

GUIDELINES FOR INFECTION PREVENTION AND CONTROL



IN THE PHYSICIAN'S OFFICE



BC Centre for Disease Control
AN AGENCY OF THE PROVINCIAL HEALTH SERVICES AUTHORITY

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INFECTION PREVENTION AND CONTROL IN THE PHYSICIAN'S OFFICE

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EXECUTIVE SUMMARY

Over the last 10 years several new viral pathogens have appeared in human populations both here in BC and abroad (Avian Influenza H5N1 and SARS-CoV). We have also seen the re-emergence of other well known infectious diseases such as measles and TB. ***It is time to reassess our current practice patterns and commit to a 'NEW STANDARD' for infection prevention and control in the outpatient setting[†].***

Routine Infection Control Practices

Routine infection control practices are to be used with all patients, at all times, regardless of presumed infectious status or diagnosis. Routine Infection Control Practices include:

- **The separation of infected, contagious patients including those with respiratory symptoms from uninfected patients.**
- **Hand cleaning should occur before and after every patient contact.** Wash hands with soap and warm water for 15 to 30 seconds. Waterless (alcohol-based) hand antiseptics are also effective. Soap and water should be used if hands are visibly soiled.
- **Gloves should be used as an additional measure, not as a substitute for hand washing.**
- **Personal Protective Equipment**, such as gowns, masks and eye protection should be **worn during patient care activities likely to generate splashes or sprays** of blood, body fluids, secretions or excretions.
- **Mouthpieces and resuscitation bags should be available** for performing CPR.
- **Safe handling and disposal of needles and other sharp devices.**
- **Appropriate sterilization and disinfection of reusable equipment and office surfaces (counters, furniture) must be routine.**

[†] Outpatient settings include, but are not limited to, ambulatory care clinics, physicians' offices, walk in clinics and community health centres.

Preventing Transmission

Preventing the transmission of infectious diseases spread by either airborne or droplet routes poses a significant challenge in the outpatient setting.

Special arrangements for patients with a suspected respiratory infection can reduce this risk. These include:

- **Screening patients** at the time the office visit is scheduled.
- Making efforts to see these patients at the **end of the day**.
- Quickly **triaging these patients out** of common waiting areas.
- **Closing the door of the examining room** and limiting access to the patient by visitors and staff members who are not immune to the suspected disease.

Preventing the transmission of infectious diseases spread by direct contact such as antibiotic resistant organisms (e.g. MRSA, VRE) require special attention to decrease the likelihood of spread. Patients may harbour resistant bacteria as part of their respiratory or gastrointestinal tract flora for an extended period. Precautions include:

- **Disinfecting surfaces and equipment** that have been in direct contact with the patients immediately after a visit.
- **Patients known to be carriers** of these organisms should have this **indicated in their medical record** in order to facilitate recognition on subsequent visits.

Occupational Health

Patients and health care providers are at risk from persons who are either infected with or carriers of an infectious agent:

- **Written policies should exist regarding exclusion of health care providers** with contagious illness.
- **All health care providers should be screened for tuberculosis** on hiring and on exposure to an infectious patient. In practices where there is high rate of documented tuberculosis amongst patients screening should be done yearly.
- **A system for the rapid evaluation, first aid and referral for treatment for persons exposed to blood and body fluids (BBF) must be in place** as mandated by the WCB.

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1. INTRODUCTION

Infection Prevention and Control is an integral part of medical practice in both the outpatient setting and in hospitals.

Education of all health care providers regarding the epidemiology and specific precautions pertaining to the prevention and control of infectious diseases should be carried out to ensure that personnel are educated appropriately and understand their responsibilities. Policies for infection control and prevention should be written, readily available, regularly updated and enforced.

In 1992, the College of Physicians and Surgeons of British Columbia published a booklet titled "The Prevention of Cross Infection in the Physician's Office". The booklet, authored by Dr. Douglas Drummond, was written in response to the noted inconsistency in sterilization techniques and infection control practices in medical offices. At the time this booklet was developed, it was unique since no comprehensive, easily accessed resource material was available. The booklet was distributed to all physicians in the province and has been adopted by a number of other provincial regulatory bodies across Canada.

Over the last 10 years several new viral pathogens have appeared in human populations both here in BC and abroad. We have also seen the re-emergence of other well known infectious diseases. It is time to reassess our current practice patterns and commit to a 'NEW STANDARD' for infection prevention and control in the outpatient setting.

The BC Centre for Disease Control, part of the Provincial Health Services Authority, as a province-wide resource provides leadership by assisting non-institutionalized health care settings to set useful guidelines for Infection Prevention and Control. This current guideline is intended as a revision to Dr. Drummond's original document. In addition, Health Canada's "Routine Practices and Additional Precautions for Preventing the Transmission of Infection in Health Care"¹ can be readily applied for most patient encounters.

This guideline is designed to be used as a reference for health care providers and should be **easily accessible in the office**. A list of further suggested resources is included as Appendix 9.

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2. REVIEWING ORGANIZATIONS

This document has been reviewed by:

BC Centre for Disease Control

The British Columbia Emerging Infectious Disease Working Group

BC Chapter of the Canadian Association of Medical Microbiologists

BC Professionals in Infection Control

BC Chapter of the Canadian College of Family Practitioners

University of British Columbia Department of Family Practice

The Office of the Provincial Health Officer

BC College of Physicians and Surgeons

And in consultation with general practitioners in the community.

3. ROUTINE INFECTION CONTROL PRACTICES

- **Routine infection control practices are to be used with all patients, at all times**, regardless of presumed infectious status or diagnosis.
- Routine infection control practices refers to the routine use of hand washing and personal protective equipment (gloves, facial protection and gowns) to prevent exposure to blood and body fluids and control the transmission of communicable diseases.
- Routine practices apply to:
 - ✓ Blood,
 - ✓ All body fluids, secretions, and excretions regardless of whether they contain visible blood or not,
 - ✓ Non-intact skin and mucous membranes.
- **Education of health care providers regarding the epidemiology** and specific precautions pertaining to the prevention and control of infectious diseases should be carried out to ensure that personnel are educated appropriately and understand their responsibilities.

