



ADA Guidelines for Infection Control



August 2008

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Foreword

This publication is the result of nearly 20 years of dedicated work by the Australian Dental Association's Infection Control Committee. During that time the Committee has assisted external expert bodies help define safe practice. We now feel there is an overwhelming body of evidence and experience to support the writing of our own standards. The profession, to its credit, has been quick to adopt new standards. We commend the Committee for their efforts, both in promoting safe practice and developing this document.

Not all infection control principles are based on strong evidence but rather are founded upon expert advice or opinion. Where the evidence base for infection control policies and procedures for dentistry in these guidelines is not strong then the philosophy of applying standard, common, or established practice has been adopted. It has been determined by the Australian Dental Association's Infection Control Committee, in consultation with stakeholders including Boards. Updates and modifications to the following standards and guidelines will be made when evidence does become available.

The ADA declares that no conflict of interest existed in the development of these guidelines and that they have been developed independently without any corporate interest or sponsorship.

Our thanks to the ADA's Infection Control Committee (chaired by Dr Liz Coates), Dr Vincent Amerena and the Dental Practice Board of Victoria for their assistance in the preparation of this document. Also, the Committee drew on information developed by the ADA (Vic Branch) in its *Systematic Operating Procedures 2005 – a Manual for Infection Control and Occupational Health and Safety for the Dental Practice 2005*.

John Matthews
President ADA

Introduction

This document describes the standards of infection control that dental care providers and dental staff in a dental practice are expected to follow. The techniques and routine work practices outlined here must be used to reduce the number of infectious agents in the dental practice environment; to prevent or reduce the likelihood of transmission of these infectious agents from one person or item/location to another; and to make and maintain items and areas as free as possible from infectious agents. The responsibility for the implementation of these guidelines applies to all dental care providers. They are responsible for ensuring that all dental staff are familiar with and able to apply the guidelines.

The standards described are mainly evidence-based or otherwise based on current international best practice: they have been drawn from current expert knowledge and advice in infection control. Therefore, the document will be regularly reviewed and updated in light of changes to that knowledge. It is important to acknowledge that professional judgement is essential in determining the necessary application of these guidelines.

The document provides standards and guidelines about the primary responsibilities of dental care providers in relation to infection control and the rationale for those obligations. It also includes a description of some of the key procedures to be carried out to implement those requirements. While the standards and guidelines are applicable to all dental premises, individual practices must have their own infection control procedures in place which are tailored to their particular daily routines. These procedures must be clearly documented, accessible to all dental staff and kept up to date. Dental staff need appropriate training in the infection control measures – compliance with the procedures is more likely if those involved in carrying them out understand the rationale behind the requirements. This includes knowing how infections are transmitted, what personal protection is needed and when and how to use it correctly, what vaccinations are needed and why, as well as the details of how to keep the practice clean and hygienic and what to do in the event of an infection control incident. Effective infection control also involves maintaining documentation about processes (e.g., sterilization logs, penetrating injury incident reports and so on).

Regular monitoring and review of protocols, training and documentation is necessary to ensure that current standards are being implemented.

References used to prepare these standards and guidelines are listed at the end of the document and can be sourced for further information.

Definitions

Allied Dental Personnel are those other than dentists, working in the provision of dental services – namely dental assistants, dental therapists, dental hygienists, dental prosthetists, dental laboratory assistants and dental technicians.

Board is a Federal, State or Territory dental registration board.

Dental Care Provider is a person registered by a Board to provide dental care.

Dental Staff are all those employed in a dental practice setting – namely dentists, allied dental personnel and clerical staff.

Disinfection is the destruction of pathogenic and other kinds of micro-organisms by physical or chemical means.

Exposure Incident is any incident where a contaminated object or substance breaches the integrity of the skin or mucous membranes or comes into contact with the eyes.

Exposure-Prone Procedures (EPPs) in dentistry are procedures where there is the risk of injury to the dental care provider (DCP) resulting in exposure of the patient's open tissues to the blood of the DCP and include "... any situation where there is a potentially high risk of transmission of blood borne disease from [practitioner] to patient during medical or dental procedures ..."*

There are a few procedures in dentistry which are exposure-prone for the patient. These are:

- oral surgical procedures including extraction of teeth (but excluding extraction of highly mobile or exfoliating teeth);
- periodontal surgical procedures;
- endodontic surgical procedures; and
- implant surgical procedures.

Invasive Procedure is any procedure that pierces skin or mucous membrane or enters a body cavity or organ. This includes surgical entry into tissues, cavities or organs, or repair of traumatic injuries.

A Surgical Procedure is one where there is a planned breach of a patient's physical barrier such as skin or mucosa and penetration into deeper layers which have a different immune response.

* From *Infection control guidelines for the prevention of transmission of infectious diseases in the health care setting* (ICG), Glossary G3.

A. Infection control

1. What is infection control?

The purpose of infection control in a dental surgery is to prevent the transmission of disease-producing micro-organisms such as bacteria, viruses and fungi from one patient to another patient, from dental care provider to patient, and from patient to dental care provider or other dental staff. In addition, it is necessary that endogenous spread of infection also be prevented by giving attention to the limitation of the spread of pathogens in the same patient.

Micro-organisms can spread in the surgery by:

- direct contact from one person to another;
- indirect contact via instruments and equipment; and
- droplets or aerosol/spray.

The micro-organisms can gain access to the body by what are known as 'portals of entry'. The micro-organisms may be:

- inhaled;
- implanted;
- ingested;
- injected; or
- splashed onto the skin or mucosa.

Whether the spread of these micro-organisms causes clinical infection depends in part on the virulence (power to infect) of a particular micro-organism and on the susceptibility of the host. For instance, considering the virulence of the organism, Hepatitis B virus (HBV) is highly infectious, the chance that this disease will be transmitted by a contaminated penetrating injury¹ is approximately one in three (depending on the infective status of the source of injury). In comparison, the chance of transmission of the Hepatitis C virus (HCV) by similar means is one in 30; and for HIV/AIDS, one in 300. Patients and dental staff have varying susceptibilities to infection depending on their age, state of health, underlying illnesses, and immune status (which may be impaired by medication, disease, cancer therapy and other factors such as malnutrition and hormone deficiency). Infection control is about limiting or controlling some of the factors that influence the transmission of infection or that contribute to the spread of micro-organisms. The spread of micro-organisms can be reduced by:

- limiting surface contamination by the micro-organisms;
- adhering to good personal hygiene practices;
- using personal (barrier) protection;
- using disposable products as required (e.g., paper towels); and
- undertaking risk minimization techniques.

Standard precautions are the basic processes of infection control which will prevent the transmission of infection and include:

- regular hand hygiene before and after patient contact;
- use, where appropriate, of personal protective barriers such as gloves, masks, eye protection and gowns;
- use, where appropriate, of environmental barriers such as plastic coverings on chair headrests and difficult to clean areas such as triple syringe buttons;
- wearing of appropriate protective equipment when cleaning instruments;
- appropriate handling of contaminated waste;
- appropriate handling of sharps;
- appropriate reprocessing of reusable instruments;
- effective environmental cleaning; and
- appropriate management of spills of potentially infectious matter.

¹ A penetrating injury is any injury from a sharp object such as an injection needle, scalpel blade, dental bur or denture clasp contaminated with a patient's blood or saliva.

Standard precautions minimize the risk of transmission of infection from person to person and they are essential for the care and treatment of all patients regardless of their perceived or confirmed infectious status. They are essential in the handling of blood (including dried blood), saliva and other body fluids (excluding sweat) whether containing visible blood or not, and when touching non-intact skin or mucous membranes.

Standard precautions must be employed at all times during:

- patient treatment;
- cleaning and processing instruments;
- cleaning the dental surgery environment; and
- handling items contaminated with saliva (e.g., radiographs, dentures and other prosthetic work).

Successful implementation of infection control involves:

- understanding the basic principles of infection control;
- creating systems which allow infection control procedures to be implemented effectively and make compliance with them easy (this includes having clear procedural documentation, comprehensive dental staff training and a process of regular monitoring);
- knowing about specific infectious diseases and how to take precautions against them; and
- identifying the settings that need modified procedures (e.g., nursing homes).

2. Duty of care

Dental care providers have a duty of care to their patients that must ensure adequate infection control measures are in place and complied with in the practice. Proprietors and dental care providers have an obligation to maintain a safe working environment for all dental staff. All dental care providers and dental staff have a responsibility to follow the specific infection control policies in their place of work.

Dental care providers and those responsible for provision of dental care services must:

- develop and implement work practices to ensure compliance with infection control standards;
- implement specific training and education on the physical protection;
- ensure all dental staff have been offered appropriate immunization and are aware of their immune status; and
- have in place a system of reporting, monitoring and rectifying breaches of infection control protocols.

The law expects practitioners to take reasonable steps to accommodate a patient's disability. It is illegal for dental care providers to discriminate against or refuse to treat a patient simply because the patient is, or is believed to be, infected with a blood-borne virus.² Standard precautions apply for treating all patients, except for those with specified diseases where transmission-based precautions are mandatory.

For further information on these specified diseases see Section G: *Infectious Diseases, Allergies and Transmission-Based Precautions for Infection Control*.

Dental care providers who undertake exposure-prone procedures (EPPs) have a responsibility to know their infectious status for blood-borne viruses such as Hepatitis B, Hepatitis C and Human Immunodeficiency Virus. (See Section G.6: *Blood-borne viruses and the infected dental care provider*).

Infected dental care providers

Dental care providers who are infected with, or who are carriers of, blood-borne viruses should seek the advice of medical experts and the local Board and/or health authority on their fitness to practice. They may need to modify their clinical practice and this may include not undertaking EPPs. As a result of possible limitation of practice it is recommended that students with a blood-borne virus be advised that it is unlikely they will be able to complete their clinical course requirements in dentistry and practice as a dental care provider. Advice on alternative courses and counselling should be available.

² Anti-discrimination and equal opportunity laws apply. Relevant State, Territory and Commonwealth legislation is listed in the References and Additional Reading.

B. Standard precautions of infection control

The following standard precautions form the basis of infection control and must be carried out routinely.

1. Handwashing and hand decontamination

Handwashing/hand decontamination reduces the number of infectious micro-organisms on the skin and is the single most important measure of infection control in the dental surgery. Hands must always be washed when they are visibly soiled, at the start of a session, after food or toilet breaks and on leaving the surgery. Handwashing should be undertaken in dedicated (clean) sinks preferably fitted with non-touch taps (or done with a non-touch technique) and not in the (contaminated) sinks used for instrument cleaning. If touch taps are used the taps may be turned on and off with a paper towel.

Hands must be washed with a liquid handwash or decontaminated using alcohol-based gels or liquids (also known as waterless handwashing) before and after every patient contact and before gloves are put on and after they are taken off. Wet hands must be dried with single use linen or paper towels.

Hand care

Hands must be well cared for and the skin protected against dryness. Lacerated, chafed or cracked skin can allow entry of micro-organisms, therefore any cuts or open wounds need to be covered with a waterproof dressing. All hand, wrist or nail jewellery should be removed prior to putting on gloves as its presence compromises the fit and integrity of gloves and also promotes significant growth of skin micro-organisms. (A plain band ring such as a wedding ring may be left on for non-surgical procedures but may cause irritation of the underlying skin, in which case it must not be worn).

Artificial fingernails can harbour micro-organisms and must not be worn. All fingernails must be kept short to prevent glove tears and to allow thorough cleaning of the hands.

For further information on handwashing and hand decontamination see www.ada.org.au.

2. Personal protective equipment

The wearing of protective personal clothing and equipment where aerosols are likely to be generated is an important way to reduce the risk of transmission of infectious agents. Not only must dental care providers and dental staff be provided with all appropriate necessary protective clothing and equipment for the procedure being undertaken, they also need to be educated about how to use it correctly.

Barrier protection, including gloves, mask, eyewear and gown must be removed before leaving the work area (e.g., dental surgery, instrument processing or laboratory areas).

Gloves

Dental care providers and dental staff must wear gloves whenever there is risk of exposure to blood, saliva or other body secretions or when hands will come in contact with mucous membranes. This means they must be worn for all clinical procedures.

Wearing gloves does not replace hand decontamination because hands may still become contaminated as a result of damage to the gloves during use or through manufacturing defects that were not immediately obvious.

Gloves used in patient care must not be washed or reused. A new pair of gloves must be used for each patient and changed as soon as they are cut, torn or punctured. Gloves must be removed or overgloves may be worn before touching any environmental surface without a barrier or before accessing clean areas.

