



# **Guidelines On Infection Control In Anaesthesia**

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## 1. INTRODUCTION

This guideline replaces the previous version of HKCA P15 Guidelines in infection control in Anaesthesia. It standardizes definitions with the CDC, elaborates basic infection control principles to prevent hospital associated infections which are applicable to both patients and health care worker occupational hazards, discusses the role of anaesthesiologists in prevention of surgical site infection, and summarizes the management of tuberculosis patients or airborne infections undergoing surgery in Hong Kong. This guideline should be viewed with infection control guidelines issued by other international and local authorities as listed in the reference section. A microbiologist or hospital infection control team should be consulted on matters requiring clarification.

## 2. DEFINITIONS <sup>[1]</sup>

**Sterilization** describes a process that destroys or eliminates all forms of microbial life and is carried out in health-care facilities by physical or chemical methods. Steam under pressure, dry heat, ethylene oxide (EtO) gas, hydrogen peroxide gas plasma, and liquid chemicals are the principal sterilizing agents used in healthcare facilities.

**Disinfection** describes a process that eliminates many or all pathogenic microorganisms except bacterial spores, on inanimate objects.

**Cleaning** is the removal of visible organic and inorganic soil from objects and surfaces and normally is accomplished manually or mechanically using water with detergents or enzymatic products.

**Decontamination** removes pathogenic microorganisms from objects so they are safe to handle, use or discard.

**Antiseptics** are germicides (germ-killing agents) applied to living tissue and skin and are used only on the skin and not for surface disinfection.

**Disinfectants** are antimicrobials applied only to inanimate objects because they can injure skin and other tissues.

Instruments and items for patient care are categorized as critical, semi-critical, and non-critical according to the degree of risk for infection involved in use of the items.

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**Critical** items are objects that enter sterile tissue or the vascular system and must be sterile because any microbial contamination could transmit disease. These include surgical instruments, cardiac and urinary catheters, implants and ultrasound probes used in sterile body cavities. Most of these items should be purchased as sterile or preferably be sterilized with steam. Heat-sensitive objects can be treated with EtO, hydrogen peroxide gas plasma or by liquid chemical sterilants.

**Semi-critical items** are objects that would contact mucous membranes or non-intact skin. At a minimum, they require high-level disinfection (complete elimination of all microorganisms in or on an instrument except for small numbers of bacterial spores) using chemical disinfectants. These include respiratory therapy and anaesthesia equipment such as laryngoscope blades, endoscopes and oesophageal probes.

**Non-critical items** are those that come in contact with intact skin but not mucous membranes and can be divided into patient care items and environmental surfaces. Non-critical patient-care items (e.g. blood pressure cuffs and bedpans) are decontaminated where they are used and do not need to be transported to a central processing area. Non-critical environmental surfaces (e.g. bed rails) are frequently touched by hands of health-care workers or by contacting medical equipment that subsequently contacts patients. They require low level disinfection such as mops and reusable cleaning cloths that are changed regularly.

Factors affecting the efficacy of disinfection and sterilization include number and location of micro-organisms, innate resistance of micro-organisms, concentration and potency of disinfectants, physical and chemical factors (temperature, pH, relative humidity, water hardness), organic or inorganic matters, duration of exposure and biofilms of micro-organisms.

### **3. BASIC INFECTION CONTROL PRINCIPLES IN PREVENTION OF HEALTHCARE ASSOCIATED INFECTIONS (HAI) <sup>[2,3]</sup>**

There are two tiers of recommended precautions to prevent the spread of infections in the healthcare settings: standard precautions and transmission-based precautions. Aspects relevant to anaesthetic practice are elaborated below.

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### **3.1. Standard precautions**

Implementation of standard precautions constitutes the primary strategy for the prevention of healthcare associated transmission of infectious agents among patients and healthcare personnel. They should be used in all patients. They include the following elements:

- (1) perform hand hygiene
- (2) use personal protective equipment (PPE)
- (3) follow respiratory hygiene/ cough etiquette principles
- (4) proper handling of needles and sharps
- (5) follow safe injection practices and wear masks in neuraxial blocks
- (6) properly handle, clean and disinfect patient care equipment and instruments/devices as well as environment
- (7) handle soiled textiles and laundry carefully
- (8) ensure appropriate patient placement

#### **3.1.1. Perform hand hygiene**

3.1.1.1. When hands are visibly dirty or contaminated with proteinaceous material or visibly soiled with blood or other body fluids, wash hands with soap and water.