Hand Washing/Hand Antisepsis

- **Hands must be cleaned:**
 - ✓ When you arrive and before you leave work.
 - ✓ After any direct contact with a patient, before contact with the next patient (direct contact refers to hand contact with the patient's skin).
 - ✓ Before performing invasive procedures.
 - ✓ After contact with blood, body fluids, secretions and excretions and exudates from wounds.
 - ✓ After contact with potentially contaminated items.
 - ✓ Immediately after removing gloves and/or other barriers.
 - ✓ Between certain procedures on the same patient where soiling of hands is likely, to avoid cross-contamination of body sites.
 - ✓ Before preparing, handling, serving or eating food or smoking and whenever hands are visibly soiled.
 - ✓ After personal hygiene.

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- Plain soap may be used for routine hand washing. **Washing hands for 15 to 30 seconds with soap and warm running water, ensuring that all surfaces of the hands are cleaned, is considered a routine hand wash.** Use of a paper towel to turn off taps prevents recontamination of hands.
- **Alcohol-based hand antiseptics are effective in reducing hand contamination** and should be made available as an alternative to hand washing². **They are especially useful when time for hand washing or access to sinks is limited.**
- Hands which are **visibly soiled should be washed** with soap and warm water.
- **A surgical scrub** with either antiseptic soap or an alcohol-based hand antiseptic is indicated before performing invasive procedures.
- **Hand washing sinks should be in sufficient numbers** and easily accessible.
- **Patients and family members should be reminded of the importance of proper hand hygiene.** Patients should be instructed to clean hands on entering a physician's office.

Gloves

- **Gloves are not** a substitute for hand washing.
- Gloves are not required for routine patient care activities in which contact is limited to a patient's intact skin.
- Clean, non-sterile gloves should be worn:
 - ✓ For contact with blood, body fluids, secretions and excretions, mucous membranes, draining wounds or non-intact skin (e.g. open skin lesions or exudative rash).
 - ✓ For handling items visibly soiled with blood, body fluids, secretions or excretions
 - ✓ When the health care provider has open skin lesions on the hands (open lesions on the hands can pose a health risk to both patients and the health care provider).
- When indicated, gloves should be put on just before the task or procedure requiring gloves and removed immediately after use and before touching clean environmental surfaces.

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- Gloves may need to be removed and changed between activities and procedures on the same patient if handling materials that may contain high concentrations of microorganisms (e.g. a dressing changes, ostomy care or examination of the oral cavity).
- Hands should be washed immediately after removing gloves.
- Single-use disposable gloves should not be reused or washed.

Glove Use Guide:

- Sterile (surgical gloves) are required for performing sterile procedures.
- Non-sterile disposable gloves are used for contact with non-intact skin, any body fluids, or mucous membranes. Canadian Standards Board approved gloves for medical procedures provide adequate protection from blood borne pathogens.
- Vinyl, latex or nitrile gloves all provide adequate protection and should be selected based on the procedure being performed and staff or patient latex sensitivity³.

Facial Protection

- Masks and eye protection or face shields should be worn where appropriate to protect the mucous membranes of the eyes, nose and mouth during procedures and patient care activities likely to generate splashes or sprays of blood, body fluids, secretions or excretions.

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Facial Protection Use Guide:

Masks type should be selected by intended use...

- A fluid resistant surgical or procedural mask should be worn to protect mucous membranes from splashes of body fluids.



- If protection is required from airborne or aerosolized pathogens then a NIOSH approved N95 respirator must be worn^{† †}. Masks that meet this standard will have this printed on them.



- Eye protection can be provided with safety glasses, goggles or face shields.
- In any situation that a mask is worn as a barrier against exposure to blood or body fluids, eye protection should be worn as well.



- Prescription eyeglasses are not considered adequate eye protection.
- Eye protection should be cleaned if it has been contaminated with body fluids.

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† † NIOSH is the National Institute for Occupational Safety and Health, an agency affiliated with CDC Atlanta, and is responsible for conducting research on work related illness and injury. The N95 designation indicates that the respirator is capable of filtering all particles larger than 0.3 microns and 95% of particles smaller than 0.3 microns when worn by a worker that has been “fit-tested” for the given make and model. The Worker’s Compensation Board of BC accepts the NIOSH rating of N95 respirators and requires that workers be fit-tested for the respirator if it is being used to protect the worker against airborne hazards⁴. Fit testing refers to a qualitative or quantitative assessment of the given respirator to protect the wearer from airborne particles and must be done by qualified personnel. Testing is available through the manufacturers of the respirators or occupational health providers. For more information refer to the WCB document http://www.ohsah.bc.ca/media/WCB_SARS_june 16.pdf

Gowns

- The routine use of gowns is not recommended.
- Gowns should be used to protect uncovered skin and prevent soiling of clothing during procedures and patient care activities likely to generate splashes or sprays of blood, body fluids, secretions, or excretions.



- Gowns used should be fluid resistant.
- Gowns should be applied immediately prior to the procedure and should be removed carefully once the procedure is completed to avoid contamination of the clothing. They should not be used for procedures on more than one patient.

4. TRANSMISSION BASED PRECAUTIONS

Transmission based precautions are used for patients known or suspected to be infected or colonized with certain microorganisms. A list of these organisms is provided in Appendix 1.

Airborne Precautions

- Airborne Precautions are used for patients known or suspected to have microorganisms spread by the airborne route. These may consist of small particle residue (5 microns or smaller) that result from the evaporation of large droplets or dust particles containing skin squames and other debris. These can remain suspended in the air for long periods of time and are spread by air currents within a room or over a long distance.
- Any health care provider entering the room occupied by a patient suspected or known to have an airborne-transmitted infectious disease should at a minimum be wearing an N95 respirator.
- The following special arrangements should be considered for patient's who may be contagious:
 - ✓ Screening patients at the time the office visit is scheduled;
 - ✓ Making efforts to see these patients at the end of the day;
 - ✓ Quickly triaging patients out of common waiting areas and into a private exam room;
 - ✓ Closing the door of the examining room and limiting access to the patient by visitors and staff members who are not immune to the suspected disease.
 - ✓ A sample triage questionnaire is included as Appendix 2.
- The duration of time that air-borne viruses remain suspended in a room depends on air exchange rates; for example, if the air exchange rate is 6 per hour, concentration of droplet nuclei will be reduced by 99% in 60 minutes⁵. Recommended air exchange rates depend on the stated use of a room. Recommendations and guidelines are made by the Canadian Standards Association⁶. The current recommended air exchange rate for a medical office examination room is at least 6 air changes per hour with 2 outside air exchanges per hour. The number of air exchanges in buildings that house outpatient facilities often is low, and the air is frequently recirculated. Physicians should be aware of airflow patterns to limit transmission of airborne pathogens.

