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General Directorate of Infection Prevention and
Control in Healthcare Facilities

(GDIPC)

Infection Control Guidelines in the Operating Room (OR)

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بِسْمِ اللَّهِ الرَّحْمَنِ الرَّحِيمِ

In the name of ALLAH, Most Gracious,
Most Merciful

General Director's Message

It gives me immense pleasure to explore the first Edition of Infection Prevention & Control (IPC) Guidelines of the Operating Room in healthcare facilities. It will serve as a significant guide for health care providers to implement effective infection prevention & control measures and to ensure the safety of patients and health care workers simultaneously.

Surgical Operating Rooms are one of the main areas that are influenced by improper infection control practices and have a significant impact on patient outcomes in terms of morbidity & mortality. As the patients in this area are extremely susceptible to Healthcare-Associated Infections (HAIs) due to the high demand of various invasive procedures and their vulnerable immunity.

Therefore, surgical safety is of utmost importance in order to prevent major and life-threatening complications and strict implementation of appropriate IPC practices in the operating room should be critically emphasized.

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Purpose of the Guidelines

To provide a guidance tool for the main recommendations of the evidence-based infection prevention & control (IPC) practices in surgical operating rooms and it will serve as a useful means to construct those approaches.

Additionally, it explores the main IPC measures in Operation Room (OR), specific design and construction of the same area, dress code specifications, the main infection prevention and control interventions that are required in encountering infectious transmissible respiratory infected cases, and environmental cleaning and disinfection at this high-risk area.

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Introduction

The main issue encountered in the practice of surgical safety is that existing safety measures are not adequate. Appropriate infection prevention and control is essential to ensure the safety of the patient undergoing any surgical procedure in the operating theater. The surgical site infections (SSIs) constitute one of the most prominent factor of hospital-acquired infections. Patients who experience postoperative complications, which lead to increase their hospital length of stay, healthcare costs, and higher morbidity and mortality rates dramatically.

The risk for infection is influenced by various approaches related to the patient, the operation, the surgeon(s), and the facility, thus creating a need for an all-encompassing infection prevention and control program focusing on the main IPC measures that must be implemented in OR. Integrating infection control protocols in the operating theater is the key to decrease negative consequences among those factors.

This document will demonstrate the main recommendations of the infection prevention & control (IPC) practices in surgical operating rooms. Additionally, it explores the specific design and construction of the same area, dress code specifications, the major IPC practices that are required in dealing with infectious transmissible respiratory cases, and environmental cleaning and disinfection of this high-risk area.

Applicability

Infection prevention staff, healthcare administrators, operating room staff, surgeons, other healthcare providers who are working in OR and its designated area.

Operating Room (OR) Design:

- The surgery unit is divided into three designated areas-unrestricted, semi-restricted and restricted-that are defined by the physical activities performed in each area.
- Theater room in the surgical suite that meets the requirements of a restricted area and is designated and equipped for performing invasive procedures.
- The design provides a clear demarcation between unrestricted, semi-restricted, and restricted areas.
- Sanitary openings are not allowed inside the restricted area in OR, basins inside operation rooms are not allowed.

General Requirements:

The following are main requirements that must be followed in the OR:

1. Walls

- Walls are should be painted with a seamless coating material that is bacteriostatic and can tolerate washing with detergents and disinfectants without deterioration of the surface bonding (Epoxy - acrylic resin), and smooth without cracks, seams, open joints, crevices or dividers.
- Walls must be scratch-resistant, withstanding wear and tear, with fixed soft trolley height wall protectors along corridors and exit areas.
- Wall surfaces should be hard and resist impact, impermeable, stain proof and easy to clean harbor dust, insects or bacteria, and all cut edges should be tapered to the wall to prevent the collection of dust.
- Walls that are penetrated by pipes, ducts and conduits should be tightly sealed to minimize entry of insects and rodent

2. Floors:

- The surface/flooring must be slip-resistant, solid & waterproof with minimum joints.
- The operating theatre suite floor should be 2-5 mm thick flexible, antistatic vinyl sheet.
- They are welded at the seams to provide a safe continuous waterproof surface.
- All corners shall be rounded slightly to prevent the harboring of dust and bacteria, and there should be no cracks or cervices at the seams or at the walls, which may allow pests such as ants and cockroaches into these clean areas.