3.1.1.2. When hands are not visibly soiled, use an alcohol-based hand rub for routine decontamination. Hands should be decontaminated in the following situations :

- (1) before having direct contact with patients,
  - (2) before donning sterile gloves when inserting intravascular catheters,
  - (3) before insertion of vascular catheters or invasive devices,
  - (4) after contact patients' intact skin,
  - (5) after contact with body fluids, mucous membranes, wound dressings if not visibly soiled,
  - (6) after contact with inanimate objects in immediate vicinity of the patient,
  - (7) after removing gloves,
  - (8) before eating, and
  - (9) after using a restroom
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#### 3.1.1.3. Surgical hand asepsis

Remove rings, watches, bracelets before beginning the surgical hand scrub. Remove debris from underneath fingernails using a nail cleaner under running water. Use either an antimicrobial soap or an alcohol-based hand rub before donning sterile gloves.

#### 3.1.1.4. Antiseptics <sup>[4,5]</sup>

The surgical hand aseptic product should be either an antimicrobial soap (e.g. 4% chlorhexidine or 7.5% povidone-iodine) or an alcohol-based hand rub. Alcoholic chlorhexidine was found to have greater residual antimicrobial activity.

“Alcohol” refers to ethyl alcohol and isopropyl alcohol, that are rapidly bactericidal rather than bacteriostatic against vegetative forms of bacteria, tuberculocidal, fungicidal and virucidal but do not destroy bacterial spores. Hence they are not recommended for sterilizing medical and surgical materials because they lack sporicidal action and cannot penetrate protein-rich materials. They also damage the shellac mountings of lensed instruments, swell and harden rubber and certain plastic tubing after prolonged and repeated use, bleach rubber and plastic tiles and damage tonometer tips. They are flammable and must be stored in a cool-well ventilated area. For alcohol based solutions for antiseptic skin preparation to prevent surgical site infection, see *Table 1* below.

3.1.1.5. Artificial fingernails are prohibited. Hand jewellery and nail polish should be removed before operations

**3.1.2. Use personal protective equipment (PPE)** whenever possible exposure to infectious material is expected.

3.1.2.1. PPE refers to a variety of barriers and respirators used alone or in combination to protect mucous membranes, airways, skin and clothing from contact with infectious agents. The selection of PPE is based on the nature of the patient interaction and/or the likely mode of transmission. They include gloves, gowns, face protection (masks, goggles, face shields) and respiratory protection.

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#### 3.1.2.2. Gloves

Gloves are used to prevent contamination of healthcare personnel hands when:

- (1) anticipating direct contact with blood or body fluids, mucous membranes, non-intact skin and other potentially infectious material;
- (2) having direct contact with patients who are colonized or infected with pathogens transmitted by contact route, e.g. VRE, MRSA, RSV;
- (3) handling or touching visibly or potentially contaminated patient care equipment and environmental surfaces

Gloves are removed after caring for a patient. Do not wear the same pair of gloves for the care of more than one patient. Change gloves during patient care if moving from a contaminated body site to a clean body site. Specific care should be taken not to contaminate the environment with gloves that have had previous patient contact. Hand hygiene should be performed before and after wearing of gloves.

#### 3.1.2.3. Gowns

Gowns protect the healthcare workers' arms and exposed body and prevent contamination of clothing with blood, body fluids and other potentially infectious material. When applying standard precautions, an isolation gown is worn only if contact with blood or body fluid is anticipated. Gowns are always worn in combination with gloves and with other PPE if indicated. Gowns are usually the first piece of PPE to be donned. Gowns should be removed before leaving patient care area in a manner that prevents contamination of clothing or skin.

#### 3.1.2.4. Face masks

Face masks are used for three primary purposes and placed on:

- (1) healthcare personnel to protect from contact with infectious materials from patients;
  - (2) healthcare personnel when engaged in procedures requiring sterile technique to protect patients from exposure to infectious
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agents carried in a healthcare worker's mouth or nose and;

- (3) coughing patients to limit potential dissemination of infectious respiratory secretions from the patient to others.