Gloves must be removed as soon as clinical treatment is complete and hands washed/decontaminated immediately to avoid the transfer of micro-organisms to other patients or environments.

Gloves do not need to be sterile for general dental procedures but must comply with AS/NZS 4011. Sterile gloves must be worn when a sterile field is necessary, for procedures such as oral, periodontal or endodontic surgery.

Gloves also need to be worn when cleaning instruments and environmental surfaces. The type of glove worn must be appropriate to the task. For instance, heavy duty utility, puncture-resistant gloves must be used during instrument cleaning. These gloves can be reused, but must be washed in detergent after each use, stored dry and replaced if torn, cracked, peeling or showing signs of deterioration.

The use of powder-free gloves will minimize the risk of and alleviate the symptoms of latex allergy. If the dental care provider, dental staff or patient is allergic to latex, alternatives such as neoprene or nitrile gloves must be used.

For further information on latex sensitivity see the ADA's *The Practical Guides* and www.ada.org.au.

Masks

A number of diseases may be transmitted via the airborne (inhalational) route. In the dental surgery, the most common causes of airborne aerosols are the high speed air rotor handpiece, the ultrasonic scaler and the triplex syringe. The aerosols produced may be contaminated with bacteria from the oral cavity (saliva and dental plaque), as well as viruses from the patient's blood. Therefore, dental care providers and dental staff must wear suitable fluid-resistant masks to protect the mucous membranes of the nose and mouth, wherever there is a potential for splashing, splattering or spraying of blood, saliva or body substances, or where there is a probability of the inhalation of aerosols with a potential for transmission of airborne pathogens. It is suggested however that masks be worn at all times when treating patients to prevent contamination of the working area with the operator's respiratory or nasal secretions/organisms.

Dental procedures can generate large quantities of aerosols of 3µm or less in size. Therefore, dental care providers and dental staff working in the operating zone must wear masks or facial barriers which block particles of this size. These masks must conform to AS 4381.

Surgical masks (fluid-repellent paper filter masks) must be worn during surgical procedures and non-surgical dental procedures which generate aerosols.

The following are some basic protocols to be observed in relation to masks. They must:

- be fitted and worn according to the manufacturer's instructions;
- cover both the nose and mouth;
- be removed as soon as practicable after becoming moist or visibly soiled and it is recommended, where possible, that the mask be changed after 20 minutes in an aerosol environment;
- be removed by touching the strings and loops only; and
- be removed and discarded after every patient.

They must not:

- be touched by the hands while being worn; or
- be worn loosely around the neck while the dental care provider or dental staff member walks around the premises, but be removed and discarded as soon as practicable after use.

Eye protection

Dental care providers and dental staff must wear protective eyewear (AS 1337) or a face shield to protect the mucous membranes of the eyes during procedures where there is the potential for penetrating injury or exposure to aerosols, splattering or spraying with blood, saliva or body substances.

This includes most clinical procedures, especially during scaling, the use of rotary instruments, the cutting and use of wires and during the cleaning of instruments and equipment.

Eyewear must be optically clear, anti-fog, distortion-free, close-fitting and shielded at the sides. Prescriptive lenses are not considered a substitute for protective eyewear unless inserted in protective frames.

Patients must be provided with protective eye equipment to minimize the risk of possible injury from materials or chemicals used during treatment. Tinted lenses may protect patients from the glare of the light. Spectacles for vision usually do not provide sufficient protection. If patients refuse to wear the protective glasses, the risks should be explained and the refusal noted in their dental records.

With regard to cleaning, eyewear must be either single use or reusable after cleaning with detergent and water.

Protective clothing

Protective clothing (e.g., reusable or disposable gown, laboratory coat or uniform) should be worn to cover street clothing while treating patients when aerosols or splatter are likely to be generated or when contamination with blood or saliva is possible. The most suitable type of gown varies according to the nature of the procedure and the equipment used and is a matter of professional judgement. Where there is a risk of large splashes with blood or body substances an impermeable gown must be worn. Disposable gowns should be placed in general waste after use, or if visibly contaminated with blood they must be disposed of according to local regulations.

Gowns must be changed as soon as possible when visibly soiled or after repeated exposure to contaminated aerosols. The protective gown worn in the clinical area must be removed before eating, drinking, taking a break or leaving the practice.

Uniforms worn by dental care providers and dental staff must be clean and in good condition.

Footwear

Dental care providers and dental staff should wear enclosed footwear which will protect them from injury or contact with sharp objects (e.g., accidentally dropped sharps or spilt chemicals).

3. Surgical procedures and aseptic technique

The principles of sterile aseptic technique must be applied to all surgical procedures undertaken in the oral health care setting. From a dental perspective this would include a mucosal incision, surgical penetration of bone or elevation of a muco-periosteal flap.

Procedures involved would be:

- surgical removal of teeth;
- minor oral surgery procedures such as removal of soft tissue;
- periodontal and surgical endodontics; and
- implant placement.

The following additional requirements are necessary to provide for asepsis and a sterile field:

- sterile gloves must be worn;
- sterile prepacked gowns must be used;
- long hair must be tied back and covered; and
- beards must be covered.

In addition, these procedures include specific requirements for surgical handwashing (using an anti-microbial handwashing solution), gowning and gloving and the handling of sharps in the operative field. Gloves (which comply with AS/NZS 4179) must be sterile when EPPs such as incision into soft tissue or surgical procedures are carried out.

4. Management of sharps

The practice of dentistry frequently involves the use of sharp instruments so that a dental care provider may be exposed to a patient's blood or to blood-contaminated saliva. Occasionally, conditions of limited access and poor visibility will exist such that there is a risk of a penetrating injury to the dental care provider with the subsequent possibility of exposure of the patient to the blood of the dental care provider. It is essential that all sharp instruments must be handled and used with care and techniques employed which minimize the risk of penetrating injuries to dental care providers and dental staff.

Sharp instruments such as scalpels and scalers must never be passed by hand between dental staff members and must be placed in a puncture-resistant tray or bowl after each use. Instruments and sharp items must be carried from the surgery to the sterilizing area in a lidded puncture-resistant sharps transport container.

Needles must not be re-sheathed unless an approved recapping device or single-handed technique is used. Contaminated needles must never be bent or broken by hand or removed from disposable syringes.

Inappropriate handling of sharps both during and after treatment is the major cause of penetrating injuries which involve potential exposure to blood-borne diseases in the dental surgery.

The dental practice must have an easily accessible, clear set of written instructions on the appropriate action to take in the event of a sharps injury. These instructions must be understood and followed by all dental care providers and dental staff.

For further information see Appendix: *Blood and Body Fluid Exposure: Action Plan Diagram and Protocol*, the ADA's *The Practical Guides* and www.ada.org.au.

Disposing of sharps

The person who has used a disposable sharp instrument/equipment must be responsible for its immediate safe management or disposal after use. This must be at the point of use (i.e., the surgery or treatment room) unless transferred in appropriate containers.

Used disposable needle syringe combinations, needles, scalpel blades, orthodontic bands, burs and other single use sharp items must be discarded in clearly labelled, puncture and leakproof containers which conform to AS 4031 or AS/NZS 4261 as applicable.

A separate sharps container should be in each operative dental surgery, close to the point of use of any disposable sharp. Sharps containers must be placed in a safe position within the treatment room to avoid accidental tipping over and must be out of the reach of small children. Sharps containers must be sealed when they are three-quarters full and then collected by licensed waste contractors for disposal according to local regulations.

5. Management of clinical waste³

Management of medical and related waste must conform to local State or Territory regulations and AS/NZS 3816. Waste in the dental practice should be separated according to its category (medical or non-medical) at the point of generation, using appropriately colour coded and labelled containers according to AS/NZS 3816.

Medical waste includes recognizable human tissues (excluding teeth) and material or solutions containing free-flowing blood. Such waste must be placed in appropriate leak-resistant bags and then yellow containers bearing the international black biohazard symbol and clearly marked medical waste. Standard precautions (gloves, mask, protective eyewear) must be used when handling medical waste bags and containers. These must not be overfilled and must not be compacted by hand.

Medical waste and hazardous waste (some chemicals and mercury used in dental practice) must never be disposed of at local refuse tips. Medical waste and sharps containers must be stored securely before collection by licensed waste contractors for final disposal using approved technologies by licensed/accredited contractors.

Extracted teeth may be given to the patient or wrapped before disposal in the general waste. In some States/Territories it is illegal to incinerate teeth restored with amalgam, therefore those teeth must not be placed in medical waste or the sharps container.

6. Environment

A range of environmental controls can be used to reduce the risk of transmission of infectious agents in the dental practice. These should be considered when designing or refurbishing a dental practice.

Design of premises

The design of the premises and the layout of the dental surgery and treatment areas are important factors in implementing successful infection control. Work areas should be well lit and well ventilated with sufficient uncluttered and easily cleaned bench space to accommodate necessary equipment.

The surgery must have clearly defined clean and dirty areas and workflow in clinical areas must be from clean to contaminated areas (e.g., from the treatment zone to the periphery of the surgery). Care must be taken to avoid contaminated instruments/equipment re-entering clean work areas.

³ Local regulations on waste management and disposal of teeth may apply.

Floor coverings in the treatment area must be non-slip and impervious with sealed joints. Coved joints with the walls are preferred for ease of cleaning. Carpet is acceptable in the waiting room but must not be used in clinical, laboratory and instrument reprocessing areas as it is not impervious and any spills are difficult to clean.

Computer keyboards may harbour micro-organisms such as MRSA and they should be covered where possible in treatment areas and cleaned regularly in non-treatment areas.

Eating and recreation areas for dental care providers and dental staff must be separate from work areas and patient treatment areas and lunchroom crockery must not be washed in the hand or instrument wash basins. Food must not be stored in a refrigerator with dental materials, sealed clinical specimens or medical products such as drugs, vaccines and blood.

Cleaning the environment

Although surfaces such as floors, walls and curtains pose minimal risk of disease transmission in a dental practice, these surfaces nevertheless must be maintained in a clean and hygienic condition.

All environmental surfaces (i.e., apart from work areas and those in the operating field) must be cleaned at least weekly. Such areas include floors, window sills, blinds, door handles and telephone handsets, office and waiting room furniture. They must be cleaned by wiping or scrubbing with detergent and water. Walls, blinds and window curtains in patient care areas must be cleaned when they are visibly dusty or soiled.

Treatment areas

Routine cleaning of treatment areas is necessary to maintain a safe environment as deposits of dust, soil and microbes on environmental surfaces can transmit infection. Surfaces of dental units must be impervious as they may become contaminated with potentially infective material. Work surfaces and bench tops in treatment areas must be non-porous, impervious to water, smooth without crevices and have sealed joints to facilitate cleaning and prevent the accumulation of contaminated matter. The surfaces in the treatment area (treatment zone) must be cleaned after every patient by wiping the surface with a neutral detergent. Standard precautions (including wearing of personal protective equipment as applicable) must be implemented when cleaning all surfaces and cleaning methods must avoid the generation of aerosols.

A neutral detergent and warm water solution or commercially packaged pre-moistened, neutral detergent wipes should be used for all routine and general cleaning. Neutral pH detergents are best for environmental cleaning because they are less likely than acid or alkaline detergents to damage metals such as stainless steel or to cause skin irritation. Neutral detergents also leave little residue on surfaces. Fresh cleaning solutions of detergent should be prepared as instructed by the manufacturer daily. Containers for these fresh solutions should be emptied, washed and dried overnight prior to refilling for subsequent use.

Written cleaning protocols for the practice must be prepared, including methods and frequency of cleaning.

General work surfaces, not in the treatment zone, must be cleaned and dried after each session or when visibly soiled. Sinks and wash basins must be cleaned at least daily, or more often if appropriate. Damp dusting and dust-retaining mops are recommended but brooms must not be used in clinical areas as they disperse dust and bacteria into the air. Mops and cloths must be cleaned after use and allowed to dry before reuse; or use single use, disposable mop heads or cloths.

Spills must be cleaned up as soon as practicable.

7. Cleaning blood spills

If blood is spilled it must be cleaned up as soon as possible. The person who deals with the spillage must wear appropriate protective clothing, including heavy duty household gloves, protective eyewear and a disposable apron. In the surgery and work areas spots or drops of blood or other small spills can be managed by wiping the area immediately with a paper towel and then cleaning with water and detergent.

Large spills of blood are unusual in a general dental practice but having a commercial spill kit (which contains appropriate products and instructions for clean up) on hand for such an eventuality can be useful. After removal of body fluid and waste the area should be cleaned with a detergent and water.

Good ventilation is essential and the generation of aerosols must be avoided.