3. Ceiling:

- Ceiling shall be smooth, nonporous, scrubable, non-perforated, without cervices or seams and capable of withstanding harsh chemicals.
- The ceiling shall be easily cleanable, non-friable and monolithic.
- Cracks or perforations in these ceilings are not allowed.

4. Doors:

- The doors of each theater should be sliding doors as no air currents are generated.
- All fittings in theater should be flush type and made of washable material which can tolerate washing with detergents and disinfectants, e.g. (steel).

- All doors should be electronically operated.
- The theater doors should not be manufactured of wooden material.

5. Surgical Scrub Sinks:

- Surgical scrub sinks should be allocated in a semi-restricted area near the entry of the theater.
- At least one large scrubbing sink is available at the entry to each operating theater.
- A scrub sink is a long deep sink that can accommodate one or more staff scrubbing for a sterile surgical procedure at one time.
- The sink should be deep to avoid splash during the surgical scrub procedure that may cause contamination of the hand.
- The scrub sink should be of cleanable and disinfectable material such as stainless steel.
- The sink should have rounded corners to allow easy cleaning.
- Hands-free operation is necessary such as elbow operated or electronic sensors.
- The surgical scrub solution shall be dispensed with hands-free apparatus.
- The scrubbing Room shall have an identified timer or clock for the timing of the scrubbing procedure (It could be an electronic timer).

Operating Room Areas:

a) Unrestricted area:

- An area may include a central control point for designated personnel to monitor the entrance of patients, personnel, and materials into the semi-restricted areas, staff changing areas, staff lounge, offices, waiting rooms or areas, dirty utility rooms pre- and postoperative patient care areas.
- Street clothes are permitted in this area.
- Public access to unrestricted areas should be limited according to the internal policy and procedures of the healthcare facility.

b) Semi-restricted area:

- A peripheral area that supports surgical services.
- This area can include storage for equipment, clean and sterile supplies, work areas for processing instruments, sterile processing facilities, hand scrub stations, corridors

leading from the unrestricted area to the restricted area of the surgical suite, and entrances to staff changing areas, pre-and postoperative patient care areas, and sterile processing facilities.

- Personnel in the semi-restricted area should wear surgical attire and cover both head and facial hair.
- Access to the semi-restricted area should be limited to authorized personnel and patients accompanied by authorized personnel.

c) Restricted area:

- A designated space contained within the semi-restricted area and accessible only through a semi-restricted area.
- The restricted area includes an operating theater and other rooms in which surgical operations or other invasive procedures are performed.
- Personnel in the restricted area should wear surgical attire and cover both head and facial hair.
- Masks should be worn when the wearer is in the presence of open sterile supplies or of persons who are completing or have completed a surgical hand scrub.
- Only authorized personnel and patients accompanied by authorized personnel should be admitted to this area.

Operating Theaters Ventilation:

- Operating theater or procedure rooms are required to be maintained under a positive pressure ventilation system, relative to any adjacent area.
- The pressure gradient must provide an airflow direction from OR to the surrounding areas to prevent infection.
- Terminal filters at the point of entry to the OR should be (high efficacy particulate) HEPA or (ultra-low penetrating air) ULPA filters, with provision for testing filter integrity.
- All HEPA filters replace based on manufacturer instruction.
- A minimum of four exhaust or return air intake grilles should be located in the corners of the OR, approximately 200mm above floor level.
- Temperature ranges from (21 to 24) Celsius, relative humidity ranges from (20-60%), positive pressure value (+2.5) Pascal as a minimum, air change per hour (ACH) at minimum or equal to (20 ACH/hour) as a minimum 20% is fresh air.
- The ventilation system of the OR should be continuously operated 24/7 and never be shut down except for ventilation system maintenance as closing and sudden activation

of the ventilation system in OR cause rapid air turbulence that stirs air particles to be airborne and can cause surgical site infection (SSI) for the first patient.