When masks are worn they should be worn to cover the nose and mouth completely and be firmly secured by the upper and lower tapes. Masks should be removed immediately after use and replaced for fresh patient interaction. Following removal and disposal, hand hygiene should be performed.

#### 3.1.2.5. Goggles, face shields

Protection for the eyes by goggles or face shields depend upon the circumstances of exposure, other PPE used and personal vision needs. Personal eyeglasses and contact lenses are not considered adequate eye protection. Protection for the eyes, nose and mouth by using a mask and goggles, or face shield alone, is necessary when it is likely that there will be a splash or spray of any respiratory secretions or other body fluids.

#### 3.1.2.6. Theatre attire

In addition to the above Standard precautions for all patients, all personnel entering operating theatre should wear a freshly laundered suit, gowns, caps and overshoes provided for use within the suite. Theatre attire should be changed daily and as soon as possible when visually soiled.

Hair should be completely covered with a disposable theatre cap or a freshly laundered lint free hat.

Caps and hoods should cover head and face hair fully.

Dedicated footwear is preferred for restricted areas. Footwear must meet occupational health and safety standard and be kept clean for use in theatres. Overshoes are not necessary for clean shoes that are specially kept for use in theatres. If overshoes are used, hand hygiene must be performed after donning and removing them.

3.1.2.7. When carrying out procedures under aseptic technique, mask should be worn to fully cover mouth and nose, and caps to fully cover

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head and face hair. They must be completely and be firmly secured by the upper and lower tapes. Masks should not be worn around the neck nor taken down to speak. Surgical gowns and drapes should be sterile and resistant to liquid penetration and remain effective barriers when get wetted.

3.1.2.8. Gloved and ungloved hands that are potentially contaminated with pathogens should not touch the mouth, nose, eyes or faces. Careful placement of PPE before patient contact will help avoid the need to make PPE adjustments and possible face or mucous membrane contamination during use. Patients should be positioned to direct sprays and splatter away from the face of the caregiver.

### **3.1.3. Follow respiratory hygiene/ cough etiquette principles**

3.1.3.1. The elements include :

- (1) source control measures (e.g. cover the mouth/nose when coughing and prompt disposal of used tissues)
- (2) hand hygiene after contact with respiratory secretions
- (3) spatial separation, ideally  $\geq 3$  feet, of persons with respiratory infections in patient waiting areas when possible
- (4) education of healthcare facility staff, patients and visitors
- (5) posted signs with instructions to patients and family members

3.1.3.2. Respiratory protection of healthcare workers with the use of a respirator with N95 or higher filtration to prevent inhalation of infectious particles is recommended for personnel exposed to patients with suspected or confirmed tuberculosis, diseases that transmitted through airborne route, performance of aerosol-generating procedures (intubation, bronchoscopy and suctioning) on patients with SARS Co-V infection, avian influenza and pandemic influenza. A user-seal check should be performed by the wearer each time a respirator is donned.

3.1.3.3. Vaccination recommendations, including those against seasonal influenza guidelines from the CHP, HK should be taken notice of.

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### **3.1.4. Proper handling of needles and sharps**

3.1.4.1. Needle-stick Injuries. Injuries due to needles and other sharps have been associated with transmission of HBV, HCV and HIV to healthcare personnel. Sharps must be handled with care at all times, disposed immediately following use and not be re-sheathed, bent, broken or manipulated by hand. The same also applied to drug ampoules made of glass, which may produce sharp edges and cause injuries to the health care workers and others during breaking open of the ampoules or afterwards. The use of needle-free injection systems and cannula with needle protection systems (e.g. needle retraction) is encouraged

#### 3.1.4.2. Vascular cannulations

Follow the above guidelines on hand hygiene and use of gloves. The patient's skin should be disinfected prior to cannulation, which is performed in a manner to ensure the shaft and the tip of the cannula remain sterile. Cannulation of central veins should follow the above guideline on aseptic technique.