Droplet Precautions

- Droplet Precautions are used for patients known or suspected to have microorganisms transmitted by droplets larger than 5 microns. These droplets may be produced during coughing, sneezing or during certain procedures such as suctioning or bronchoscopy. These particles are propelled a short distance, less than one meter, and do not remain suspended in the air.
- Any health care provider coming within one meter of a patient suspected or known to have a droplet-transmitted infectious disease should wear a surgical mask and eye protection. Prescription eyewear is not considered adequate eye protection.
- The current scientific and epidemiological evidence available indicate that SARS is transmitted by large droplets generated when an infected patient coughs, sneezes or talks. These droplets may travel through the air up to 1 metre before settling. Transmission may happen if these droplets settle on a mucous membrane or through the indirect inoculation of membranes with contaminated hands or equipment. The possibility of the creation of aerosols that may contain virus particles during high risk procedures such as bronchoscopy, intubation, and high flow oxygen or nebulizer therapy cannot be ruled out. Current **guidelines recommend that airborne precautions** be practiced when performing such procedures for patients suspected of having SARS infection.

Contact Precautions

- Contact Precautions are used for patients known or suspected to have microorganisms that can be spread by direct contact with the patient or by indirect contact with environmental surfaces or patient care equipment.
- Any health care provider likely to have direct skin-to-skin contact with a patient suspected or known to have a contact transmitted infectious disease should wear gloves and a fluid resistant gown.

Antibiotic Resistant Organisms

- Guidelines have been published for isolation and precautions for patients who acquire resistant flora while in hospital⁷. Patients may harbour resistant bacteria as part of their respiratory or gastrointestinal tract flora for an extended period. These organisms include methicillin-resistant *Staphylococcus aureus* (MRSA), vancomycin intermediate *S. aureus* (glycopeptide intermediate *S. aureus* or GISA), vancomycin-resistant *Enterococcus* species (VRE), and extended-spectrum β -lactamase-producing or multiply-resistant Gram-negative bacteria^{8,9}.
- Antibiotic resistant organisms are usually spread on the hands of health care providers. Hand washing or use of an alcohol-based hand antiseptic before and after contact with colonized or infected patients is the key to preventing transmission.
- Patients known to be carriers of these organisms should have this indicated in their medical record in order to facilitate recognition on subsequent visits.
- Equipment used on the patient (e.g. exam tables, chairs, stethoscopes) should be cleaned and disinfected with a low-level disinfectant product.
- The following detergent disinfectants are suggested for use in the daily cleaning and disinfection of office surfaces/equipment; phenolic, iodophor, quaternary ammonium compound or a fresh solution of sodium hypochlorite diluted 1:50 with water. Solutions containing 0.5% accelerated hydrogen peroxide (AHP) are now commercially available. Refer to manufacture's recommendations for use.
- Antibiotic resistance does not infer disinfectant resistance; therefore measures beyond routine disinfection practices are not warranted.

5. PATIENT CARE EQUIPMENT

The following guidelines for equipment used in patient care should be followed:

- Use disposable equipment when possible. Single use equipment should not be reused unless cleaning and disinfection procedures are provided by the manufacturer.
- Protect reusable equipment from gross contamination with blood and body fluids as much as possible.
- Reusable equipment that has been in direct contact with the patient should be cleaned and reprocessed before use in the care of another patient. See Appendix 3.
- Items that are in contact with intact skin only should have a monitored routine cleaning schedule if cleaning between patients is not feasible. Refer to section 7 - Sterilization, Disinfection and Antisepsis.
- Equipment that is visibly soiled should be cleaned before reuse.
- Visibly soiled equipment should be handled in a manner that prevents contamination of the worker's skin, mucous membranes, clothing and surrounding environment.
- Procedures should be established for assigning responsibility and accountability for routine cleaning of all patient care equipment.
- Used needles and other sharp instruments should be appropriately handled to avoid injuries during disposal or re-processing. Sharp items should be disposed of immediately in puncture-resistant containers located in the area where the items were used.
- Mouthpieces and resuscitation bags should be available for staff performing CPR. This equipment requires cleaning and disinfection if used.

6. ENVIRONMENTAL CONTROL

Procedures should be established for routine care, cleaning and disinfection of office furniture and environmental surfaces. Education for health care providers in these practices should be regularly updated and documented.

Office Design

Sinks

- Dedicated hand washing sinks with a single faucet, adjacent soap dispensers, and disposable towels should be conveniently located in all patient care areas. Faucet aerators are discouraged because they are often contaminated by *Pseudomonas* species and other bacteria.
- Alcohol-based hand antiseptics are effective in reducing hand contamination and should be made available as an alternative to hand washing. Hand antiseptics are especially useful when time for hand washing or access to sinks is limited. When there is visible soiling, hands should be washed with soap and water.

Waiting Areas

- Waiting rooms and reception areas offer the opportunity for patient-to-patient transmission of infectious agents. Avoid crowding and shorten waiting times as much as possible.
- Symptomatic patients who are possibly contagious should be moved into a private exam room as quickly as possible.
- Triage patients should begin at the time the office visit is scheduled. Patients known or suspected to have a communicable disease should register with the receptionist immediately, and in some cases, may be asked to use a separate entrance to avoid the waiting area. A sample triage questionnaire is included as Appendix 2.
- Ideally, immunocompromised patients should not wait in the general waiting area, but be escorted immediately to an examining room.
- Toys in the office should be washable and of appropriate sizes and shapes to avoid aspiration or other injuries. Toys contaminated with body fluids should be removed until cleaned. The value of antibacterial agents within the toys is unproven. Cleansing of toys in a dishwasher on a routine basis will decrease microbial contamination and keep the toys clean.

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- Floors in the waiting area and examination rooms should be cleaned regularly. Following spills involving blood or body fluids contaminated with blood, floors should be first cleaned with detergent, and then disinfected promptly using a disinfectant solution. See Appendix 5.
- Linoleum or wood floors are optimal surfaces to keep clean.
- Carpeting in waiting areas and examination rooms is discouraged.

Examination Rooms

- Equipment need be cleaned after each use. Furniture in the room generally is not a major concern for transfer of infectious agents, although contamination of the examining table can be a problem.
- Cover the examination table with disposable paper or linen, and change it between patients. More thorough cleaning and disinfection should be done if contamination is visible or diaper changing has occurred.
- The examination table should be cleaned on a daily basis.