C. Infection control strategies within the operating field

The boundaries of the operating field need to be clearly defined during dental treatment and the spread of droplets and aerosols contained within that field. This can be achieved in part by the use of dental dams, high volume evacuation and proper patient positioning. Rubber dam minimizes the spread of blood or saliva. When rubber dam is not applied, high volume aspiration becomes essential.

All surfaces and items within the operating field must be deemed contaminated by the treatment in progress. The surfaces must be cleaned and other items removed, cleaned and sterilized before the next patient is treated.

Note: any instruments selected for a treatment session but not used must be regarded as contaminated. Items such as opened containers of gloves need to be stored outside the treatment zone and protected from aerosols.

Protective coverings such as plastic wraps may be applied to surfaces that have been cleaned at the beginning of the day. Surface barriers should be used to protect clinical contact surfaces, particularly those that are difficult to clean (e.g., switches on dental chairs). These coverings should be disposed of after each patient treatment. Clinical contact surfaces that are not barrier-protected need to be cleaned after each patient.

1. Clean and contaminated zones

Within the dental surgery, clean and contaminated zones must be clearly demarcated. Every person must understand the zones, the requirements for each zone and adhere to the outlined protocols. Dental care providers and dental staff should not bring personal effects, changes of clothing or bags into the clinical areas where cross-contamination is likely to occur.

The operating field and areas where contaminated instruments are placed are regarded as contaminated zones whereas clean areas include those surfaces and drawers where clean or sterilized instruments are stored and which never come in contact with contaminated instruments or equipment. A system of zoning aids and simplifies the decontamination process.

It is recommended wherever possible that materials such as cotton rolls, dental floss, gingival retraction cord and restorative materials should be pre-dispensed. However, if additional instruments and materials have to be retrieved from outside the operating field during a patient treatment, it must be by a method which does not contaminate other instruments or materials in the drawers:

- drawers must be opened by elbow touch, de-gloving or a suitable no touch technique such as use of transfer tweezers, the use of overgloves or single use barriers on drawer handles;
- retrieval of instruments and materials such as extra cotton rolls from drawers must be by transfer tweezers which are kept separate from the other instruments; and
- overgloves must be used or gloves must be removed and hands washed/decontaminated to dispense materials.

In some circumstances dental staff may need to move from the contaminated zone to a clean zone. Gloves must be removed and hands washed or decontaminated before touching non-clinical items without a barrier. Whenever gloves are removed hands must be washed/decontaminated and then re-gloved before re-entering the contaminated operative field.

The equipment must be cleaned after each patient use or if it is difficult to clean then barrier protection should be applied and changed between patients.

Items where barrier protection should be considered include:

- the operating light handle, the X-ray head, tubing for suction, handpieces not in use and triplex syringe, together with the cradles they rest in;
- the polymerising light, intra-oral camera and fibre-optic illuminator; and
- the bracket table and handle.

2. Waterlines and water quality

Most dental unit waterlines contain biofilm, which acts as a reservoir of microbial contamination and while biofilm in dental unit waterlines is an unknown hazard it may be a source of known pathogens (e.g., *Legionella spp*). All waterlines and air lines must be fitted with non-return (anti-retraction) valves to help prevent retrograde contamination of the lines. Routine maintenance of these valves is necessary to ensure their effectiveness.

An independent water supply can help to reduce the accumulation of biofilm. The manufacturer's directions for appropriate methods to maintain the recommended quality of dental water and for monitoring water quality should be followed. Biofilm levels in dental equipment can be minimized by using a range of measures, including chemical dosing (e.g., hydrogen peroxide, silver ions and peroxygen compounds), flushing lines (e.g., triple syringe and handpieces) after each patient use, and flushing waterlines at the start of the day to reduce overnight or weekend biofilm accumulation. This is particularly important after periods of non-use (such as vacations and long weekends). Waterlines must be cleaned and disinfected in accordance with the manufacturer's instructions.

Air and waterlines from any device connected to the dental water system that enters the patient's mouth (e.g., handpieces, ultrasonic scalers, and air/water syringes) must be flushed for a minimum of two minutes at the start of the day and for 30 seconds between patients.

Water quality

Water for tooth irrigation during cavity preparation and for ultrasonic scaling should be of no less than potable standard (< 500 CFU/mL)⁴.

It may be wise to use water in which the number of colony forming units (CFU) per mL is less than 200 when treating immunocompromised patients. CFU levels can be tested using commercially available test strips.⁵

Sterile irrigants such as sterile water or sterile saline must be used for surgical procedures.⁶

3. Single use items

Dental items designated as single use by the manufacturer must not be reprocessed and reused on another patient, but must be discarded after use.

Single 'one patient' use sterile instruments should be used whenever indicated by the clinical situation. These items include, but are not limited to, local anaesthetic needles and cartridges, scalpel blades and matrix bands (not sterile when imported and must be sterilized before use). Instruments which are very small and/or sharp and are difficult to clean should be considered single use. They must not be reused unless a validated and safe cleaning process is employed.

Stainless steel endodontic files, reamers and broaches are to be considered single use items as currently no cleaning method has yet been validated as being effective in removing organic material from these items and, therefore, they are not reprocessable.

Injecting apparatus (including hypodermic syringes, needles, dental local anaesthetic solution and needles) must be sterile at time of use and are single patient use only. For example, incompletely used local anaesthetic cartridges must be discarded after each patient use. Similarly, suture materials, suture needles and scalpels must be used for one patient and then disposed of.

⁴ See CDC (2003) *Guidelines for Infection Control in Dental Health-Care Settings*, page 29: "...the number of bacteria in water used as a coolant/irrigant for nonsurgical dental procedures should be ... at a minimum < 500 CFU/mL, the regulatory standard for safe drinking water established by EPA and APHA/AWWA."

⁵ See recommendation in *Infection Control Guidelines for the prevention of transmission of infectious diseases in the health care setting*, section 35.5, pages 35-3 and 35-4.

⁶ See CDC (2003) *Guidelines for Infection Control in Dental Health-Care Settings*, page 29: "Sterile solutions (e.g., sterile saline or sterile water) should be used as a coolant/irrigation in the performance of oral surgical procedures..."

D. Instrument reprocessing

Contaminated instruments can transmit infections to patients if used during clinical procedures and the adequate reprocessing of instruments between each patient use is essential to prevent the transmission of infection from one patient to another. The type of instrument and its intended use will determine the method of reprocessing and, as a general rule, if an instrument cannot be cleaned it cannot be safely reprocessed. Reprocessing of instruments must be in accordance with AS/NZS 4815 or 418. For guidance on specific dental items see section 12.4 of AS/NZS 4815.

1. Categories of instruments: infection risk relative to instrument use

Contaminated instruments can transmit infections to patients during clinical procedures. The risk of this happening is related to the site of use. How much reprocessing or preparation for reuse is required for reusable instruments and equipment depends on their intended use. The Spaulding classification describes three instrument/risk categories (critical, semi-critical and non-critical), each of which has specific reprocessing requirements.

Equipment and instruments which are used in the treatment of mucosal lesions or tissue and which come in direct contact with mucosa and gingiva must be single use, disposable or cleaned and reesterilized after each patient. Examples are electrosurgery, cryotherapy and related devices and tips.

Category of instrument ⁷		Reprocessing requirements*
<p>Critical: Highest risk</p> <p>Where there is entry or penetration into sterile tissue, cavity or bloodstream (i.e., invasive and surgical dental procedures).</p> <p>Examples: dental forceps and elevators, flap retractors and surgical burs, instruments used in the placement of implants, implantable items including mini implants, surgical dental handpieces.</p>		<ol style="list-style-type: none"> 1. These instruments must be sterile at the time of use and must be either 'single use disposable' or capable of being steam sterilized. 2. They must be used immediately after sterilization or bagged prior to sterilization and kept stored in bags until used. Instruments stored in bags which are found to be damaged must be reesterilized before use. 3. It may be appropriate to track these instruments.
<p>Semi-critical:</p> <p>Where there is contact with intact non-sterile mucosa or non-intact skin.</p> <p>Examples: mouth mirrors, restorative instruments, endodontic instruments, dental tweezers and probes, metal impression trays, and other non-critical items when used occasionally in the mouth (e.g., Le Cron carver).</p>		<ol style="list-style-type: none"> 1. Instruments must be sterilized where possible and when not possible a barrier must be placed (e.g., curing light tip). 2. Instruments should be 'single use disposable' or sterilized after use. 3. After processing, semi-critical instruments should be stored in a way to prevent contamination prior to use by being kept bagged in closed drawers or in dedicated closed containers. 4. Instruments used in semi-critical procedures need to be sterilized between patients but do not need to be tracked back to a steam sterilizer cycle and are not required to be sterile at the point of use. 5. In some rare instances thermal disinfection using heat and water is acceptable and professional judgement needs to be exercised (e.g., thermal disinfection of denture polishing buffs may be appropriate as they are unlikely to be contaminated with blood).
<p>Non-critical: Lowest risk</p> <p>Where there is contact with intact skin.</p> <p>Examples: prosthetic gauges and measuring devices, face bows, protective eyewear, bib chains and dappen dishes, Willis gauges.</p>		<ol style="list-style-type: none"> 1. Cleaning alone with detergent and water is generally sufficient but in some cases thermal disinfection with heat and water is appropriate. After processing, these instruments should be stored in the same way as semi-critical instruments to prevent contamination prior to use.

⁷ This is based on the Spaulding classification system as described in the *Infection Control Guidelines for the prevention of transmission of infectious diseases in the health care setting* (ICG), pages 4-9 and 16-5.

* Reprocessing is all steps necessary to make a contaminated reusable device ready for its intended use. These steps may include cleaning, functional testing, packaging, labelling, disinfection and sterilization.

2. Instrument reprocessing area and workflow

Part of the dental premises must be designated as the reprocessing area for reusable instruments (including cleaning, packaging and sterilizing) and not used for any other purpose. Ideally, this should be a dedicated room separate from the treatment room(s) but if not environmentally possible then reprocessing should occur well clear of the contaminated zone with good workflow processes established and when there is minimal risk of aerosol contamination of the reprocessing area.

The cleaning process should flow in one direction from contaminated area and items to clean area and items. If instrument washing must take place in the clinical or laboratory area due to limitations of space, then contaminated areas and instrument washing sinks must be clearly designated. Instrument flow must still be in one direction: from dirty area to clean.

To minimize particulate contamination and bio-burden (pathogenic bacteria, fungi and viruses), the principles of environmental control need to be observed. The reprocessing area must be divided into distinct areas for:

- receiving, cleaning and decontamination;
- preparation and packaging;
- sterilization; and
- storage.

Processed instruments must not be stored in an area where contaminated instruments are held or cleaned or where there is a possibility of contamination from organisms carried in droplets or aerosols.

Design of reprocessing area

The following are design features of the reprocessing area which will facilitate successful infection control:

- instrument flow in one direction – from dirty to clean;
- good lighting to minimize the risk of sharps injury and enable inspection of cleaned instruments;
- efficient ventilation;
- non-slip water-impervious flooring which is readily cleanable;
- smooth work surfaces without crevices made of non-porous materials such as artificial stone, granite, stainless steel or laminate to facilitate cleaning. There must be no inaccessible areas where moisture or soil can accumulate;
- work benches of a standard height and storage cupboards located at heights which minimize bending over or stretching overhead;
- sinks must be deep enough and taps provided with anti-splash devices to prevent splashing. There should be three sinks – one for handwashing, one for washing contaminated instruments and one for rinsing cleaned instruments;
- both hot and cold water taps should ideally be non-touch or electronic in operation and liquid handwash dispensers should be operated by elbow, knee or foot;
- sufficient drawers, cupboards and shelves to keep work benches as clutter-free as possible and to facilitate storage of sterilized packages as well as general items such as tracking guns, logbooks, cleaning agents and self sealing bags;
- sufficient bench space for drying and packaging areas to enable efficient work practices; and
- a cooling area for sterile items awaiting storage. This is essential to prevent damage to packs. Trays of instruments, when removed from the steam sterilizer, should be placed on racks and not directly on the bench to prevent damage from water condensation under the cooling packages.

3. Transfer of dirty instruments and transfer of sharps

Instruments should be carried to the sterilizing area in a cassette or container, preferably lidded and puncture-proof, to minimize handling and prevent the potential for a penetrating injury.

A systematic approach to the decontamination of instruments after use will ensure that dirty instruments are segregated from clean. The contaminated instruments should be carried with gloved hands to the cleaning area and placed on the bench in the 'dirty area'. The gloves must then be taken off and hands washed. Once the cleaning process commences heavy duty gloves must be worn.