3.1.4.3. Reporting needle-stick injury. Any person exposed to a needle-stick or other blood or body fluid incident should follow the protocol provided by the institution in which it occurs. This includes having a medical evaluation with particular reference to the risk of infection with HIV, HBV or HCV.

### **3.1.5. Follow safe injection practices and wear masks in neuraxial blocks**

#### 3.1.5.1. Safe injection practices<sup>[4]</sup>

These include the use of a sterile, single-use, disposable needle and syringe for each injection given and prevention of contamination of injection equipment and medication.

#### 3.1.5.2. Drip set and 2-ways/ 3-ways stopcocks

Every drip set should be dedicated to one patient. The tip of the drip set and injection ports of the stopcocks should be kept clean all the times.

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#### 3.1.5.3. Fluid and drug vials

Whenever possible, use of single-dose vials is preferred over multiple-dose vials, especially when medications will be administered to multiple patients.

#### 3.1.5.4. Regional anaesthesia procedures

When regional anaesthetic blocks are performed, guideline on hand hygiene, gloves and theatre attire should be followed. The patient's skin should be disinfected and the procedure done in a way that the needle remains sterile.

When performing central neuraxial blocks, full aseptic technique should be used including sterile gown and sterile drapes to create a bordered field. Surgical mask is mandatory to prevent droplet transmission of oral pharyngeal flora when injecting material into the spinal or epidural space or with indwelling catheter.

### **3.1.6. Properly handle, clean and disinfect patient care equipment and instruments / devices as well as environment**

The following measures are intended to minimize the risk of transmission of infection in the respiratory tract via anaesthetic equipment. This guideline does not address the processing of equipment during long term ventilation. Medical equipment and instruments/devices must be cleaned and maintained according to manufacturers' instructions. Cleaning to remove organic material must always precede high level disinfection and sterilization of critical and semi-critical instruments and devices because residual proteinaceous material reduces the effectiveness of the disinfectants and sterilization processes.

#### 3.1.6.1. Devices to be sited in the upper airway

Devices passing through the nose or mouth will become contaminated in the upper airway. There should be separation of unused items and soiled items during use.

- (1) Endotracheal tubes, nasal and pharyngeal airways should be kept sterile until used
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- (2) Reusable face masks must be thoroughly decontaminated and then undergo disinfection prior to each use.
- (3) Devices which may cause bleeding (e.g. laryngoscope blades and temperature probes) must be sterilized before reuse.
- (4) Laryngoscope handles should be decontaminated before use.
- (5) Endotracheal cuff pressure should be  $> 20\text{cmH}_2\text{O}$  to limit micro-aspiration but  $< 30\text{cmH}_2\text{O}$  to limit mucosal ischaemia.
- (6) Flexible laryngoscopes and bronchoscopes are considered semi-critical items that require careful cleaning, including any open suction or biopsy channel, followed by high level disinfection or sterilization.

#### 3.1.6.2. The breathing circuit

For each patient the breathing circuit should have been sterilized, or decontaminated and disinfected, or protected by the use of appropriately positioned new filters. A bacterial viral filter with an efficiency rating of  $> 99.99\%$  for particle sizes of  $0.3\mu\text{m}$  should be routinely placed in the anaesthesia circuit where it will protect the machine from contamination with airborne infectious diseases. When a filter is used, it is recommended that disposable items between the patient and the filter be disposed of and non-disposable items, including in-line measurement devices, be decontaminated and disinfected prior to reuse. Any condensate collected in the tubing of a breathing circuit should be periodically drained and discarded, taking precautions not to allow condensate to drain towards the patient. Hands should be washed after handling the fluid.

#### 3.1.6.3. Sampling lines for side stream gas analysis

These do not need to be re-sterilized before reuse because of the one-way flow of gas through them. Sampled gas from a capnograph or other such measurement devices should not be returned to the anaesthetic circuit unless it has first passed through a viral filter ( $0.2\mu\text{m}$  mesh)

#### 3.1.6.4. Carbon dioxide absorbers

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When a filter in the circuit as described in 3.1.6.2 above is used, sterilization of the carbon dioxide absorber prior to every case is not necessary nor practical with most models, although disposable versions and models capable of being sterilized are available. The device including the unidirectional valves should be disinfected regularly.