Rest Rooms

- Rest rooms for staff and patient use should be provided and cleaned daily and whenever visibly soiled.
- A diaper changing area should be provided in at least 1 rest room with disposable paper covers and a receptacle for soiled diapers and paper.

Personal and Diagnostic Equipment

- The role of stethoscopes and other examining devices in transmitting infectious agents is unclear. However, stethoscopes have been shown to be contaminated with antibiotic resistant organisms (e.g. MRSA, VRE).
- The stethoscope bell, diaphragm and tubing should be cleaned regularly and whenever soiled. Soap and water or an alcohol wipe is effective. The handle and body of otoscopes or ophthalmoscopes should be cleaned in a similar fashion.
- Ear curettes should be cleaned and disinfected with an intermediate-level disinfectant (e.g. alcohol or dilute bleach) after each use if not disposable.

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- Ballpoint pens, patient charts, computer keyboards and computer mice can be contaminated with infectious agents that can be transmitted by hands to other environmental sources. Because these items rarely are cleaned, hand washing before and after patient contact is necessary to minimize the potential transfer of infectious agents from equipment to patients.
- Blood pressure cuffs are usually placed on intact skin so the risk of transmission of infectious agents is minimal. Cuffs should not be placed in direct contact with damaged or non-intact skin.
- Plastic sleeves are available for use with glass or electronic thermometers. A contaminated thermometer should be cleaned and disinfected.
- The "box" of electronic thermometers should be wiped whenever soiled. Paper towels with soap and water or an alcohol wipe can be used.
- Other office equipment should be cleaned regularly and whenever contaminated by patient secretions.

7. STERILIZATION, DISINFECTION AND ANTISEPSIS

Sterilization completely eliminates or destroys all forms of microbial life. Disinfection reduces, but does not eliminate all microbes. The extent of disinfection depends on the type of disinfectant and its concentration, the resistance of the microbes, and the contact time. Mechanical cleaning removes foreign material from equipment. Antisepsis refers to the process used to reduce the number of microorganisms on the skin of the patient or health care provider.

General Principles

- All equipment should be cleaned regularly and stored where it will not become contaminated.
- Equipment that will contact only intact skin requires cleaning and low level disinfection.
- Equipment having contact with mucous membranes requires cleaning and high-level disinfection, whereas instruments that penetrate skin or mucosal membranes must be cleaned and then sterilized.
- Written policies for cleaning, sterilization and disinfection in the office will ensure that these procedures are performed properly. Regular reviews should be conducted to be sure that policies and procedures are being followed, monitored and documented.

Appendix 4 describes the Spaulding classification of level of disinfection for medical equipment.

Sterilization

- Sterilization is accomplished by autoclave, dry heat, or gas. Items must be mechanically cleaned with soap and water to remove organic debris before autoclaving:
 - ✓ Steam autoclaving uses distilled water whose steam must reach a temperature of 121° to 133°C. Recommended exposure time varies with temperature, material and whether the instrument is wrapped or not. Follow the manufacturer's recommendations for exposure times. Unwrapped instruments should be used immediately or aseptically transferred to a sterile container.
 - ✓ Hot air oven sterilization is used only for items that cannot be sterilized by autoclaving. The oven temperature should be 171°C for an exposure time of 1 hour.

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- The sterilization of equipment should be monitored using various indicators to ensure that the process has been effective:
 - ✓ Mechanical indicators ensure that a machine reaches the correct temperature and pressure for the required time.
 - ✓ Chemical indicators show that the wrapped package has been exposed to the correct temperature or chemical conditions.
 - ✓ Biological indicators are necessary to ensure sterility. A variety of indicator systems are commercially available. These contain spores (*B. stearothermophilus* for steam sterilization or *B. subtilis* for dry heat). Rapid readout biological indicators can provide assurance of sterility within 60 minutes.
 - ✓ Follow the procedure recommended by the manufacturer to document sterility. At least weekly, results should be recorded and monitored.
- Packs that have been sterilized should be stored in clean, dry areas to minimize recontamination. Packs should be dated for the purposes of rotation.
 - ✓ Packs suspected of being compromised should not be used. If they are wet, torn, dusty, the seal broken or if they have been dropped or damaged they are compromised.
 - ✓ Packs should be inspected before use.

High-level Disinfection

- High-level disinfection is accomplished by two types of procedures:
 - ✓ Boiling – Instruments are cleaned and then placed in boiling water for at least 20 minutes. The vessel used for boiling should be cleaned daily.
 - ✓ Chemical disinfection – Instruments are cleaned and then soaked in a chemical disinfectant such as glutaraldehyde, hydrogen peroxide, or sodium hypochlorite (bleach).
 - **Manufacturer's recommended contact times must be followed to achieve disinfection.**
 - Two percent glutaraldehyde solutions are most commonly used in hospitals. However, these products have potential toxicity if proper ventilation is not ensured. Solutions should be prepared according to manufacturer's instructions, a quality assurance process to assess aldehyde levels should be done, and adequate ventilation provided.
 - A 6% solution of hydrogen peroxide is safe and effective to use with most medical instruments.
 - A 1:50 dilution of sodium hypochlorite is effective for disinfection.
 - WCB regulations for use and ventilation must be observed.
- After disinfection, instruments are rinsed with sterile water, air dried, and stored aseptically to avoid recontamination.

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Intermediate-level Disinfection

- Intermediate-level disinfection is accomplished with ethanol and isopropanol, iodine and iodophors, phenols and phenolics, and 1:64 dilutions of sodium hypochlorite.
- Manufacturer's recommended contact times must be followed to achieve disinfection.

Low-level Disinfection

- Low-level disinfection is accomplished with disinfectants including phenols and phenolics, quaternary ammonium compounds, 1:500 dilutions of sodium hypochlorite, iodine and iodophors and 0.5% accelerated hydrogen peroxide (AHP).
- Manufacturer's recommended contact times must be followed to achieve disinfection.

A list of commonly used chemical disinfectants, their uses, advantages and disadvantages is included as Appendix 5.