Remember: instruments must pass in one direction only, from dirty to clean.

4. Cleaning

Used dental instruments are often heavily contaminated with blood and saliva unless pre-cleaned by wiping at the chairside. Dental instruments and devices that are contaminated with blood and body solutions and other contaminants must be cleaned immediately to prevent the substances drying on them. This will reduce the need for intensive cleaning by hand at a later stage. Remove gross soil from instruments by wiping them at the chairside onto an adhesive-backed sponge or dampened gauze. Alternatively, if they are unable to be cleaned immediately, the instruments may be soaked in detergent or an enzymatic cleaner to prevent hardening of residue. Enzymatic cleaners should not be used, however, for routine cleaning of instruments and should not be sprayed as they can cause lung irritation.

The presence of organic material left on instruments/equipment may prevent the penetration of steam during sterilization, therefore instruments must be completely cleaned before they are disinfected or sterilized. Cleaning significantly reduces the number of micro-organisms which need to be killed during sterilization or disinfection. In addition, removing the organic material lessens the chance of micro-organisms multiplying on the instruments before reprocessing commences. If saliva dries and coagulates – particularly if blood is present or if hot water is used for cleaning – it can entrap the organisms inside the mass formed and inhibit penetration of the sterilizing/disinfecting agent. Even when these potentially disease-producing organisms are killed, released endotoxins may remain and may sometimes cause fevers in patients if introduced into cuts or wounds. Similarly, dislodged soil and foreign particles, even if sterile, can produce severe complications such as granulomas if they enter a cut in skin or ulcer in a breach of the oral epithelium.

Staff cleaning contaminated instruments must use heavy duty (puncture and chemical-resistant) gloves, wear eye protection/face shield/mask and a waterproof/fluid-resistant gown/apron. Cleaning techniques should aim to avoid spraying liquid into the air. Splashes of cleaning agents on a person's skin must be washed quickly with clean water and then treated in accordance with the manufacturer's instructions.

Dental staff who clean and reprocess instruments must be given formal training in the relevant procedures.

Instruments can be cleaned either by hand or mechanically (in either an ultrasonic bath or instrument washer/disinfector). Automated mechanical cleaning is preferred to manual cleaning as it more efficient, reduces the risk of exposure to blood and reduces the risk of penetrating skin injuries from sharp or pointed instruments.⁸ After either manual or mechanical cleaning, instruments should be checked visually under good lighting to ensure all soil/contaminant is removed. Damaged or rusted instruments must be repaired or discarded and those with visible residue soil/contamination must be re-cleaned. Remember, if the item is not clean the sterilization process may be compromised.

Manual cleaning

Clean, lukewarm water which is fit for drinking is suitable for cleaning instruments (hot water is not used at this stage as it coagulates protein which increases the difficulty of cleaning). In a like manner, cold water solidifies lipids and should not be used. Cleaning dental instruments by hand is the least efficient method, but if used, the instruments should be fully immersed in a dedicated instrument cleaning sink pre-filled with warm water and detergent and a long-handled instrument brush used to remove debris.

A mildly alkaline, low foaming, free rinsing non-abrasive liquid detergent should be used which is much more effective than a neutral pH detergent in removing blood and fatty substances. Common household detergents must not be used due to their high foaming properties and the difficulties in rinsing items free of detergent residue which can interfere with the sterilizing/disinfecting process. In addition, too much foam prevents the operator from seeing instruments under the water in the sink and thereby greatly increases the risk of cuts and penetrating injuries from sharp instruments.

Rinse instruments thoroughly to remove all traces of detergent with warm to hot running water. Visually inspect under good light to ensure all surfaces of all instruments are clean.

Cleaning brushes must be washed rinsed and stored dry. A wire bur brush maintained in good condition is also necessary for cleaning tungsten carbide and diamond burs.

Abrasive cleaners such as steel wool and abrasive cleaning powders should not be used as they can damage instruments and residues may be left.

⁸ See article by Miller, Tan, Beiswanger, Gaines, Setcos & Palenik (2000) 'Cleaning dental instruments: measuring the effectiveness of an instrument washer/disinfector'.

Mechanical cleaning

Mechanical cleaning of instruments can be carried out in instrument washers or ultrasonic cleaners. Instrument washers/disinfectors are more efficient at pre-sterilization cleaning than ultrasonic cleaners or manual cleaning. Current models of washers/disinfectors are designed for dental instrument and handpiece cleaning, have performance recorders and print out parameters of each cycle.

Instrument washers/disinfectors are more efficient at pre-sterilization cleaning than ultrasonic cleaners, manual cleaning or domestic dishwashers. They must not be used as a substitute for sterilization where the items can be sterilized. There are bench top and floor mounted models for use in dental surgeries. They have closed cabinets linked to the water supply and drainage systems and must be serviced according to the manufacturer's instructions and comply with AS/NZS 2945 or AS 3836.

Washer/disinfectors must be well maintained and cleaned regularly to prevent formation of biofilms which could contaminate the instruments being processed.

Ultrasonic cleaners which comply with AS 2773 may be used for cleaning, especially small items such as endodontic rotary files (following a validated protocol), and dental burs which are reprocessible. They are particularly useful for cleaning jointed instruments such as scissors, stainless steel syringes or those with serrated beaks such as artery and extraction forceps.

Items must be free of visible soil before being placed in an ultrasonic cleaner. In addition:

- lids, tank, gaskets and strainers must be cleaned daily;
- cleaning fluid must be changed a minimum of twice daily (or when it appears heavily contaminated);
- an aluminium foil test (or another approved performance test) must be performed daily and the result recorded;
- the lid must be closed during operation (to avoid dispersal of aerosols);
- instruments must be completely submerged in fluid; and
- no part of the operator's fingers or hands is permitted to be immersed in the fluid during operation of the cleaner.

At the end of each day, the ultrasonic cleaner tank must be emptied, cleaned and left dry.

For further information see the ADA's *The Practical Guides* and www.ada.org.au.

Drying instruments

As residual moisture may impede the sterilization process, instruments to be sterilized by steam should be dried. Suitable methods include using a drying cabinet, using a lint-free cloth or wipe, and using a short rinse in very hot water. Instrument washers have a drying cycle which eliminates the need for a separate drying step.

5. Packaging prior to steam sterilization

Instruments which must be sterile at time of use (i.e., critical instruments which penetrate normally sterile tissue), must be bagged or wrapped prior to sterilization. After sterilization, critical instruments must remain bagged or wrapped until use. In an emergency situation a critical instrument may be processed unbagged and transported to the treatment zone in a sterile container for immediate use. Where feasible non-critical instruments should be stored in cassettes or bagged, since these facilitate storage and protect against contamination from aerosols.

Paper bags/wraps conforming to AS 1079.2 and textile linen wraps conforming to AS 3789.2 are suitable for steam sterilization. Paper and synthetic packaging is single use (i.e., used once and then discarded).

Packaging and wrapping materials must permit the penetration of steam into the pack and the removal of steam and water vapour after sterilization. For a B class cycle of sterilization, packs must be used which allow air removal prior to the introduction of steam into the chamber of the sterilizer.

Trays or cassettes used for packaging instrument sets must be perforated to allow for penetration of steam and efficient drying.

Instruments with hinges or ratchets must remain open and unlocked. Sharp instruments should be packaged in such a way as to prevent perforation of the pack.

Packs or bags must be sealed prior to processing. This can be done by using a heat sealing machine, applying autoclave tape, or by using bags which are self-sealing. String, domestic adhesive tape, staples and elastic bands are not suitable as sealants.

Identification colour-coded tapes on instruments must not be used as they can prevent the penetration of steam under the tape, may harbour micro-organisms in their adhesive layer and may detach from the instrument during surgery, compromising patient safety. Further, silicone rubber rings used to identify instruments may impede sterilization and if used, micro-organisms may be present under the rubber ring after sterilization, thus compromising the sterility of the instrument. Therefore, etching of instruments as a method of identification is preferred for critical instruments.

Felt tipped non-toxic marking pens and rubber stamps using water-resistant ink may be used for the labelling of packs and bags on the laminated side of packs prior to sterilization.

6. Steam sterilization (autoclaving)

Sterilization is the process of rendering an item free of all forms of viable micro-organisms, including spores. In office-based dental practice the most efficient and simplest means of sterilizing dental instruments is steam under pressure (commonly called steam sterilizing or autoclaving). It involves the combination of heat and moisture maintained at the right temperature and pressure for the right length of time to kill micro-organisms. The sterilization process requires that all air in the chamber be replaced by steam.

Dry heat sterilization and chemoclaves are not recommended for sterilizing dental instruments and equipment. Ultraviolet light and boiling water do not sterilize instruments and must not be used.

Portable bench top steam sterilizers (formerly called autoclaves)

Small, portable or bench top steam sterilizers are the most reliable and efficient sterilizing units for use in office-based practice. They must be operated according to the standards AS/NZS 4187 and AS/NZS 4815 and manufacturer's instructions.

There are several types of sterilization cycles including:

- N class cycles – steam pushes the air downwards and forces it out a port in the bottom of the chamber;
- S class cycles – multi-pulse vacuum steam sterilizers; and
- B class cycles – air is exhausted by a mechanical pump to create a vacuum before steam is introduced into the chamber.

Some steam sterilizers are capable of being operated through more than one kind of cycle, depending on the circumstances and the type of instruments.

Maintenance and testing

All steam sterilizers must be commissioned on installation.

Validation of the sterilization process

In order to ensure appropriate sterilization of items in the surgery a concept known as validation of the sterilization process is undertaken. In order to ensure the items are sterilized, the function of the sterilizer must be checked.

The validation process involves the following steps:

Commissioning (Installation qualification and operational qualifications)

Commissioning report includes installation documents and operation verification. This is performed by the service technician when new or repaired sterilizers are installed in the practice.

Performance qualification

- a. Physical qualification (by a qualified instrument technician or manufacturer's technician):
 - Calibration report (6-12 monthly depending on the age of the machine and the amount of usage);
 - One-off chamber/heat distribution report. This record is obtained once only for the life of the sterilizer or after major repairs; and
 - Penetration report which checks the physical attributes of the sterilizer. This record is obtained once only for the life of the sterilizer or after major repairs or when pack contents or packaging changes significantly.
- b. Microbiological Report to confirm functioning of the sterilizer.

The Validation Report summarises satisfactory completion of commissioning and performance qualification. It is validation of the total process.

Monitoring of cycles

It cannot be assumed that sterilization has been achieved without the appropriate testing and load checking. Time, temperature and, where applicable, pressure must be measured with continuous, automatic, permanent monitoring (e.g., process recorder, printer or data logger). Where these parameters are displayed on the devices/gauges of steam sterilizers which have no recording device, readings of the sterilizing process should be documented at intervals of 10 seconds. Alternatively, a biological/enzymatic indicator or Class 4, 5 or 6 chemical indicator for steam sterilizers or a Class 3 indicator for dry heat sterilizers can be used for each load. The processed chemical indicator must achieve all sterilization parameters applicable to the indicator used and that information recorded.

The steam sterilizer's performance must also be monitored by periodic testing (including daily and weekly tests as described in AS/NZS 4815).

Operating the steam sterilizer

As with all infection control procedures, dental staff must be trained in the correct operation of the steam sterilizer. An operator's manual must be available on site and the unit must be used according to the manufacturer's instructions.

Before steam sterilizing an instrument, the operator must verify that the item is suitable for the process (some instruments made of plastic cannot withstand the process).

Steam sterilizers which incorporate a drying cycle in their design can be used to process both wrapped and bagged items. Those without a drying cycle are suitable only for sterilizing unwrapped items which must then be used immediately after sterilization if they are critical items.

Steam sterilizer performance tests

It is necessary to regularly monitor the sterilization process to ensure the process has met all parameters and that consequently the reprocessed instruments can be assumed to be sterile.

There are a range of tests that must be carried out prior to commencing the first sterilizing cycle for sterilizers with a Class B cycle. In summary they include:

Leak rate test – A leak rate test is a simple push-button operation that is built into steam sterilizers with a Class B cycle. It tests the security of seals on the machine. Most modern pre-vacuum autoclaves incorporate automatic air leak detection, and a leak rate test is only performed weekly. In the absence of automatic air leak detection, this test should be run every working day.

Air removal and steam penetration test (Class 2 test) – Bowie Dick-type test for use when processing porous loads or a Process Challenge Device (PCD) Compact-PCD Process Challenge Device – also known as a helix test for non-porous loads. For non-porous loads, depending on the contents of the load to be sterilized, one or other of these tests must be performed before the first sterilizing cycle in order to determine whether the autoclave is operating correctly.