#### 3.1.6.5. Ventilator circuits and bellows

These items should be cleaned and disinfected regularly.

#### 3.1.6.6. Anaesthetic machine

Routine daily sterilisation or disinfection of internal components of the anaesthetic machine is not necessary if a bacterial/viral filter is used between patient and circuit. However, cleaning and maintenance policies should be followed and bellows, unidirectional valves and carbon dioxide absorbers should be cleaned and disinfected periodically.

#### 3.1.6.7. Flexible laryngoscopes and bronchoscopes

These are considered semi-critical equipment and require careful cleaning, including open suction or biopsy channels, followed by high level disinfection or sterilization.

#### 3.1.6.8. Surfaces and monitors

The surface of the anaesthetic machine and monitoring equipment should be cleaned between patients with water and detergent. These include non-invasive blood pressure cuffs and tubings, pulse oximeter probes and cables, stethoscopes, electrocardiographic cables, blood warmers, the exterior of anaesthetic machines and monitors etc. Equipment such as temperature probes used on patient surfaces should get high level disinfection and those items intended for single use should follow manufacturers' recommendations. Touch screens and control knobs should also be cleaned.

#### 3.1.6.9. Ultrasound probes – surface probes

Non critical use. Following non-invasive procedures (e.g. scanning over intact skin) the ultrasound transducer, following decontamination should be disinfected with a cloth soaked in alcohol-based solution (either alcohol alone or alcohol combined with antiseptic).

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Semi-critical use. For invasive procedures (e.g. ultrasound guided nerve block or central venous catheterization), the probe and cable ideally should be covered with a long sterile sheath and be prepared in such a way as to maintain the sterility of the region under procedure. Any conducting medium (e.g. ultrasound gel) between the probe cover and the skin should be sterile. Following use, the transducer cover should be removed without contaminating the surface of the transducer or the ultrasound machine. The probe should now be processed as for a non-invasive procedure. In this setting, decontamination, which includes removal of any gel remaining on the transducer, should then be followed by disinfection, such as by an alcohol soaked cloth.

The cleaning procedure for ultrasound used in both non-invasive and invasive procedures should also include the entire cable from the transducer to the machine and extend to the surface of the machine. Any probe that is contaminated with blood or other biological fluid should be cleaned as for critical use (see below) and undergo high-level disinfection with chemicals such as orthophthalaldehyde.

#### 3.1.6.10. Ultrasound probes – internal probes – semi-critical/critical use

Transoesophageal echocardiography (TOE/TEE) probes require management as semi-critical devices because they contact gastrointestinal mucosa and potentially infectious bodily fluids. When cleaning TOE probes it is important to ensure that disinfection and sterilization is undertaken of the probe tip and the insertion shaft and also that the handle, cable and external parts of the socket are decontaminated and disinfected, for example, by wiping over with water /detergent and a non-alcohol disinfectant. It is important to ensure that manufacturers' instructions are strictly adhered to. Once sterilized, the TOE probe should be stored in a clean non-contaminated environment.

Care should also be taken when using the TOE probe to avoid cross-contamination between the hand manipulating the probe shaft and the probe controls and ultrasound machine controls.

#### **3.1.7. Handle soiled textiles and laundry carefully**

Soiled laundry should be handled:

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- (1) without shaking the items that may aerosolize infectious agents
- (2) avoiding contact of one's body and personal clothing with soiled items being handled
- (3) containing soiled items in a laundry bag or designated bin

### **3.1.8. Ensure appropriate patient placement**

3.1.8.1. Hospital settings. Single patient rooms are always indicated for patients placed on Airborne precautions and are preferred for patients who require Contact or Droplet precautions.

3.1.8.2. Ambulatory settings. Healthcare providers are urged to implement source containment measures (e.g. asking coughing patients to wear a surgical mask or cover their coughs with tissues) to prevent transmission of respiratory infections, beginning at the point of initial patient encounter. Application of the same infectious control precautions should be extended to the person(s) accompanying the patient even when asymptomatic.