Antiseptics

- Antiseptics are chemical agents intended for use on skin or tissue.
- Most skin preparation agents must be allowed to dry to provide effective antiseptics.
- Skin preparation agents include isopropyl alcohol, chlorhexidine gluconate, iodine, and iodophors².
- Alcohol is the most commonly used skin preparation for immunizations and venipuncture.
- Tincture of iodine, povidone iodine or chlorhexidine gluconate are commonly used skin preparation agents for invasive procedures, such as insertion of indwelling intravenous catheters and when obtaining blood for culture.
- Contamination of antiseptics has been associated with outbreaks of infections. To prevent contamination of solutions, bottles of antiseptics should be dated, should not be refilled, and should be inspected and discarded if not used within 3 months. Single use pads and swabs pre-moistened with antiseptics are available and eliminate the need for bottles of antiseptics.
- Chemical agents formulated as antiseptics should not be used as cleaning agents for surfaces and instruments – they are not disinfectants.

8. GENERAL HOUSEKEEPING

- Offices, office equipment and examination rooms should be regularly cleaned.
- Surfaces should be cleaned with a low-level disinfectant. Phenolics, iodophors, and quaternary ammonium compounds are appropriate for use in daily cleaning and disinfection of surfaces.
- Blood spills should be cleaned using a detergent to remove organic material. The area should then be disinfected with a disinfectant solution (e.g. 1 part household bleach to 10 parts water applied for at least 30 seconds and wiped after the minimum contact time). Gloves should be worn during cleanup of any blood or body fluid.

9. WASTE DISPOSAL

- Municipal and provincial regulations dictate the proper disposal of biomedical wastes. Health care providers should be aware of the policies in their local municipality and ensure that regulated wastes are disposed of properly.
- Basic principles include:
 - ✓ Defining which items constitute infectious waste and which do not.
 - ✓ Separating, labelling, storing, and transporting items in these 2 categories.
 - ✓ Instructing staff on how to handle infectious wastes.
 - ✓ Developing plans for managing waste, spills, and inadvertent exposures.
 - ✓ Links to waste regulations are available at <http://wlapwww.gov.bc.ca/epdiv/index.html>
- Two categories of waste generated in offices are **regulated**:
 1. Anatomical Waste
 - Tissues, organs and body parts, not including teeth, hair and nails.
 2. Non anatomical:
 - Human liquid blood and semi-liquid blood and blood products.
 - Items contaminated with blood that would release liquid or semi-liquid if compressed.
 - Body fluids contaminated with blood excluding urine and feces.
 - Sharps including needles, needles attached to syringes and blades.
 - Broken glass or other material capable of causing punctures or cuts which would have come in contact with human blood or body fluids.

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- It is necessary that this waste be transported to an approved facility for treatment by incineration, autoclaving, chemical or other means and disposal as approved by local regulations.
- General office waste requires no special disposal methods.
- The practice of removing garbage from receptacles by hand and reusing the bag should be ***strongly discouraged*** as this practice may lead to injuries from sharp objects inadvertently placed in the regular garbage.

10. OCCUPATIONAL HEALTH

Work Restrictions for Health Care Providers

- Health care providers are frequently exposed to persons with communicable diseases.
- Health care providers can pose a risk to patients and other office staff if they have a communicable disease.
- Written policies should exist regarding exclusion of health care providers with a communicable disease.
- Suggested work restrictions for health care providers with communicable diseases can be found in Appendix 6.
- Health care providers with respiratory tract infections should be encouraged to stay home. If this is not possible, precautions should be taken with an emphasis on hand washing before all patient contact.

Tuberculosis Screening

- Screening for tuberculosis should be done before employment to ensure active tuberculosis is detected early and treated.
- When necessary, employees diagnosed with pulmonary TB should be excluded from the office until they are shown to be no longer infectious.
- A Mantoux test is considered positive if an area of induration of at least 10 mm is detected. For persons with underlying conditions or known household exposure to tuberculosis, 5 mm of induration is considered positive.
- If the Mantoux test is positive or the employee is known to have a history of a positive test or previous TB infection, they should be referred for evaluation and appropriate management if indicated.
- The frequency of repeat skin testing for Mantoux-negative employees should be based on the risk of exposure to people with active tuberculosis. Risk factors will vary from employee to employee. Yearly testing should be considered in practices where there has been a high rate of documented tuberculosis or high rate of skin test conversion among families and patients or health care workers¹⁰.
- Consultation with local health authorities or TB Control at BC Centre for Disease Control is useful to determine the prevalence of tuberculosis in your area.

INFECTION PREVENTION AND CONTROL IN THE PHYSICIAN'S OFFICE

Health Care Provider Immunization

- Policies should be established regarding immunization of health care providers, volunteers and students.
- Immunization records should be maintained for all health care providers. A list of recommended immunizations is included as Appendix 7.

Blood and Body Fluid (BBF) Exposure

- Skin surfaces that are contaminated with blood or other body fluids should be washed immediately and thoroughly with soap and warm water.
- Policies for management of needlestick injuries, percutaneous, permucosal, or non-intact skin exposure to blood or body fluids should be readily available and understood. See Appendix 8 for a sample protocol.
- A system for rapid evaluation, first aid and referral for treatment for exposed persons must be in place. If treatment is necessary it should be provided **within two hours** of the exposure.
- WCB requires that all health care providers receive education on the management of BBF exposures and that procedures are available, understood and followed.
- Immunization with hepatitis B vaccine is also mandated by WCB for all persons whose job might involve exposure to blood or blood-containing body fluids.
- Impermeable and puncture-proof needle disposal containers should be available in areas where injections are given. The containers should not be overfilled and be out of reach of young children.
- The practice of passing sharps (e.g. scalpels, syringes) hand-to-hand should be discouraged. If necessary, a kidney basin can be used to pass sharps. The recapping of used needles is also unsafe.
- Policies consistent with provincial and local regulations for removal and incineration or sterilization should be in place. See Waste Management section.
- Environmental surfaces contaminated with BBF should be cleaned with a detergent, and then disinfected. Gloves should be worn during cleaning.

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INFECTION PREVENTION AND CONTROL IN THE PHYSICIAN'S OFFICE

12. REFERENCES

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2. Boyce JM, Pittet D. Guideline for Hand Hygiene in Health-Care Settings: Recommendations of the Healthcare Infection Control Practices Advisory Committee and the HICPAC/SHEA/APIC/IDSA Hand Hygiene Task Force. ICHE 2002; 23 S12.
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13. Communicable Disease Manual. Blood and Body Fluid Exposure Management. BC Centre for Disease Control. 2003
14. Drummond D, Skidmore A. The Prevention of Cross Infection in the Physician's Office. College of Physicians and Surgeons of BC. CMAJ 1991; 145(8).