Loading

The steam sterilizer can only work effectively if steam can circulate freely and touch every surface of every instrument. The steam sterilizer trays should not be crowded and items must not be packed one on top of the other. There are a range of stacking devices to enable correct loading of the steam sterilizer. Correct loading also reduces damage to packs and their contents and maximizes the efficient use of the steam sterilizer. To ensure air removal, hollow items should be loaded according to manufacturer's instructions. Packs of drapes must be loaded with layers vertical. Flexible packaging materials must be loaded on edge with paper to laminate or flat with paper surface downwards. Only a single layer of packs must be placed on each tray. Unwrapped items should not be loaded above wrapped/bagged items to prevent condensation dripping onto wrapped/bagged items, and thus compromising their drying.

Items waiting to be sterilized must be stored in a dedicated 'pre-sterilization' area, not in the steam sterilizer. This will minimize the risk that they might be recirculated as already sterilized instruments.

A Class 1 chemical indicator must be placed in each loading tray being processed if non-bagged items are loaded.

Drying

Forced cooling of items by external fans or boosted air conditioning must not be used.

Cooling items must not be placed on solid surfaces since condensation of vapour inside the pack may result. Packaged or unpackaged items must never be dried by opening the door of the steam sterilizer before the drying cycle is completed.

In those without a drying cycle, allow unwrapped instruments to dry and cool in the steam sterilizer before they are handled to avoid contamination and thermal injury.

Unwrapped critical instruments which must be sterile at the time of use must be used immediately after completion of the sterilizing process.

Checking the completed load

Once the sterilizing process (including the drying cycle) is complete, a number of checks need to be made and the results recorded.

Check the readings – pressure, temperature, time – on the steam sterilizer's instruments and compare them to the recommended values. If any reading is outside its specified limits, the sterilization cycle must be regarded as unsatisfactory (regardless of results obtained from chemical indicators) and the sterilizing cycle repeated. If the second cycle is unsatisfactory, the steam sterilizer must not be used until the problem has been rectified by an instrument technician. Logs and print-outs must be retained for inspection and monitoring. Modern steam sterilizers have an integral printer or data logger to allow the parameters reached during the sterilization cycle to be recorded for routine monitoring. For dental instruments and equipment, steam sterilizers must reach a temperature of 134-137°C for three minutes. Existing older type bench top steam sterilizers must, where possible, be fitted with mechanisms to record these sterilizing parameters electronically. If no such mechanism is available, parameters must be monitored and recorded manually or process indicators must be used for each cycle.

Visually check that bags and contents are dry.

Check that sterilizing indicators have made the required colour change. If one pack has not changed the whole load must be regarded as suspect.

Check each bag to ensure that it is undamaged and properly sealed.

Instrument packs must not be used if mechanical or chemical indicators indicate some flaw in the sterilizing process.

If the bag/package is compressed, torn, unsealed or wet or if items have been dropped on the floor or placed on dirty surfaces, the affected instruments must be considered contaminated and must be repackaged and reprocessed.

Steam sterilizer monitoring tests

It is necessary to regularly monitor the sterilization cycle to ensure the sterility of reprocessed instruments.

Chemical indicators

Chemical indicators show that certain temperatures, times and pressures have been reached during the sterilizing process. Instruments are assumed to have been sterilized when the correct sterilization parameters have been achieved.

Chemical indicators provide information about conditions in the steam sterilizer at the specific locations where they are placed, whether in the chamber, in packs of a steam sterilizer load or in a process challenge device. Some indicators are only sensitive to changes of temperature whilst others are sensitive to variables such as temperature, time and water (as delivered by saturated steam).

Class 1 – these are intended for use on individual packs of wrapped instruments to indicate that the unit has been exposed to the sterilization process (e.g., steam sterilizer indicating tape, indicating labels). If un-bagged semi-critical or non-critical instruments are processed a Class 1 indicator must be placed in each load. The indicator must be examined after the sterilizing cycle to ensure that the pack has been exposed to a sterilizing process. These indicators usually fail only when there is gross malfunction of the steam sterilizer.

Class 2 – a specific test (either a Bowie-Dick-type test for use when processing porous loads or a Process Challenge Device (PCD) to be used for general dental instruments, particularly hollow instruments) which measures the effectiveness of air removal and even penetration of steam in a pre-vacuum sterilizer. Cool air pockets, which may be caused by an overcrowded chamber, incorrect wrapping, incorrect positioning, or incorrect use of packaging materials, are a very common cause of failed sterilization in downwards displacement steam sterilizers. Air pockets occur less often in pre-vacuum steam sterilizers.

With a pre-vacuum steam sterilizer, an air removal test such as a helix test or Bowie-Dick test must be run each day. When using a B Class steam sterilizer to sterilize porous loads of cotton rolls, gauze post-extraction packs, cotton wool and the like a Bowie-Dick-type test is recommended. If hollow loads such as handpieces are to be sterilized in a B Class steam sterilizer the appropriate test is the helix type PCD.

Class 3 – indicators of this kind respond to only one critical variable (e.g., temperature). They have poor accuracy and are only used with dry heat sterilizers. They have limited value in general dentistry.

Class 4 – are designed to react to two or more of the critical sterilizing variables (e.g., time and pressure) and indicate exposure to a sterilization cycle at the values of the variable as stated by the manufacturer.

Class 5 – an integrating indicator indicating time, temperature and moisture sometimes called a Biological Emulator because it is timed to change colour at a temperature of 134°C. It is at this point that the probability of residual viable organisms remaining is less than one in a million (the sterility assurance level).

Class 6 – Class 6 indicators are the most useful as the correct colour change indicates that the sterilizing parameters of temperature, pressure and time have been achieved. A Class 6 indicator must be used in each load when using an 'on-loan' steam sterilizer or when awaiting a technician to carry out IQ and PQ on a newly purchased or major repaired steam sterilizer or when using a steam sterilizer without a printer. Where instruments are intended to be sterile at point of use, then a high level emulating indicator (5 or 6) is required in each instrument pack. While AS/NZS 4187 permits chemical indicators between Classes 4 and 6 to be used for such a purpose a Class 6 indicator may be preferable because of its ability to provide additional information on steam quality which is not provided by Class 4 and 5 indicators.

Biological indicators

Only biological indicators, which use highly heat-resistant spores, actually show that sterility has been achieved. Steam sterilizers which have not been calibrated or validated should be monitored by a weekly test using a biological indicator or alternatively each load must be processed with a biological emulator. The preferred test organism for steam sterilization is *Geobacillus stearothermophilus*.

For further information see the ADA's *The Practical Guides* and www.ada.org.au.

7. Disinfection

Disinfection does not ensure the degree of safety associated with sterilization because it does not always destroy all microbial forms (e.g., bacterial spores). It is not a sterilizing process and must not be used where reusable instruments can withstand steam sterilization. It may be used for non-critical instruments and some semi-critical (e.g., prosthetic instruments) which cannot be steam sterilized.

Thermal disinfection

Thermal disinfection uses heat and water at temperatures which destroy pathogenic non-spore forming vegetative organisms. A common use for thermal disinfection in dentistry is for disinfecting some prosthetic instruments, polishing buffs and brushes. Most instruments used in dental prosthetics are semi-critical or non-critical and many can be disinfected by heat and water in a thermal disinfectant. However, as single use disposable instruments are now available the use of a thermal disinfectant should be minimized. If a high temperature thermal disinfectant is used the proper temperature and time parameters must be ensured.

The process

The item to be thermally disinfected must be cleaned prior to disinfection. If an item is not clean it cannot be disinfected. Wet instruments can be placed into the thermal disinfectant.

The thermal disinfectant must be cleaned regularly and the water changed frequently depending on use. Automatic washer/thermal disinfectors (mains water) may be used for thermal disinfection.

Small electric ovens and microwaves must not be used as a means of thermal disinfection.

Chemical disinfection

For practical purposes there is no place for cold high level chemical disinfection (e.g., glutaraldehyde) in dentistry.

Chemical disinfectants should only be used when thermal disinfection is unsuitable (e.g., some prosthetic or laboratory items).

Different types of disinfectants must not be mixed or combined and must be used before expiry dates. Products must be used at the recommended concentration for soaking and exposure time. Unused product must be discarded each day – ‘topping up’ is not acceptable.

Instruments must not be stored in disinfectant either before or after thermal disinfection or sterilizing.

Ultraviolet cabinets must not be used for disinfection of instruments.

8. Storage of processed instruments

The correct storage of processed instruments is important to protect them from environmental contamination. In the dental surgery the major source of environmental contamination is airborne bacteria and viruses which settle on instruments and equipment. Critical instruments which must be sterile at the time of use must be stored bagged/wrapped until use. However, an efficient way to protect all sterilized critical dental instruments from environmental contamination is to bag them prior to sterilizing and store them in the unopened bag/wrap. Critical instruments/items must be stored in a way which maintains the integrity of packs and prevents contamination from any source. Items required to remain sterile must not be stored in ultra-violet cabinets or disinfectants as these processes will compromise sterility. It is important that critical wrapped instruments are stored in a clean dry area, and are subjected to minimal handling before use.

During storage, packs can be contaminated by:

- over-handling – this can happen through excessive transferring from one place to another, or during rotation of instrument packs, from over-stocking storage areas or from bundling packs together using rubber bands;
- moisture – if the pack is placed on a wet bench top, splashed with water, other liquids or aerosols; or
- penetration – if instruments break through the surface of the pack.

A package is considered to be non-sterile when it:

- is damaged or open;
- comes out of the steam sterilizer wet or is placed on a wet surface; or
- is dropped or placed on a dirty surface.

Wrapped packages of sterilized instruments must be examined before opening to ensure the barrier wrap has not been compromised during storage. If there is any doubt that sterility was obtained during processing or the instrument pack has been compromised, re-clean, repack and resterilize.

Sterilized instruments must be stored in a clearly defined area, which is protected from splashing and aerosols produced during equipment washing, ultrasonic cleaning and reprocessing, or from clinical procedures and handwashing. Practically, this means that the storage of sterilized items must be outside the sterilizing room environment and not in the contaminated zone in the surgery. Keeping materials, equipment and instruments either bagged, covered with an impermeable material or in closed drawers until use will help to protect them from contamination by aerosols created in the dental environment. Storage areas must be dedicated for that purpose only and be free of dust, insects and vermin. For open shelving all items must be stored above floor level by at least 250 mm, from ceiling fixtures by at least 400 mm and protected from direct sunlight. This will facilitate environmental cleaning, allow unrestricted airflow and prevent heating and degradation of the packaging material.

Drawers or sealed containers are preferred for the storage of sterile wrapped items because they can be located at a height which allows the contents to be easily seen so that the most recently processed items are placed towards the back of the drawer. If the area used for storage is too small, too high, crowded or awkward it makes access difficult which increases the likelihood of compromising the packaging.

Storage containers must be kept clean, dry and in good condition. Cardboard boxes must not be used as storage containers as they are porous, cannot be adequately cleaned and may harbour organisms.

Storage areas must be cleaned regularly.

Rotation of processed items

It is good practice to rotate packaged instruments, ensuring that packages are less likely to have become damaged over time.

Check before using

The integrity of bagged/wrapped packs must be checked before using the instruments.

Unwrapped semi-critical and non-critical items

Instruments must be stored dry, and in a way that will prevent contamination prior to use. This can be achieved by storing in:

- closed drawers lined with plastic sheeting; or
- sealable plastic containers with lids.

The drawers or containers must be cleaned with detergent and water regularly and all instruments in the drawers must be reprocessed before replacement in drawers.

Care must be taken to ensure that storage areas do not become contaminated. During patient treatment, de-gloving, overgloving or using a suitable no-touch technique (transfer tweezers) must be used to access items.

E. Documentation and practice protocols for infection control

1. Maintaining sterilization records

Dental care providers have a duty to maintain a range of documentation relating to the sterilization process. These sterilization records include: installation qualification, operational qualification (calibration) and performance qualification; records of steam sterilizer daily tests (daily Helix or Bowie-Dick tests) and ultrasonic tests which have been carried out and checked; print-outs of sterilizing cycles or record of cycle monitoring (results of load indicator tests) kept if no print-out.

Maintenance of these records provides evidence of quality management processes and allows for some instrument tracking, recall of compromised items and may be needed for medico-legal purposes. How long documentation needs to be kept varies depending on the States or Territories, but is typically seven years. Since it is necessary to keep documentation for an extended period, it is important that printer readouts remain legible for at least seven years.