3.1.8.3. Transport of patients requiring Transmission-based precautions (see below). These include :

- (1) limiting transport to essential purposes
- (2) using appropriate barriers on the patient (e.g. mask, gown, use of dressings to cover infectious skin lesions or drains) consistent with the route and risk of transmission
- (3) notifying healthcare personnel in the receiving area of the precautions necessary
- (4) for patients being transported outside the facility, informing the personnel of the receiving facility as well as the emergency vehicle the precautions required

3.1.8.4. Operating theatre ventilation and flow (See Annex Table two).

Maintain positive-pressure ventilation in the operating room with respect to the corridors and adjacent areas. A minimum of 20 air changes per hour, of which at least 4 must be fresh air is recommended. Both recirculated and fresh air should be filtered through appropriate filters

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(e.g. HEPA filter) while all air should be introduced at the ceiling, and exhaust near the floor. Opening operating room doors disrupts airflow within the room, which potentially increases the risk of wound contamination. General traffic and superfluous personnel within the operating room should be minimized and doors should remain closed.

### **3.2. Transmission-based precautions**

The three categories of Transmission-based precautions are: Contact precautions, Droplet precautions and Airborne precautions. They are always used in addition to Standard precautions.

Transmission-based precautions are for patients who are known or suspected to be infected or colonized with infectious agents, which require additional control measures to effectively prevent transmission. Since the infecting agent often is not known at the time of admission to a healthcare facility, transmission-based precautions are used empirically, according to the clinical syndrome and the likely etiological agent at the time, and then modified when the pathogen is identified or a transmissible infectious etiology is ruled out.

Providing patients who are on Transmission-based precautions with dedicated noncritical medical equipment (e.g. stethoscope, blood pressure cuff, thermometer) has been beneficial for preventing transmission.

#### **3.2.1. Contact precautions**

Intended to prevent transmission of infectious agents spread by direct or indirect contact with the patient or the patient's environment. Contact precautions also apply where the presence of excessive wound drainage, faecal incontinence, or other discharges from the body suggest an increased potential for extensive environmental contamination and risk of transmission. Ideally,  $\geq 3$  feet spatial separation between beds is advised in multi-patient rooms. Healthcare personnel caring for patients on Contact precaution should wear a gown and gloves for all interactions that may involve contact with the patient or potentially contaminated areas. Donning PPE upon room entry and discarding before exiting the patient room is done to contain pathogens.

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### **3.2.2. Droplet precautions**

Intended to prevent transmission of pathogens spread through close respiratory or mucous membrane contact with respiratory secretions. Spatial separation of  $\geq 3$  feet and drawing the curtain between patient beds is especially important for patients in multi-bed rooms. Healthcare personnel should wear a mask (a respirator is not necessary) for close contact with infectious patient. Patients transported outside single room must be wearing a mask and follow Respiratory Hygiene/Cough etiquette.

### **3.2.3. Airborne precautions**

Intended to prevent transmission of pathogens that remain infectious over long distances when suspended in the air. The preferred placement for patients is an airborne infection isolation room (AIIR) equipped with special air handling and ventilation capacity. In settings where Airborne precautions cannot be implemented due to limited engineering resources, masking the patient, placing the patient in a private room with the door closed, providing N95 or higher level respirators or masks for healthcare personnel will reduce the likelihood of airborne transmission.

Healthcare facilities should provide a screening and vaccination program for their workers. It is the responsibility of individual anaesthesiologists to avail themselves of health resources and ensure their immunization is up to date. Non-immune healthcare workers should not care for patients with vaccine-preventable airborne disease (e.g. measles, chickenpox and smallpox).

## **4. PREVENTION OF SURGICAL SITE INFECTIONS (SSI) <sup>[5, 6]</sup>**

In addition to compliance with the above basic infection control principles, anaesthesiologists play important roles in the prevention of surgical site infections (SSI) as highlighted below. SSI is a surgical wound with local signs and symptoms of infection, and in more serious cases, with systemic signs of fever or a raised white cell count. All SSI preventive measures effective in adult surgical care are also applicable to paediatric surgical care. All SSI preventive measures applied to open surgeries are also

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indicated for their minimally invasive (e.g. laparoscopic) counterparts.

#### 4.1. Preoperative preparation of the surgical patients

4.1.1. Eradicate or treat all infections remote to the surgical site pre-operatively whenever possible.

4.1.2. Implement protocol to adequately control the serum blood glucose level perioperatively for patients undergoing major operations.

