7.1 (cont'd) Categories and ranges of activity of the active chemical substances used to formulate disinfectants and antiseptics

Activity range	Other properties/comments ^a
<p>Chlorhexidine and biguanide polymers</p> <ul style="list-style-type: none"> • Effective: <ul style="list-style-type: none"> gram-positive organisms less active against gram-negative organisms • Variable: <ul style="list-style-type: none"> virucidal fungicidal (subject to species variation) • Poor: <ul style="list-style-type: none"> not mycobactericidal not sporicidal • Ineffective: <ul style="list-style-type: none"> CJD 	<p>Low toxicity and irritancy</p> <p>Inactivated by organic matter, soap and anionic detergents</p> <p>Useful for skin and mucous membrane disinfection but are neurotoxic (must not contact middle ear) and may cause corneal damage</p> <p>Chlorhexidine activity range increased when combined with other agents (eg alcohol)</p> <p>Polyhexamethylene biguanide hydrochloride may be combined with quarternary ammonium compounds for increased activity</p> <p>May only be used on instruments if labelled as an instrument-grade disinfectant</p>
<p>Hypochlorites</p> <ul style="list-style-type: none"> • Effective: <ul style="list-style-type: none"> bactericidal fungicidal virucidal • Variable: <ul style="list-style-type: none"> sporicidal (pH 7.6 buffer) mycobactericidal (5000 ppm available chlorine) <p>May be used at 20,000 ppm available chlorine against CJD if more stringent procedures are not suitable (Table 31.9)</p>	<ul style="list-style-type: none"> • Fast acting • Inactivated in presence of organic matter at low concentrations • Incompatible with cationic detergents • High concentrations corrosive to some metals (some compounds may contain corrosion inhibitors) • Diluted form unstable with short shelf life • Decomposed by light, heat, heavy metals • Chlorine gas released when mixed with strong acids • Carcinogenic reaction product when mixed with formaldehyde • Useful in food preparation areas and virology laboratories • Activity may be increased by combining with methanol • May only be used on instruments if labelled as an instrument-grade disinfectant • There are available chlorine requirements for: <ul style="list-style-type: none"> – Blood spills: 10,000 ppm (1%) – Laboratory discard jars: 2500 ppm (0.25%) – Clean environmental disinfection: 1000 ppm (0.1%) (ie environment that has been precleaned of all soil and other organic and inorganic material or has not been exposed to soiling with body fluids) – Disinfection of clean compatible items: 500–1000 ppm (0.05–0.1%) • Higher-risk CJD spills/contamination: 20,000 ppm for 1 hour (see Table 31.9)
<p>Iodine preparations</p> <ul style="list-style-type: none"> • Effective: <ul style="list-style-type: none"> bactericidal mycobactericidal fungicidal virucidal • Variable: <ul style="list-style-type: none"> sporicidal • Variable/partially effective: <ul style="list-style-type: none"> CJD 	<ul style="list-style-type: none"> • May be inactivated by organic matter • May corrode metals (eg aluminium) • Useful as a skin disinfectant but some preparations may cause skin reactions (povidone–iodine is much less irritant than iodine itself) • Antiseptic-strength iodophores are not usually sporicidal • May be used on instruments only if labelled as an instrument-grade disinfectant

Table 7.1 (cont'd) Categories and ranges of activity of the active chemical substances used to formulate disinfectants and antiseptics

Activity range	Other properties/comments ^a
<p>Peracetic acid and other peroxide compounds</p> <ul style="list-style-type: none"> Effective: <ul style="list-style-type: none"> bactericidal fungicidal virucidal sporicidal mycobactericidal Variable/poor: <ul style="list-style-type: none"> mycobactericidal (peroxygen compounds) Ineffective: <ul style="list-style-type: none"> sporicidal (peroxygen compounds) CJD 	<ul style="list-style-type: none"> Peracetic acid is highly irritant Corrosive to some metals/instruments Reduced activity in presence of organic matter Usually contain detergent Useful for small spills May be used as an instrument-grade disinfectant or sterilant under specified conditions, if compatible Hydrogen peroxide and potassium monoperoxygen sulfates have low toxicity and irritancy
<p>Phenolics</p> <ul style="list-style-type: none"> Effective: <ul style="list-style-type: none"> bactericidal mycobactericidal fungicidal Variable: <ul style="list-style-type: none"> virucidal Poor: <ul style="list-style-type: none"> nonenveloped viruses Ineffective: <ul style="list-style-type: none"> CJD 	<ul style="list-style-type: none"> Avoid contact with skin/mucous membranes Stable in presence of organic matter Incompatible with cationic detergents Not for use on food preparation surfaces/equipment Detergent usually included Absorbed by rubber and plastics Diluted form unstable Useful for mycobacteria on surfaces
<p>Sodium dichloroisocyanurate (SDIC) granules</p> <p>Similar to hypochlorites</p> <ul style="list-style-type: none"> Ineffective: <ul style="list-style-type: none"> CJD 	<ul style="list-style-type: none"> Less corrosive than hypochlorite More resistant to inactivation in presence of organic matter Stable in dried form; unstable in solution
<p>Acids (formic) and alkalis (sodium hydroxide)</p> <ul style="list-style-type: none"> Restricted use for CJD 	<ul style="list-style-type: none"> Corrosive/caustic Use only with special care

CJD = Creutzfeldt–Jakob disease; HAV = hepatitis A virus; HIV = human immunodeficiency virus

^a Classification of a product using any of these active ingredients as household, hospital, instrument or sterilant grade or as an antiseptic depends on the formulation used.

Note: Instruments contaminated with the agent of CJD should either be destroyed or reprocessed according to the guidelines in **Table 31.9**.

Sources: Ascenzi (1996), Ayliffe et al (1993 1999), Block (1991), Gardner and Peel (1998), Russel et al (1999), Rutala (1995, 1998), WHO (2000).