INFECTION PREVENTION AND CONTROL IN THE PHYSICIAN'S OFFICE

APPENDIX 1

Microorganism transmission routes and precautionary measures

Transmission Route	Diseases	Precautions Required
Airborne	Pulmonary tuberculosis Disseminated zoster Rubeola (measles) Varicella (chickenpox) Hemorrhagic fevers (Lassa, Ebola, Marburg) Smallpox	N95 particulate respirator* Eye Protection Move to private exam room Close door Hand cleaning
Droplets	Diphtheria Influenza Meningococcal meningitis Mumps Pertussis Rubella Upper respiratory Infections** (Adenovirus, Parainfluenza, Rhinovirus, RSV) Parvovirus B-19 Pneumonic Plague Invasive Grp. A Streptococcus	Surgical mask Eye protection Hand cleaning
Direct Contact	Infectious diarrhea *** (Campylobacter, E. coli, Giardia, Rotavirus, Salmonella, Shigella, Yersinia) C. difficile Major burn wound infection Desquamation skin disorder Hepatitis A, E HSV **** Scabies Varicella Zoster Viral respiratory infections(see above) Hemorrhagic fevers Antibiotic Resistant Organisms	Gloves Fluid resistant gown Hand cleaning

* Any staff member entering the room occupied by a patient suspected of having an airborne-transmitted infectious disease should at a minimum be wearing a fit-tested, NIOSH approved, N95 respirator.

** Until viral infection ruled out.

*** If patient incontinent and stool cannot be contained in a diaper

**** In neonatal or disseminated mucocutaneous.

Source: Health Canada. Routine Practices and Additional Precautions for Preventing the Transmission of Infection in Health Care. CDR 25S4. 1999

APPENDIX 2

SAMPLE TRIAGE QUESTIONNAIRE

Name: _____ Date: _____ Time: _____

Are you experiencing **any** of the following symptoms?

- 1. **Muscle aches.....No Yes**
- 2. **Severe fatigue, feeling unwell.....No Yes**
- 3. **Severe headache (worse than usual).....No Yes**
- 4. **New or worsening cough.....No Yes**
- 5. **Shortness of breath (worse than is normal for you).....No Yes**
- 6. **Feeling feverish or have had a fever in the last 24 hours.....No Yes**
- 7. **New rash associated with fever.....No Yes**
- 8. **Have you recently travelled or been in contact with a sick person that has travelled in the last 14 days?No Yes**

If you answer “yes” to any of the above questions, please notify the receptionist. You may be placed in a private exam room and health care providers may wear a mask.

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APPENDIX 3

Cleaning and Disinfection of Patient Care Equipment

Equipment	Level of Disinfection	Frequency
Surgical instruments Biopsy equipment Acupuncture needles All instruments used for foot care	Critical Items: Clean and sterilize	Between each use
Endoscopes Laryngoscopes Respiratory therapy equipment Nasal specula Tonometer foot plates Ear syringe nozzles Vaginal specula Sonographic vaginal probes Cervical caps Breast pump accessories Glass thermometers	Semicritical items: Clean and high-level disinfection	Between each use
Environmental surfaces contaminated with BBF Bedpans, urinals Stethoscopes Blood pressure cuffs Ear specula	Reusable equipment: Clean and low-level disinfection	Between each use
Horizontal surfaces (work counters, baby scales, tables) Walls, curtains, blinds Floors Carpets, upholstery Toys Toilets	Low-level disinfection	Thorough regular cleaning; Cleaning when soiled

Source: Health Canada. Handwashing, Cleaning, Disinfection and Sterilization in Health Care. CCDR. 24S8. 1998

INFECTION PREVENTION AND CONTROL IN THE PHYSICIAN'S OFFICE

APPENDIX 4

Spaulding's Classification of Medical Equipment (modified)

Instrument	Level of Disinfection
Critical instruments or devices: any instrument that enters tissue (e.g. needles)	Sterilize
Semicritical instruments or devices: contact mucous membranes but do not enter tissue (e.g. laryngoscopes or specula)	Sterilize or high-level disinfection
Noncritical instruments or devices: instruments that touch only intact skin (e.g. stethoscopes or blood pressure cuffs)	Detergent and water cleaning or low-level disinfection
Environmental surfaces: (e.g. knobs, handles, carts, or table tops)	Soap and water or low-level disinfection

Source: Drummond DC and Skidmore AG, CMAJ 1991; 145(8).

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APPENDIX 5

Disinfectant Uses, Advantages and Disadvantages

Disinfectant/Use	Advantages	Disadvantages
Alcohols Intermediate level disinfectant Disinfect thermometers, external surfaces of some equipment	Fast acting No residue Non staining	Volatile Evaporation may diminish concentration May harden rubber or cause deterioration of glues Intoxicating
Chlorine Intermediate level disinfectant Disinfect environmental surfaces (1:50 bleach) Following blood spills; (1:10 bleach) used to decontaminate area after blood has been removed	Low cost Fast acting Readily available in non hospital settings	Corrosive to metals Inactivated by organic material Irritant to skin and mucous membranes Use in well-ventilated areas Shelf life shortens when diluted
Glutaraldehydes 2% formulations — high level disinfection for heat sensitive equipment	Noncorrosive to metal Active in presence of organic material Compatible with lensed instruments Sterilization may be accomplished in 6-10 hours	Extremely irritating and toxic to skin and mucous membranes Shelf life shortens when diluted (effective for 14-30 days depending on formulation) High cost Monitor concentration in reusable solutions
Hydrogen peroxide Low level disinfectant (3%) High level disinfectant (6%)	Strong oxidant Fast acting Breaks down into water and oxygen	Can be corrosive to aluminum, copper, brass or zinc Surface active with limited ability to penetrate
Phenolics Low/intermediate level disinfectants Clean floors, walls and furnishings	Leaves residual film on environmental surfaces Commercially available with added detergents to provide one-step cleaning and disinfecting	Do not use in nurseries Not recommended for use on food contact surfaces May be absorbed through skin or by rubber Some synthetic flooring may become sticky with repetitive use
Quaternary ammonium compounds Low level disinfectant Clean floors, walls and furnishings	Generally non- irritating to hands Usually have detergent properties	DO NOT use to disinfect instruments Non-corrosive Limited use as disinfectant because of narrow microbicidal spectrum

Source: Handwashing, Cleaning, Disinfection and Sterilization in Health Care. CCDR 24S8, December 1998: Health Canada.