4.1.3. Minimize the preoperative length of stay of patients in the hospital whenever possible.

4.1.4. Encourage patients to stop smoking at least 30 days before scheduled operations

#### 4.2. Antimicrobial prophylaxis

4.2.1. Administer surgical antimicrobial prophylaxis as indicated. Operations classified as contaminated or dirty surgical wounds are frequently receiving therapeutic antimicrobial agents preoperatively to treat related infections. They are not regarded as surgical antimicrobial prophylaxis

4.2.2. Antimicrobial dosage should be modified according to body weight, liver and renal function.

4.2.3. For many prophylactic antimicrobial agents, the administration of an initial dose should be finished within 30 minutes *before* surgical incision to achieve an adequate tissue concentration at the time of initial incision. Administer additional intraoperative doses if the operation time exceeds two serum half-lives of the agent, or massive intraoperative blood loss occurs. Administration of Vancomycin and fluoroquinolones should begin within 120 minutes before surgical incision.

4.2.4. When a tourniquet is required, complete the infusion of the prophylactic antimicrobial agents before the tourniquet is inflated.

4.2.5. For cesarean section, administering the initial dose of antimicrobial prophylaxis prior to skin incision is now considered more effective than after the umbilical cord is clamped.

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**4.3. Ventilation and environment in operating theatres (see Annex Table two)**

4.3.1. Exert traffic control of operating room by restricting the number of people allowed in the operating room. Keep doors closed to prevent in and out traffic, and limiting unnecessary movement and talking once in the operating room

4.3.2. Maintain positive pressure ventilation in operating rooms with respect to corridors and adjacent areas. A program for periodic checking and system maintenance assessment should be in place to ensure that the target pressure gradient is maintained and that out of range performance can be detected. A device or a simple visual method which requires a minimum differential pressure to indicate airflow direction is desirable.

4.3.3. Ventilation should be maintained at a minimum of 20 air changes per hour (ACH) of which at least 4 ACH should be fresh air.

4.3.4. Filter all incoming air through MERV 14 filters (or equivalent) at a minimum.

4.3.5. Introduce air at the ceiling and exhaust air near the floor.

4.3.6. Laminar airflow ventilation systems and ultraviolet irradiation are not necessary to decrease overall surgical site infection risk if appropriate antiseptic precautions and prophylactic antibiotic policy are implemented.

4.3.7. Maintain relative humidity at 20%-60% and temperature at 20-24°C.

4.3.8. Do not shut down the heating, ventilation and air conditioning systems for purposes other than required maintenance, filter changes and construction.

4.3.9. The design of sinks should reduce risk of splashes. If strainers are used in water taps, they should be inspected, cleaned, descaled and disinfected regularly or on a frequency defined by the proper risk evaluation, taking account of the manufacturer's recommendations.

4.3.10. Do not use tacky mats at the entrance to the operating room suite or individual operating rooms for infection control.

4.3.11. For microbiological air sampling, allow adequate time for commissioning including microbiological assessments by the hospital infection prevention and control team before an operating theatre is first used and after any substantial modifications that may affect airflow patterns in pre-existing theatres. For

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conventional operating rooms, aerobic cultures on nonselective media should not exceed ten bacterial and/or fungal colony forming units per cubic meter (CFU/m<sup>3</sup>).

#### **4.4. Intraoperative management**

4.4.1. The principle of aseptic technique should be complied during operations, when inserting intravascular devices, administration of admixture and medications or placing anaesthetic devices

4.4.2. Sterile instruments, medications and solutions should be assembled just prior to use.

4.4.3. Maintain normothermia (above 36°C) during the surgical procedure unless contraindicated by the procedure.

4.4.4. Maintain optimal oxygenation during surgery. In particular, give patients sufficient oxygen during major surgery and in recovery period to ensure a haemoglobin saturation of more than 95% is maintained in adults.

4.4.5. Maintain adequate perfusion during surgery

4.4.6. Do not give insulin routinely to patients who do not have diabetes to optimize blood glucose postoperative as a means of reducing the risk of surgical site infection.