For each sterilizing cycle (even those which do not include any packs of critical instruments) the results need to be filed for access if necessary. Information which must be recorded and retained includes:

- steam sterilizer number or code (to identify the machine the item was sterilized in);
- date and time of sterilization;
- cycle or load number;
- exposure time, temperature, pressure;
- name(s) of loading and unloading operator(s) – the person who checked the results and authorised the load for use;
- contents of load – e.g., wrapped or unwrapped, number of packs;
- print-out of parameters used; and
- results of the chemical indicators.

An entry that the steam sterilizer met performance data must be recorded in a logbook for every steam sterilizer cycle and the related print-outs kept. The print-outs should be initialled by the dental staff member reviewing them. Keeping chemical indicators is not a substitute for a permanent record of a sterilizing process, because exposed chemical indicators may change with time and therefore are not a reliable record.

The results of any performance qualification tests must be recorded, including:

- the date of the test;
- the brand and type of packaging system tested;
- the type of biological indicator/enzymatic indicator used and the batch number. It is important to ensure prior to performance qualification that the biological indicators/enzymatic indicators to be used have not expired;
- the location and number of the steam sterilizer (if there are multiple steam sterilizers in the practice);
- the name of the operator running the performance qualification; and
- the exact parameters which have been tested.

A certificate of calibration and operational qualification should be issued by the technician carrying out the process and must be kept.

For further information see the ADA's *The Practical Guides* and www.ada.org.au.

2. Batch control identification (tracking and tracing)

Systems should be in place which allow critical items of equipment (e.g., instruments used in high risk procedures such as surgical procedures) to be tracked. Tracking (better described as batch control identification) links a pack of instruments to a particular sterilizing cycle and allows dental care providers to demonstrate that tracked dental instruments used on a patient have been through a particular steam sterilizer cycle with verifiable performance data. Tracing refers to being able to identify which individual instruments have been used on a particular series of patients. In office-based dental practice the requirements for tracing are limited.

Being able to track instruments, however, enables patients to be followed-up and assessed for infection risk in the case of a sterilization failure.

For further information on tracking instruments see the ADA's *The Practical Guides* and www.ada.org.au.

3. Infection control for dental care providers and dental staff

Immunization

Dental care providers and dental staff are at risk of exposure to many common vaccine-preventable diseases (VPDs) through contact with patients and the general community. Immunizations substantially reduce the potential for acquisition of disease, thereby limiting further transmission to other dental care providers, dental staff and patients. All dental care providers and dental staff are to be advised to have immunization screenings and offered relevant vaccinations consistent with *The Australian Immunisation Handbook*⁹. Dental surgeries should have education programmes to support their immunization strategy and all dental staff should be advised of the potential consequences of non-immunization. Any dental care provider and dental staff member has the right to refuse vaccination and this refusal must be documented with their reason for refusal noted and signed by him/her.

Dental care providers and dental staff who have not been previously immunized or do not have natural immunity must be offered Hepatitis B, varicella and influenza vaccination. Measles-mumps-rubella (MMR) must be offered to those born during or since 1966 who are either without immunization or are seronegative upon screening. State and local guidelines apply for TB screening and immunization. After a full course of Hepatitis B immunization or rubella vaccination, testing for antibody levels should be carried out to identify poor responders. Depending on their individual health and situation, dental care providers and dental staff should also consider immunizations for poliomyelitis, pneumococcal disease, Hepatitis A, meningococcal disease and typhoid.

Immunization records

The practice must develop and maintain regularly updated immunization/health records for dental staff. It is recommended that dental care providers also maintain their own immunization and screening records. Those dental care providers involved in carrying out exposure-prone procedures have an ethical and professional duty to know their immune status in respect to Hepatitis B, Hepatitis C and HIV and if they are carriers of any of these diseases they should continue to practise only in accord with local Board and health authority policies.

Education

Dental staff must be provided with comprehensive training in the full range of infection control procedures that they are expected to know about and carry out in their day-to-day work. Regular refresher training is also appropriate to ensure that the necessary infection control measures are being complied with and understood.

New clinical dental staff should complete an induction programme. This pre-service training should include the practical implementation of occupational health and safety and infection control measures used in the practice.

This induction programme should comprise the following:

- general orientation to the physical environment of the practice;
- practice expectations in terms of infection control and safe working procedures;
- recommendations for vaccination prior to commencing work (Hepatitis B and others);
- reporting requirements for sharps injuries and workplace incidents;
- policy on wearing and cleaning of uniforms;
- emergency procedures for fire and medical emergencies;
- first aid procedures;
- management of waste streams and hazardous substances;
- confidentiality of patient information;
- identification of clean and contaminated zones;

⁹ See NHMRC (2008) *The Australian Immunisation Handbook*, 9th Edition, pp 104-107.

- use of personal protective equipment;
- safety rules in terms of hair, footwear and jewellery;
- procedures for changeover between patients; and
- instrument cleaning and sterilization.

Exposure incident protocol

In the health care environment, the term 'exposure incident' refers to any incident where a contaminated object or substance breaches the integrity of the skin or mucous membranes or comes into contact with the eyes. This includes:

- penetrating injuries of the skin caused by sharps (e.g., dental instruments, needles and scalpel blades);
- an injury that involves direct skin contact with blood or saliva visibly contaminated with blood and where there is compromised skin integrity, such as a cut, open wound, abrasion or dermatitis;
- bites or scratches inflicted by patients; and
- direct contact with blood or body fluids with the mucous membrane of the mouth, nose or eyes.

While the site where such sharps injuries are sustained can become infected with micro-organisms, the major area of concern to dental care providers and dental staff is the risk of the transmission of HIV, Hepatitis B and Hepatitis C by contaminated blood.

For exposures involving the skin, the larger the area of skin exposed and the longer the time of contact, the more important it is to verify that all the relevant skin area is intact.

To comply with occupational health and safety legislation, all exposure incidents must be recorded, and followed up. For sharps injuries, the required post-injury counselling may be undertaken by a designated medical practitioner or infection control practitioner. Services such as sharps injury telephone hotlines may also be of value.

Follow-up tests must be offered after a significant exposure incident, and blood samples for testing are obtained from the source (i.e., the patient) wherever practicable. These tests include Hepatitis B, Hepatitis C and HIV. Where the source is positive, follow-up tests will need to be repeated at intervals for the injured person, to assess the status of seroconversion. Post-exposure prophylaxis may be available from public hospitals. This process would normally be overseen by specialists in infectious diseases.

For further information see Appendix: *Blood and Body Fluid Exposure: Action Plan Diagram and Protocol*.

4. Infection control manual and other practice management issues

Each dental care provider has a duty to:

- take good medical histories which can establish if a patient may be more susceptible to infection and therefore may require transmission-based precautions to prevent infection (e.g., patients with leukaemia or neutropenia may require antibiotic prophylaxis);
- ensure adequate physical facilities are maintained and all equipment is always in sound working order by regular quality checks; and
- provide infection control education and training in hygiene and management of infectious hazards. This information should be provided when employees are first appointed.

Dental practices should:

- maintain awareness of new vaccines and ensure dental staff at risk are fully immunized;
- offer testing following occupational exposure such as a sharps injury;
- ensure dental care providers and dental staff are adequately informed of the rights and responsibilities of patients, especially in their right to refuse to give information on their infectivity status or to refuse to be tested for a blood-borne virus;
- develop a plan for infection control within the practice;
- provide dental staff infection control measures including personal protective equipment and immunization, effective reporting systems for breaches of protocols and safe work practices;
- inform dental staff when they are employed of the health screening policies of the practice;

- inform patients of the risks associated with their dental care and the protocols in place for protecting their privacy and confidentiality;
- inform patients of the infection control strategies in place and provide information about procedures for dealing with concerns about infection control procedures; and
- provide a specific programme of education and training in infection control principles, policies and procedures for dental care providers and dental staff.

Infection control manual

A comprehensive infection control manual which is pertinent to the daily routines of the practice must be developed. It must describe the infection control procedures for the practice as a whole and be used as the foundation for training dental staff. Dental care providers and dental staff need to know who is responsible for ensuring certain activities are carried out and to whom to report any accidents or incidents.

The manual must include information about and specifications for:

- methods of hand hygiene (routine and surgical);
- personal protective equipment requirements;
- setting up the treatment area between patients;
- defined treatment areas which require barrier protection and cleaning between patients;
- management of spills and exposure to blood or body fluid;
- handling and disposal of sharps;
- waste disposal;
- processing of reusable items (cleaning, packaging, sterilization, disinfection, storage);
- processing of radiographs in a manner to avoid cross-contamination;
- quality control mechanisms including documentation for the maintenance and monitoring of equipment;
- immunization requirements;
- single use items;
- continuing education;
- recording of information during patient treatment in a manner to avoid cross-contamination;
- use of computers and computer-run equipment during patient treatment in a manner to avoid cross-contamination;
- management of waterlines used in direct patient contact; and
- latex allergy.

Manuals which are easily adapted to the individual practice are available from professional dental associations. Practice manuals must be updated regularly.

F. Special areas and their particular dental infection control requirements

Some aspects of dental care, or particular settings in which dental care is provided, present specific challenges to dental care providers and dental staff in implementing effective infection control measures. These are outlined below.

1. Dental radiology and photography

Any items or materials placed in a patient's mouth which are subsequently removed for processing can be considered biologically contaminated and must be handled in a safe manner. Gloves must be worn when taking radiographs and handling contaminated film packets or sensors. Other personal protective equipment (e.g., mask, protective eyewear) must be used if spattering of blood or other body fluids is likely. The use of heat-tolerant or disposable intra-oral radiograph devices (unless using digital radiography) is recommended wherever possible and these semi-critical items (e.g., film-holding and positioning devices) must be cleaned and heat-sterilized or barrier protected before patient use.

Exposed radiographs need to be transported and handled carefully to avoid contamination of the developing equipment. After exposure of the radiograph, dry the film packet with paper towel to remove blood or excess saliva and place in a container (such as a disposable cup) for transport to the developing area.

Protective barriers should be used on developing equipment where possible and when surfaces become contaminated they must be cleaned.

Radiography equipment (e.g., radiograph tubehead and control panel) which has become contaminated must be cleaned after each patient use. Alternatively, barrier protection can be applied which must be changed after each patient use. Digital radiography sensors come into contact with mucous membranes and are considered semi-critical devices and they must be covered with a barrier before use.

Most State regulations accept film packets and barrier envelopes that have been contaminated with blood to be disposed of as general waste. However, some regional authorities require these to be treated as contaminated medical waste which is placed in yellow containers or plastic bags which are appropriately marked with the international biohazard symbol and collected and disposed of by a licensed operator.

2. High technology intra-oral equipment and devices

High technology intra-oral equipment and devices include, for example:

- curing light;
- CAD/CAM;
- computer components associated with CAD/CAM and other electronic devices;
- air abrasion;
- intra-oral cameras;
- lasers;
- apex locators;
- electronic periodontal probe;
- occlusal analysers; and
- electrosurgery units.

Dental care providers should consult the manufacturers about the appropriate barrier and cleaning/sterilization procedures required for these devices. If the item is exposed to mucous membrane or body fluids and cannot tolerate heat sterilization then, at a minimum, it must be cleaned first then protected with a single use barrier before patient use.

When replacing barriers:

- remove the contaminated barrier/covering while gloves are still on;
- remove gloves and decontaminate/wash hands;
- if there is any chance of saliva or blood contamination of the item it should be cleaned by wiping with a neutral detergent before the next barrier is put in place; and
- it is not always essential (but it is highly recommended) to clean items between change of barriers.

Barriered items must be cleaned regularly each day.

Curing light

Curing light tips are semi-critical pieces of equipment and should be heat sterilized or have an appropriate barrier placed over the tip for each patient. Although some curing light tips may be heat sterilized this is not necessary if an appropriate barrier has been applied to the tip during the treatment of the patient. Another advantage of a barrier is that the sensitive light conducting rods are protected from accidental damage or material contamination. Barrier protection is an appropriate level of infection control for all light curing tips, as the equipment is not intended to contact mucosa. The tips must always be cleaned prior to having the barriers placed and a new barrier must be used for each patient.

Air abrasion, electrosurgery units and lasers

Electrosurgery units, dental lasers and air abrasion devices create particular bioaerosol hazards, and high volume suction devices are essential during their use.

Air abrasion devices create alumina dust, which can be a respiratory irritant for dental care providers, dental staff and patients. High-efficiency particulate air (HEPA) filtration must be used, since particles and micro-organisms dispersed from air abrasion can be distributed by air currents through ventilation and air conditioning systems. Patients who are immuno-suppressed for any reason are particularly vulnerable to infection caused by organisms which are spread in this manner.