INFECTION PREVENTION AND CONTROL IN THE PHYSICIAN'S OFFICE

APPENDIX 6

Work Restriction Policies for Health Care Providers

Infection	Restriction	Length of Restriction
Conjunctivitis	Restrict from direct patient care	Until discharge resolved
Gastroenteritis	Restrict from direct patient care and food preparation	Until symptoms resolve or person is deemed non-contagious
Hepatitis A	Restrict from direct patient care and food preparation	Until 1 wk after onset of jaundice
Hepatitis B	None*	
Hepatitis C	None*	
Herpes simplex, orofacial	Restrict from direct care of newborn infants	Until lesions dry
HIV	None*	
Viral respiratory infections, acute febrile (e.g. Influenza, RSV)	Restrict from direct patient care	Until 5 d after symptom onset or acute symptoms resolve whichever is sooner
Measles	Exclude from office	Until 7 d after onset of rash
Mumps	Exclude from office	Until 9 d after onset of parotitis
Pediculosis	Restrict from direct patient contact	Until treated
Pertussis	Exclude from office	Until treated for 5 d
Rubella	Exclude from office	Until 5 d after onset of rash
Staphylococcal skin infection	Restrict from direct patient care	Until treated for 24 h
Streptococcal infection, group A	Restrict from direct patient care	Until treated for 24 h
Tuberculosis, active	Exclude from office	Until proven noninfectious
Varicella	Exclude from office	Until lesions crusted
Zoster	If covered, restrict from care of immunocompromized patients	Until lesions crusted
	If cannot be covered, restrict from patient care	Until lesions crusted

*Health care providers with these infections should avoid performing procedures considered to be at risk for transmission of blood from provider to patient.

Source: Boylyard EA, Tablan OC, Williams WW, Pearson ML, Shapiro CN, Deitchman SD and the Hospital Infection Control Practices Committee. Guideline for infection control in health care personnel, 1998. ICHE. 1998; 19; 410-446.

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APPENDIX 7

Recommended Immunizations for Health Care Providers

Vaccine	Indication
Measles-mumps-rubella vaccine	All health care providers born after 1957 should have received 2 doses of vaccine, unless the person has had natural measles. Note that it is very difficult to diagnose rubella. Office staff members often have contact with pregnant women; thus, it is optimal to ensure that all health care providers are immune to rubella. Some experts recommend serologic screening for all employees to ensure immunity to measles and rubella.
Polio	Most health care providers will have been immunized as children. This should be documented in employee records. If an employee has not been immunized, the person should receive inactivated poliovirus vaccine (series of 3 doses, at least 1 month between the first 2 doses and 4 months between the second and third doses).
Hepatitis B vaccine	Hepatitis B vaccine should be offered free of charge and strongly recommended for any health care provider who might come in contact with blood. If the employee refuses vaccination or has a medical contraindication to hepatitis vaccine, this should be documented in the employee's file.
Varicella-zoster vaccine	All health care providers should be questioned about a history of varicella. Those employees with a negative or unknown history of disease who have not previously received vaccine should have a varicella antibody test performed. All employees with no history of disease or vaccination and who lack detectable varicella antibody should be offered varicella vaccine. Alternatively, vaccine can be offered to all employees with no history of infection. Adults require 2 doses of varicella vaccine, each dose separated by a minimum of 4 weeks. If the employee has a medical contraindication to varicella vaccine or refuses vaccination, this information should be placed in the employee's file.
Influenza vaccine	Vaccine use should be promoted and offered free of charge yearly to all health care providers
Diphtheria and tetanus vaccine	Diphtheria and tetanus immunization is recommended every 10 years

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Pneumococcal Vaccine	This vaccine is recommended for adults and children at risk for serious disease due to the pneumococcus. All adults older than 65 years and persons with splenic dysfunction or absence, spinal fluid leaks, nephrotic syndrome, chronic cardiorespiratory disease, cirrhosis, alcoholism, chronic renal disease, diabetes mellitus, HIV infection, and other conditions associated with immunosuppression should be immunized.
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Source: CDC. Immunization of health care workers: recommendations of ACIP and HICPAC. MMWR 1997; 46 (RR-18): 1-42.

INFECTION PREVENTION AND CONTROL IN THE PHYSICIAN'S OFFICE

APPENDIX 8

Blood and Body Fluid Exposure Protocol

Cleanse:

Mucous membrane or eye: Rinse well with water and/or normal saline.

Skin: Wash well with soap and water.

DO NOT promote bleeding of percutaneous injuries by cutting, scratching, squeezing, or puncturing the skin.

Do not apply bleach to the wound or soak the wound in bleach.

Triage:

If percutaneous, permucosal, or non-intact skin exposure has occurred, the exposed person should **go to the local hospital Emergency Department as soon as possible**.

If antiretroviral therapy is indicated for possible HIV exposure, it should be administered **as soon as possible after exposure, preferably within 2 hours**.

Hepatitis B vaccine and hepatitis B immune globulin (HBIG) are known to be effective in reducing the risk of transmission of hepatitis B if given **as soon as possible** after exposure, preferably within 48 hours.

Detailed risk assessment and management of potential exposure to **ALL** pathogens (HIV, Hepatitis B&C) can take place in the Emergency Department or other health facility supplied with antiretroviral starter kits by the **BC Centre for Excellence in HIV/AIDS (1-800-665-7677)**.

Assess the Risk:

The following body substances have **not** been implicated in the transmission of HIV, Hepatitis B (HBV) or Hepatitis C (HCV) unless they contain visible blood: faeces, nasal secretions, sputum, sweat, tears, urine, and vomitus. The risk for transmission of Hepatitis B or C and HIV infection from these substances is extremely low.

Determine if there was a percutaneous, permucosal, or non-intact skin exposure to a potentially infectious body fluid posing a risk for HIV, HBV, or HCV transmission

INFECTION PREVENTION AND CONTROL IN THE PHYSICIAN'S OFFICE

Assess the risk of transmission from the source:

Determine if the source of the blood or body fluid is known. If the source person is known, obtain their consent for testing for anti-HIV, anti-HCV, HBsAg, anti-HBs, and anti-HBc.

The appropriate pre and post-test counseling should be done for each test. Obtaining informed consent from the source is an integral part of all post-exposure testing procedures, as is maintaining confidentiality of all information.