#### **4.5. Postoperative period**

4.5.1. Perform good hand hygiene before and after touching the surgical site or changing of dressing

4.5.2. If possible, optimize tissue oxygenation in adult for 2-6 hours postoperatively to ensure a haemoglobin saturation of more than 95%.

4.5.3. Quality assurance measures should be established to ensure effective implementation of the recommendations, such as monitoring the following performance indicators: surgical site infection rate, usage of prophylactic antibiotics, ventilation and environmental parameters of operating theatres, hand hygiene practices etc.

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## **5. MANAGEMENT OF SURGICAL PATIENTS SUSPECTED OR CONFIRMED OF PULMONARY TUBERCULOSIS (TB) OR OTHER AIRBORNE INFECTIONS <sup>[5]</sup>**

5.1. A system of detection and communication should be established to evaluate surgical patients prior to surgery and communicate to relevant departments to facilitate arrangements of necessary infection control measures.

5.2. There is no recommendation for changing pressure in operating room from positive to negative or setting it to neutral.

5.3. Perform only emergency operations or diagnostic procedures as indicated. Postpone elective surgery until after the infectious period or after effective therapy if delaying the operation does not cause increased risk to the patient.

5.4. Schedule the patient as the last case of the day to provide maximum time for adequate air changes if the delay of operations does not cause increased risk to the patient.

5.5. HEPA filters should be installed in the exhaust duct leading from the operating room into the general circulating system if air is to be re-circulated. This is allowed in existing facilities only. For new facilities, recirculation is not allowed. Exhaust air directly outdoor would be required in areas with potential contamination.

5.6. Install high-efficiency filters between the anaesthesia breathing circuit and the patients. The entire breathing circuit should be changed and safely discarded after used. Close suctioning system is preferred.

5.7. N95 respirators without exhalation valves should be worn for respiratory protection of surgical personnel in the operating theatre.

5.8. Perform aerosol generating procedures, such as intubation and extubation in an airborne isolation room if feasible.

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## 6. ANNEX

**Table One:** Options for antiseptic skin preparation <sup>[6]</sup>. Risk of fire and burn with alcohol based antiseptic solution, thus the solution must be allowed to dry and not pooled under patients.

When	Choices of antiseptic skin preparation
First choice unless contraindicated or the surgical site is next to mucous membrane	Alcohol-based solution of chlorhexidine
If the surgical site is next to a mucous membrane	Aqueous solution of chlorhexidine
If chlorhexidine is contraindicated	Alcohol-based solution of povidone-iodine
If both an alcohol-based solution and chlorhexidine are unsuitable	Aqueous solution of povidone-iodine

**Table Two:** Special ventilation requirements <sup>[7]</sup>

Function of space	Pressure relationship to adjacent areas	Min outdoor ACH	Min total ACH	All room air exhausted directly to outdoors	Air recirculated by means of room units <sup>1</sup>	Relative humidity %	Temp °C	Min Filter efficiency
Operating theatres / rooms	Positive	4	20	NR	No	20-60	20-24	MERV-14
Airborne infection isolation room (AIIR)	Negative	2	12	Yes	No	Max 60	21-24	MERV-14

1 – Recirculating devices with high-efficiency particulate air (HEPA) filters may be used in existing facilities to achieve the required room ACH, provided the specified minimum outdoor ACH is supplied.

NR – not required



## **7. REFERENCES**

- [1] CDC Guideline for Isolation precautions: Preventing transmission of infectious agents in Healthcare settings. Last update in July 2019.
- [2] ANZCA PS 28 (2015) Guidelines on Infection Control in Anaesthesia
- [3] ANZCA PS 51 (2018) Guidelines for the Safe Management and Use of Medications in Anaesthesia
- [4] CDC Guideline for Disinfection and Sterilization in Healthcare facilities. Updated May 2019.
- [5] Centre for Health Protection, Hong Kong. Recommendations on Prevention of Surgical Site Infection. 2<sup>nd</sup> edition. September 2017.
- [6] NICE guideline. Surgical site infections: prevention and treatment. Published 11 April 2019.
- [7] Department of Health, HKSAR, China. Guidelines for Healthcare Engineering Systems of Private Hospitals. December 2018