Some pathogenic viruses such as human papilloma virus are not inactivated by laser or electrosurgery procedures and remain viable within the plume (smoke) created from soft tissue vaporization. Most bacteria and viruses are rendered non-viable by laser or electrosurgery, even though fragments may be present in the plume. Moreover, the presence of an infectious agent in plume might not be sufficient to cause disease from airborne exposure, especially if the agent's normal mode of transmission is not airborne. No evidence indicates that blood-borne viral diseases such as HIV or HBV can be transmitted through aerosolization and inhalation of plume or other dental aerosols. High filtration surgical masks combined with high volume suction can prevent inhalation of particles in plume by dental care providers and dental staff and patients. As well as particles of tissue and fragments of micro-organisms, plume also contains gases (e.g., hydrogen cyanide, benzene and formaldehyde) which are irritant and noxious. Evacuation systems which will remove plume vapour and particles must be used.

Implants

In the surgical procedures involved in the placement of implants both the instruments used and the implants must be sterile at the time of use. Explanted devices must not be reprocessed and reused.

3. Dental laboratory and dental prosthetics

Standard precautions and safe work practices must be used in the dental laboratory. The most important phase is the thorough cleaning of material that has contacted oral tissue (e.g., impressions). Thorough rinsing with cold running water, followed by the application of a diluted detergent and further rinsing must continue until all visible contamination is removed.

Manufacturers' instructions for disinfectants need to be carefully followed when cleaning and disinfecting prosthetic items and materials. Even after cleaning there may still be biological contamination present and at all stages of handling of the prosthetic item standard precautions must be applied.

This includes:

- all materials, impressions, dental prostheses, intra- and extra-oral appliances must be thoroughly cleaned before insertion and adjustment;
- the area for grinding or cutting plaster and making models and the area for instrument management and sterilization must be well separated and not used at the same time if both procedures utilize the same room;

- implantable items must be sterile at time of implantation;
- any instruments, equipment, attachments and materials which are used in the operatory on contaminated prostheses or stages of prosthetic work should be either single use or cleaned and preferably heat sterilized after each patient use. If unsuitable for heat sterilization they should be thermally disinfected (e.g., polishing mops); and
- polishing pumice should be dispensed for individual use and the pumice tray cleaned after each use.

All materials transported to and from dental laboratories must first be cleaned and placed in a sealed bag or container.¹⁰

For further information on infection control in the dental laboratory see the ADA's *The Practical Guides* and www.ada.org.au.

4. Handpiece management

All dental handpieces must be cleaned and lubricated in accordance with the manufacturer's instructions and must be sterilized after each patient. Similarly, ultrasonic scaler handpieces must be sterilized between patients. The exterior surfaces of handpieces must be cleaned thoroughly, and then their internal aspects cleaned and lubricated prior to sterilizing, according to the manufacturer's instructions (e.g., using an aerosol spray can or an automated lubricating device). Care needs to be taken to ensure lubricants used do not compromise the sterilization process and this can be achieved by replacing each week the deionized water in steam sterilizers which recycle water from one cycle to the next. Because of their lower oil dosing rates, it is strongly recommended that automatic flush-through and lubricant systems be used for cleaning and lubricating dental handpieces. After sterilizing, handpieces must then be stored in a way to prevent contamination. They should not be fitted to the dental unit until the time of use on a patient and once fitted to the dental unit and exposed to contamination in the treatment zone they will then need reprocessing even if not used on that patient.

There continues to be debate about the effective decontamination of handpieces. In theory, a pre-vacuum steam sterilizer will remove the air from the lumen of a dental handpiece, allowing steam to penetrate more quickly. Current opinion is that effective pre-sterilization cleaning of dental handpieces and subsequent processing in a downward displacement steam sterilizer is acceptable for general dental treatment.

If a dedicated handpiece cleaning system is not used, the following protocol should be adopted for the pre-sterilization cleaning of handpieces:

- place a blank bur in the chuck during cleaning to prevent contamination and damage of the handpiece bearings;
- clean the outside of the handpiece with detergent and water – never clean or immerse the handpiece in disinfectant solutions or the ultrasonic cleaner;
- lubricate the handpiece with pressurised oil for the recommended period;
- clean off excess oil;
- sterilize in a steam sterilizer; and
- run the handpiece briefly before use to clear excess lubricant.

For further information on handpiece management see the ADA's *The Practical Guides* and www.ada.org.au.

5. Specimens

To protect those handling and transporting biopsy specimens, each specimen must be placed in a sturdy, leak-proof container labelled with the biohazard symbol. Gloves must be worn when handling pathology specimens and specimen containers. Once the specimen has been placed in the container, this must be packaged appropriately in a sealed container to prevent leakage during transport. Appropriate biohazard labelling must be placed on pathology specimen containers before dispatch. It is preferable to use plastic zipper bags carrying the appropriate designation provided by the pathology laboratory. If a biopsy specimen container is visibly contaminated, clean and disinfect the outside of the container before placing it into the transport bag or container.

¹⁰ Some States/Territories specify disinfection plus cleaning; check with local authorities about transport process requirements.

6. Nickel-titanium (NiTi) endodontic instruments

When endodontic rotary files are reprocessed the pre-sterilizing cleaning process must be validated as being effective. A verifiable process is described below.¹¹

Cleaning rotary endodontic files

- Immediately after use remove stoppers and insert the files into a scouring sponge soaked with 0.2% chlorhexidine gluconate aqueous solution.
- Clean the files by using 10 vigorous in-and-out strokes in the sponge.
- Place the files in a wire mesh basket and immerse in a suitable enzymatic cleaning solution for 30 minutes.
- Follow this by 15 minutes ultrasonification in the enzymatic cleaning solution.
- Drain and rinse in running water for 20 seconds.
- Proceed to steam sterilization.

7. Nursing home visits

There are many whose dental treatment must be provided in a nursing home and occasionally there is a bedridden patient at a private home or hospital who needs dental care. The often inadequate facilities can make the provision of treatment difficult.

In providing dental care in these settings, standard precautions apply – these include wearing gloves and other protective clothing and proper hand decontamination. Dental care providers may need to carry all necessary personal protective equipment with them.

All instruments and materials during transport must be carried in lidded metal or rigid plastic clean containers to prevent damage or spillage.

After use the instruments must be placed in a rigid sealed container for transport back to the dental surgery for cleaning and reprocessing. Where possible instruments should be cleaned immediately after use with detergent and water or sprayed with a cleaner to prevent hardening of debris before transport back to the dental clinic or laboratory.

Items such as impressions, try-ins and articulators must be transported in sealed plastic containers. Impressions should be rinsed of blood and saliva prior to transportation to the laboratory.

Waste should be separated at the point of generation. General waste should be disposed of in the general waste of the nursing/private home or hospital. Sharps and medical waste must be dealt with according to State regulations (a designated sharps container (AS/NZ 3816) must be transported with other instruments and equipment for this purpose).

¹¹Taken from article by Parashos, Linsuwanont and Messer (2004) 'A cleaning protocol for rotary nickel-titanium endodontic instruments'.

G. Infectious diseases, allergies and transmission-based precautions for infection control

There are some situations that require additional infection control measures from those standard precautions already outlined. These additional measures are now referred to as transmission-based precautions. Transmission-based precautions must be applied for patients with known or suspected infectious diseases not managed by standard precautions alone, for example, tuberculosis, measles, avian flu and SARS. Transmission-based precautions are tailored to the specific infectious agent concerned and may include measures to prevent airborne, droplet or contact transmission.

1. Creutzfeldt-Jakob disease (CJD)

In all patients with potential CJD infection, including those in both high and low risk categories, instruments used in routine dental and endodontic procedures which come into contact with lower infectivity tissues can be routinely reprocessed.¹²

Nearly all patients and dental procedures fall in this category.

For further information see the link on the ADA's website to the chapter on Classical Creutzfeldt-Jakob disease in the *ICG*.

2. Measles, mumps, tuberculosis

Infection by airborne transmission of respiratory secretions can occur with pulmonary tuberculosis and measles. Tuberculosis is spread by droplets or by direct contact and has been transmitted as a result of dental procedures. Patients with these diseases should have their dental treatment deferred until they are no longer infectious. Where treatment cannot be deferred (e.g., facial swelling) transmission-based precautions must be used for provision of dental treatment. The patient should be seen as the last patient of the day, appropriate barrier precautions must be used and staff assisting in the dental treatment must be aware of their immune status for the relevant infectious disease of the patient. The use of rubber dam, where possible, for restorative work is recommended to reduce dental care provider and dental staff exposure to potentially infected aerosols.

3. Staphylococcus aureus (MRSA)

Methicillin-resistant *Staphylococcus aureus* (MRSA) is a bacterium which is resistant to common antibiotics and, as a result, infections caused by this organism are difficult to treat. MRSA colonizes the nose, axillae and perineum, and abnormal skin (such as wounds, ulcers and eczematous skin). It is not normally found in the oral cavity but may occasionally be isolated from oral infections. No special infection control precautions are necessary for the dental treatment of patients colonized with MRSA but care should be taken to prevent colonization of the operatory. Care should be taken to limit the zone of contamination and in disposal of waste. MRSA can survive on surfaces such as computer keyboards for days and for weeks under acrylic nails.¹³ Dental care providers and dental staff colonized with MRSA must not undertake or assist with major surgical procedures.

4. Avian flu

Avian flu is a highly pathogenic and contagious Type A H5N1 influenza virus which normally only infects birds and occasionally pigs. Should avian flu enter Australia as a human-to-human transmission of the virus, transmission-based precautions will be essential.

For further information on avian flu see www.ada.org.au.

5. Latex sensitivity of dental care providers, dental staff or patients

Suspected natural latex allergy (NLA) in dental care providers, dental staff or patients must be treated as a serious medical issue. Symptoms may manifest as delayed hypersensitivity such as rash, conjunctivitis or rhinitis (type 4), which could then progress with time to an acute allergic anaphylactic reaction (type 1), which may result in death.

¹² See Chapter 31 on Creutzfeldt-Jakob disease (revised version as of December 2007) in *Infection control guidelines for the prevention of transmission of infectious diseases in the health care setting* (ICG): <http://www.health.gov.au/internet/main/publishing.nsf/Content/icg-guidelines-index.htm>

¹³ See e.g., articles by: Schultz, Gill, Zubairi, Huber, Gordin (2003) Bacterial contamination of computer keyboards in a teaching hospital; and Rutala, White, Gergen, Weber (2006) Bacterial Contamination of Keyboards: Efficacy and Functional Impact of Disinfectants.

All patient medical histories and new dental staff employment forms must include questions about NLA and/or sensitivity or allergy to latex/rubber products. Patients, dental care providers or dental staff with proven anaphylactic reactions to latex may need to wear a medical alert bracelet and carry self-injectable adrenaline.

If latex sensitivity is identified, then a 'latex free' environment should be created for the persons affected. This involves the use of latex-free gloves and removal from the operatory of other identifiable latex products that are likely to cause a reaction.

When selecting handcare creams, care should be taken to ensure latex and chlorhexidine compatibility and they should not be petroleum-based.

For further information on latex sensitivity see the ADA's *The Practical Guides* and www.ada.org.au.

6. Blood-borne viruses and the infected dental health care provider

Infection control against blood-borne viruses is based on the premise that for a person to be infected all of the following three conditions must be present:

- a susceptible host (i.e., anyone who is exposed to body fluids containing Human Immunodeficiency Virus (HIV), Hepatitis C (HCV) or Hepatitis B (HBV) or anyone who has not been vaccinated against HBV or who does not have HBV antibody);
- a virus with sufficient virulence (infectivity) and dose (numbers) to cause infection; and
- a portal through which the virus may enter the host, that is, a break in the skin or sharps injury.

Although transmission of blood-borne pathogens (e.g., HBV, HCV, and HIV) in dental health care settings can have serious consequences, such transmission is rare. Exposure to infected blood can result in transmission from patient to practitioner, from practitioner to patient, and from one patient to another. All patients need to be treated as potentially infectious and standard precautions applied to minimize the risk of transmission of infection from person to person.

Exposure prevention methods and exposure-prone procedures

Avoiding occupational exposures to blood is the primary way to prevent transmission of HBV, HCV, and HIV. Exposures occur through percutaneous injury (e.g., a penetrating injury or cut with a sharp object), as well as through contact between potentially infectious blood, tissues, or other body fluids and mucous membranes of the eye, nose, mouth, or non-intact skin (e.g., exposed skin that is chapped, abraded, or shows signs of dermatitis).