When the source is unknown, each individual exposure should be carefully evaluated for the risk of each specific pathogen in the source in that community and in that particular setting.

High-risk settings include needle-exchange program sites, acute care, drug and alcohol treatment clinics, and communities known to have a higher incidence of HIV, HBV, and HCV.

Except for exposures in a high-risk setting, HIV prophylaxis will not be given for an unknown source.

Documentation:

If it is an occupational exposure, follow Worker's Compensation Board (WCB) guidelines for injury reporting. This must not delay emergency assessment and management.

Source: Communicable Disease Manual. Blood and Body Fluid Exposure Management. BC Centre for Disease Control. 2003

APPENDIX 9

Resources

- 1) Blood and Body Fluid Exposure Management. BC Centre for Disease Control. 2003 <http://www.bccdc.org/content.php?item=83>
- 2) Handwashing, Cleaning, Disinfection and Sterilization in Health Care http://www.hc-sc.gc.ca/pphb-dgsp/dpg_e.html#infection
- 3) Routine Practices and Additional Precautions for Preventing the Transmission of Infection in Health Care http://www.hc-sc.gc.ca/pphb-dgsp/dpg_e.html#infection
- 4) Guidelines for the Control of Antibiotic Resistant Organisms. <http://www.bccdc.org/content.php?item=83>
- 5) Worker's Compensation Board of BC. Occupational Health and Safety Regulation http://www.worksafebc.com/publications/policies_and_regulations/Prevention_Manual/Assets/PDF/prevmnl.pdf
- 6) TB Control Manual <http://www.bccdc.org/content.php?item=128>
- 7) Infection Control Guidance in a Non-Outbreak Setting, (In the Absence of SARS) When an Individual Presents to a Health Care Institution With a Respiratory Infection. http://www.hc-sc.gc.ca/pphb-dgsp/sars-sras/pdf/sars-icg-nonoutbreak_e.pdf
- 8) Infection Control Guidance if there is a SARS Outbreak Anywhere in the World, When an Individual Presents to a Health Care Institution with a Respiratory Infection. http://www.hc-sc.gc.ca/pphb-dgsp/sars-sras/pdf/sars-icg-outbreakworld_e.pdf

INFECTION PREVENTION AND CONTROL IN THE PHYSICIAN'S OFFICE

APPENDIX 10

Glossary of Terms

Antibiotic Resistant Organism: A microorganism that has developed resistance to several antibiotics and is clinically or epidemiologically significant.

Antiseptics: Chemicals that kill microorganisms on skin or mucous membranes. Antiseptics should not be used in housekeeping.

Biomedical waste: Waste that is generated by human or animal health care facilities, medical or veterinary settings, health care teaching establishments, laboratories, and facilities involved in the production of vaccines.

Barrier Techniques: Use of single rooms, gloves, masks, or gowns in health care settings to prevent transmission of microorganisms.

Carrier: An individual who is found to be persistently colonized (culture-positive) for a particular organism, at one or more body sites, but has no signs or symptoms of infection.

Cleaning: The physical removal of foreign material, e.g., dust, soil, organic material such as blood, secretions, excretions and microorganisms. Cleaning physically removes rather than kills microorganisms.

Colonization: Presence of microorganisms in or on an individual with no signs or symptoms of infection.

Communicable: Capable of being transmitted from one person to another; synonymous with "infectious" and "contagious".

Contamination: The presence of microorganisms on inanimate objects (e.g. clothing, surgical instruments) or microorganisms on body surfaces such as hands, or in substances (e.g. water, food).

Critical items: Instruments and devices that enter sterile tissues, including the vascular system.

Decontamination: The removal of disease-producing microorganisms to leave an item safe for further handling.

Disease: Clinical expression of infection; signs and/or symptoms are produced.

Disinfection: The inactivation of disease-producing microorganisms. Disinfection does not destroy bacterial spores.

Hand antisepsis: A process for the removal or destruction microorganisms on hands.

Health care provider: Any person working in medical setting including physicians, nurses, allied health care professionals, clerical and support staff.

INFECTION PREVENTION AND CONTROL IN THE PHYSICIAN'S OFFICE

High level disinfection: Level of disinfection required when processing semicritical items. High level disinfection processes destroy vegetative bacteria, mycobacterium, fungi and enveloped (lipid) and nonenveloped (non lipid) viruses, but not necessarily bacterial spores.

Immunocompromised: Increased susceptibility to infection (e.g. HIV/AIDS, chemotherapy or blood malignancy).

Infection: The entry of an infectious agent in the tissues resulting in clinical signs and symptoms (disease).

Infectious waste: That portion of biomedical waste that is capable of producing infectious disease.

Intermediate level disinfection: Level of disinfection required for some semicritical items. Intermediate level disinfectants kill vegetative bacteria, most viruses and most fungi but not resistant bacterial spores.

Isolation: The physical separation of infected individuals from those uninfected for the period of communicability of a particular disease.

Low level disinfection: Level of disinfection required when processing noncritical items or some environmental surfaces. Low level disinfectants kill most vegetative bacteria and some fungi as well as enveloped (lipid) viruses (e.g., hepatitis B, C, Hantavirus, and HIV). Low level disinfectants do not kill mycobacteria or bacterial spores. Low level disinfectants-detergents are used to clean environmental surfaces.

Noncritical items: Those that either touch only intact skin but not mucous membranes or do not directly touch the patient.

Outbreak: An excess over the expected incidence of disease within a geographic area during a specified time period, synonymous with epidemic.

Plain soap: Detergent-based cleansers in any form (bar, liquid, or powder) used for the primary purpose of physical removal of soil and contaminating microorganisms.

Precautions: Interventions to reduce the risk of transmission of microorganisms from patient to patient, patient to health care worker, and health care worker to patient.

Routine practices: The routine use of hand washing and personal protective equipment to prevent exposure to blood and body fluids and control the transmission of communicable diseases.

Semicritical items: Devices that come in contact with nonintact skin or mucous membranes but ordinarily do not penetrate them. Reprocessing semicritical items involves meticulous cleaning followed preferably by high-level disinfection (level of disinfection required is dependent on the item).

Sharps: Needles, syringes, blades, laboratory glass or other objects capable of causing punctures or cuts.

Sterilization: The destruction of all forms of microbial life including bacteria, viruses, spores and fungi. Items must be cleaned thoroughly before effective sterilization can take place.