The majority of exposures in dentistry are preventable, and methods to reduce the risk of blood contacts have included: use of standard precautions, use of devices with features engineered to prevent sharp injuries, and modifications of work practices.

Dental care providers, including dental students, who undertake exposure-prone procedures have a responsibility to know their antibody status for blood-borne viruses such as HBV, HCV and HIV.

Exposure-prone procedures in dentistry are procedures where there is the risk of injury to the dental care provider (DCP) resulting in exposure of the patient's open tissues to the blood of the DCP and include "... any situation where there is a potentially high risk of transmission of blood borne disease from [practitioner] to patient during medical or dental procedures ..."¹⁴

Exposure-prone procedures include those where the dental care provider's gloved hands may be in contact with sharp instruments, needles, or spicules of bone or teeth inside a confined anatomical space such as the mouth and where the hands or fingertips may not be visible. Most routine dental procedures are performed in a well lit oral cavity with a minimal risk of exposure of blood-borne viruses to the patient. Oral maxillofacial, periodontal and endodontic surgical procedures are potentially exposure-prone procedures for the patient.

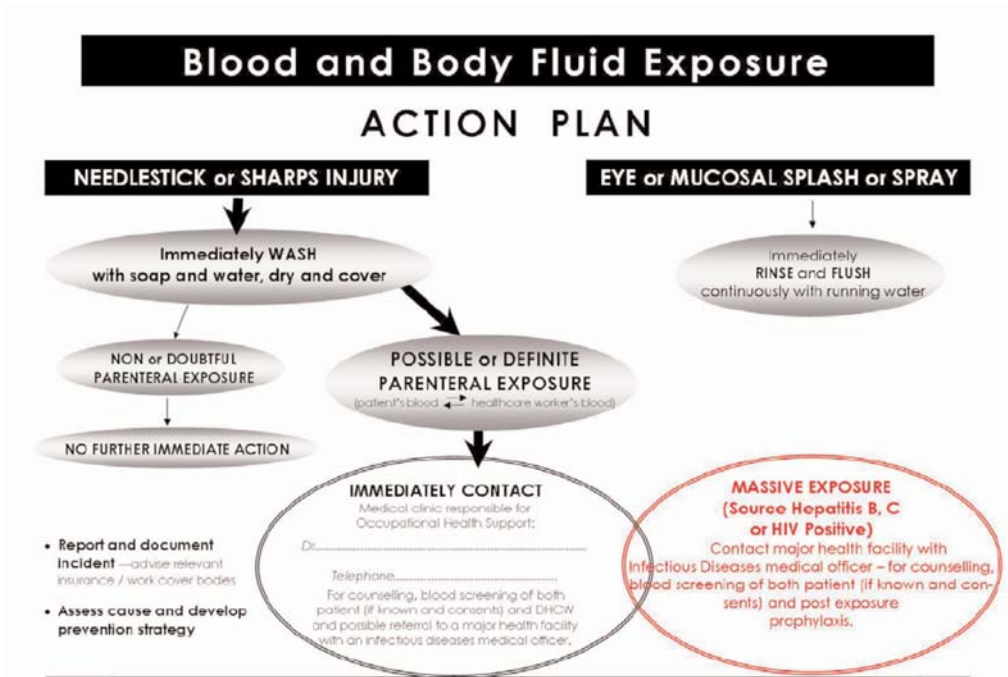
Dental care providers who carry a blood-borne virus have a professional and ethical responsibility to review the way they practise dentistry to ensure that they minimize the likelihood of transmission of infection to their patients. They should obtain and follow the advice of their treating specialist physician and must avoid exposure-prone procedures if they are viraemic. Current national policies for managing health care workers with a blood-borne viral illness should be followed.

For further information on blood-borne viruses see the ADA's website and the link to the Australasian Society for HIV Medicine's (ASHM) website.

¹⁴ From *Infection control guidelines for the prevention of transmission of infectious diseases in the health care setting* (ICG), Glossary G3.

Appendix

Blood and Body Fluid Exposure Protocol



First aid

- Stop work immediately, regardless of the situation (e.g., even if administering local anaesthetic or undertaking another type of invasive procedure).
- Allow the wound to bleed and clean it thoroughly with soap and lukewarm water. Do not use disinfectants as some retard healing.
- Flush mucous membranes/conjunctiva with normal saline or water. If contact lenses are worn, remove after flushing eye and clean as usual.
- Further management of the wound is dependant on the nature of the injury.

Assessment and record

An assessment of the risk of transmission is an urgent priority to determine whether post-exposure prophylaxis (PEP) is necessary. Expert medical advice is usually required to determine the need and type of PEP for the exposed person and the necessity or otherwise of testing the blood of the patient after appropriate pre-testing counselling.

Each dental practice should have a clear set of written instructions on the appropriate action to take in the event of a sharps injury to either staff or patients. These instructions should include emergency contact numbers for expert advice (this should name the medical practitioner experienced in dealing with such cases; they must be easily accessible and understood; and all dental care providers must follow them.

A full record of the incident should be made including details of:

- who was injured;
- how the incident occurred;
- the type of exposure;
- the presence of visible blood on the device causing the injury;
- whether a solid sharp object or hollow bore object or needle was involved;
- the gauge of the needle;
- the time the injury occurred;
- what action was taken;
- who was informed and when; and
- the details of the patient being treated.

Factors which influence whether an exposure has the potential to transmit a blood-borne virus (BBV) infection include:

- the type of exposure (mucosal splash vs a deeply penetrating skin injury);
- the type of body substance (e.g., how much blood is present in the saliva);
- the volume of blood or body fluids;
- the length of time in contact with blood or body fluids; and
- the time which has elapsed since the exposure.

In addition, to complete an accurate assessment after a sharps injury, the following factors should be considered:

- the type of device involved;
- the procedure for which the device was used (e.g., into a vein or artery);
- whether the injury was through a glove or clothing;
- whether a deep injury occurred in the exposed person; and
- whether the source patient is viraemic (e.g., with advanced/terminal HIV disease or a high viral load).

Finally, the record of all these details should be signed by those involved in the incident.

Testing

Testing should be offered following all occupational exposure to blood or body substances, particularly all 'contaminated' sharps injuries (e.g., those involving exposure to blood or blood-contaminated saliva via an instrument, bur, or contaminated wire).

Baseline tests

Baseline serum is requested from the injured staff member AND the patient (known source). The staff member should be tested at the time of the injury to establish their serological status at the time of the exposure for:

- HIV antibody;
- HCV antibody; and
- antibody to Hepatitis B surface antigen (anti-HBs).

This testing should be done as soon as possible after the injury (ideally the same day), bearing in mind the window period of the tests. If the source patient is found to be positive for a BBV, additional testing of the injured person may be required and assessment by an infectious disease physician is recommended.

If the injured staff member has ever had a blood test which demonstrates Hepatitis B immunity (anti-HBs antibodies > 10 IU/mL) – whether from vaccination or past infection – they are protected, and there is no need for Hepatitis B immunoglobulin after a potential or confirmed exposure to Hepatitis B.

Testing the source patient

If a situation arises where there is a need to know the infectious status of a patient (such as a sharps injury), the patient has a responsibility to provide information or consent for testing that enables the practice or responsible health professional to ensure the safe management of the injured staff member. Informed and voluntary consent must be obtained before taking a blood sample to

test for any purpose. When the responsible medical practitioner is obtaining this consent, the patient should be offered pre-test counselling to provide details on the test procedure, and the long and short-term consequences to the patient of the test results. Post-test counselling may also be required, particularly if the result is positive.

The source individual should be tested for:

- HIV antibody;
- HBsAg (Hepatitis B surface antigen); and
- HCV antibody (Hepatitis C antibody).

If the source individual tests positive for either of these Hepatitis B or C markers, additional tests would usually then be ordered to assess infectivity (e.g., Hepatitis B 'e' antigen, HBV DNA, and Hepatitis C RNA (the latter two by polymerase chain reaction assay)).

Refusal of testing

If the source patient refuses testing, this refusal for testing should be documented. In this case, treat the situation the same as the 'positive patient' scenario below, and consider whether post-exposure prophylaxis and appropriate long-term follow-up should be offered.

Source negative

If blood tests show that the source patient is negative for HIV, HBV and HCV, no further follow-up of the exposed staff member is generally necessary, unless there is reason to suspect the source person:

- is seroconverting to one of these viruses; or
- was at high risk of blood-borne viral infection at the time of the exposure (because they have recently engaged in behaviours that are associated with a risk for transmission of these viruses).

The window period causes a FALSE NEGATIVE test result. The patient may be infectious, but this is undetectable by testing. The window period for HIV is usually three months but it can, very rarely, be longer. The use of the polymerase chain reaction (PCR) testing for HIV/viral RNA can identify 90% of infections within four weeks, significantly reducing this window period. The window period is six months for Hepatitis B and Hepatitis C.

Source positive for Hepatitis B

If the source is KNOWN or SHOWN to be positive for Hepatitis B surface antigen (HBsAg), the level of antibodies is important. If the staff member is immune to Hepatitis B (anti-HBs antibodies > 10 IU/mL), they are protected. If levels of immunity are relatively low (i.e., between 10 and 100 IU/mL), a booster injection would be prudent.

If the staff member is NOT IMMUNE (e.g., has never been immunized, did not seroconvert to the vaccine (a non-responder), or has antibody levels to HBsAg less than 10 IU/mL), the correct treatment is to:

1. Give a single dose of Hepatitis B immunoglobulin (HBIG) within 48-72 hours;
AND
2. Start a course of HBV immunization. HBV vaccine should be given within seven days of exposure, and then repeated at 1-2 months and again at six months after the first dose. Following the final vaccine dose, the level of immunity (antibodies to surface antigen) should be checked 2-4 weeks later.

If this HBV prophylaxis is not undertaken, the risk of transmission of HBV is 6.3% if the source is 'e' antigen negative, but more than 30% if the source is Hepatitis B 'e' antigen positive.

Source positive for Hepatitis C

If the source is KNOWN or SHOWN to be positive for antibodies to Hepatitis C, there is no effective post-exposure prophylaxis (PEP) for Hepatitis C. The risks of transmission after a sharps injury from a positive source varies according to whether active viral replication is occurring. If the source is HCV RNA negative by PCR assay, the risk is 1.8–3.1%; however the risk increases to 10% if the source is PCR positive.

The injured staff member should be re-tested for HCV antibodies at three and six months, in addition to their baseline test. In addition, regular liver function tests such as ALT and AST (e.g., at two, three and six months) can be undertaken and possible

clinical signs and symptoms monitored by an infectious diseases physician or gastroenterologist, and specific therapy considered if appropriate.

Source positive for HIV

If the source is KNOWN or SHOWN to be positive for antibodies to HIV (or is at high risk of seroconverting), the assessment of the injured person needs to take into account the risk of seroconversion, which is as follows:

- after a sharps injury with HIV-infected blood: 0.3%
- after a mucous membrane exposure to HIV-infected blood: 0.09%

As only a very small proportion of occupational exposures to HIV result in transmission of the virus, the side effects and toxicity of HIV post-exposure prophylaxis (PEP) must be carefully considered against its efficacy. PEP is only indicated if there has been a significant exposure, and a proper risk assessment has been undertaken by a medical practitioner experienced in HIV management. HIV PEP is typically two or three orally administered anti-retroviral drugs and should be administered to the recipient within 24-36 hours after exposure (and preferably within two hours). This therapy should be continued for four weeks, on the advice of an infectious diseases physician.

- PEP is recommended for percutaneous (skin penetrating) exposure to potentially infectious blood or body fluids (because of the increased risk of HIV transmission).
- PEP should be offered (but not actively recommended) for exposure of ocular mucous membrane or non-intact skin to potentially infectious blood or body fluids (as there is less increased risk of HIV transmission).
- PEP should not be offered for an exposure to non-bloodstained saliva (as this is not potentially infectious for HIV).

Counselling

Some people find the experience of an occupational exposure to Hepatitis C and HIV very distressing, and they should be given the opportunity for immediate counselling to address anxieties. The exposed person should be advised on ways to prevent transmission of blood-borne viral diseases to others. This will include advice about safe sex, safe injecting/safe needle use, breastfeeding, blood donation and safe work practices. A staff member who has been exposed to HIV (or Hepatitis C) should not donate blood, semen, organs or tissue for six months, and they should not share implements that may be contaminated with even a small amount of blood (e.g., razors or toothbrushes).

Follow up

Testing for injured person

Follow-up blood tests for the injured person should be undertaken at one, three and six months, and follow-up undertaken to detect any febrile illness occurring within three months of exposure (possibly representing a HIV seroconversion illness).

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