- Laminar airflow (LAF) is the approved method of ventilation in the OR to prevent surgical site infections (SSIs).
- The use of Ultraviolet (UV) light has an approved antimicrobial effect and can be used inside the ventilation ducts.

Traffic Control:

- Traffic must be controlled to maintain separation of clean from dirty areas, to segregate clean and sterile supplies from contaminated materials, and to ensure that only authorized personnel with appropriate attire enter the operating room.

Traffic zones are established in the OR based on the Principle of the Aseptic Technique.

- **In an unrestricted zone**, personnel in street clothes are permitted and may mingle with those in surgical attire.
 - **The semi-restricted zone**, typically comprises the hallways, offices, and supply rooms adjacent to the operating room, surgical attire is required for entrance into this zone (i.e., scrub suit, hair covering, and clean shoes), Patients entering this area are dressed in hospital attire with hair covered.
 - **In the restricted zone**, the actual operating theaters and scrub areas, surgical attire should be applied for both patients and surgical personnel at all times, and surgical personnel should wear a mask once sterile supplies – instruments have been opened.
- The limitation of personnel traffic in the room decreases the amount of bacterial shedding, keeps air turbulence at a minimum, and reduces the accidental contamination of sterile items.
 - A recent investigation has suggested a trend toward increased SSI rate with increased number of personnel in the operating room.
 - Operating room doors should remain closed all the time, except as needed for the passage of equipment, personnel, and patients.

Proper Surgical Attire:

- Surgical attire that should be worn in the semi-restricted and restricted areas of the surgery department includes the headcover, masks, scrub suit, warm-up jacket, and shoes. The surgical team members are responsible for preventing SSI by properly donning and wearing the appropriate head cover or hood.
- In restricted or semi-restricted procedural areas, wear clean scrub attire that fits well.
- When choosing scrub material, consider both containment of shed skin particles and comfort. Establish and implement a process for laundering scrubs regularly and whenever they become visibly soiled.
- Change out of visibly soiled scrub attire as soon as possible without delaying exigent patient care.
- When in a restricted or semi-restricted procedural area, cover the hair and scalp with headgear made of a disposable or launderable re-useable material.
- When choosing headgear material, consider containment of shed particles, comfort and fit.
- Establish and implement a process for laundering reusable head coverings regularly and whenever they become visibly soiled.
- When in a restricted or semi-restricted procedural area, cover facial hair not contained within a mask, especially when working over or near the surgical field.
- When choosing a facial hair covering material, consider containment of shed particles, comfort, and fit.
- During a procedure in which normally sterile surfaces or mucous membranes are exposed or entered through a needle or cannula, wear a surgical mask that fully covers the mouth and nose.
- Wear the mask when sterile instruments intended for the procedure are exposed.
- The mask must be worn at all times in restricted areas including the sub sterile rooms and scrub sinks.

Note:

The mask will only be effective when properly worn:

- a) The wearing of a surgical mask and safety eyewear to protect the mucous membranes of the eyes, nose, and mouth during procedures in which the possibility of splashes or sprays of blood, body fluids and other secretions could occur.
- b) The mask should be worn to completely cover the nose and mouth.
- c) Masks should fit in a comfortable, but secure manner to prevent venting at the sides. Venting can allow the entry of infectious microbes that could contact the surgical team member's nose and mouth or dispersal of infectious microbes to the sterile field by the surgical team member.
- d) The pliable metal or plastic noseband should be contoured to fit over the bridge of the nose to aid in providing a close fit and prevent the mask from slipping.
- e) Masks should be either on or completely off. They should not be allowed to hang around the neck or folded and placed in a pocket for later use. Used masks harbor multiple microbes that can be transferred to the scrub suit and dispersed into the healthcare facility environment.
- f) When a surgical team member is performing the surgical scrub the mask must be worn; it should be secured in place prior to starting the scrub. When other surgery department personnel who are not performing the scrub are talking with a person who is performing the scrub, the non-scrub person should be wearing a mask.
- g) If wearing a mask with strings, the mask should be handled only by the strings when discarding to prevent contamination of the hands. When removing a mask, it should be immediately discarded into the biohazard waste bag or based on the internal policy of waste management of healthcare facility. The surgical team member should perform a hand hygiene after removing the mask.
- h) It is recommended that a new mask be used for each procedure or at the minimum, changed frequently and if it becomes wet and or/ contaminated by blood and body fluids.

Some practices must be considered in the tailoring of surgical attire protocols:

- a) Ensure the attire worn in each area of the procedure or surgical suite conforms to the recommended attire for that area. For example, the semi-restricted zone requires surgical scrubs and a hat.
- b) Wear facility laundered (not home laundered), clean attire in semi-restricted and restricted areas.

- c) Wear long-sleeved, fully buttoned/snapped closed jackets or long-sleeved scrub shirts in the restricted area. This guidance applies to all personnel in the surgical environment, not only to perioperative healthcare workers.
- d) Ensure all items of personal clothing such as T-shirts are completely covered by scrub attire.
- e) Masks should either be “on” or “off”. Masks should be tied on the top and bottom, with the nose and mouth completely covered. Masks should not be “partially” worn: dangling about the neck or from one ear.
- f) Do not remove hats when leaving the surgical suite. For example, when going to lunch.
- g) Don’t allow contaminated shoes or boots to leave the procedure or operating room.

Surgical Scrub:

- The surgical scrub should be performed by all members of the sterile surgical team, who will be donning a sterile gown and gloves.
- The surgical scrub is not a substitute for handwashing and it is just as important for surgical personnel to wash the hands between patient contacts in the surgical operating department as compared to the nonsurgical departments.
- The surgical scrub, when properly performed, has been shown to remove transient skin flora from the fingernails, hands and forearms; reduce the resident microbial population to an irreducible minimum, and slow the growth of bacteria in order to contribute to reducing the risk of SSI.
- Surgical hand antisepsis should be accomplished using either an antimicrobial soap or an alcohol-based solution with cumulative, persistent antimicrobial activity before donning the sterile gown and gloves.
- **The fingernails should be kept clean, not extend beyond the fingertips and the artificial nails should not be worn.**
 - a) Fingernails that are long and extend beyond the fingertips can puncture the gloves placing the patient at risk of SSI from exposure to the transient and resident skin flora.
 - b) The subungual has been identified as harboring the majority of microorganisms as compared to the skin of the hands and forearms.
 - c) Debris should be removed from the subungual area with the use of a sterile, plastic single-use, disposable nail cleaner that is usually provided with the scrub brush package.

- d) Reusable nail cleaners are not recommended.
 - e) Wood sticks should not be used to clean the fingernails due to the tendency of the wood to splinter and harbor *Pseudomonas* organisms.
 - f) The fingernails should be cleaned under running water at the scrub sink. After use, the disposable nail cleaner should be disposed of according to healthcare facility policy.
 - g) The dirty nail cleaner should not be discarded into the scrub sink in order to prevent cross-contamination.
 - h) Studies have demonstrated that the nails with chipped polish or polish that has been worn for more than four days harbor a greater number of bacteria as compared to unpolished nails.
 - i) Surgical personnel should follow healthcare facility policy related to wearing nail polish.
 - j) Artificial nails and other types of artificial nail coverings, such as silk overlays should not be worn by any member of the surgical team, no matter what team role they are fulfilling.
 - k) Cultures of surgical team members who wear artificial nails demonstrate increased bacterial and fungal counts as compared to personnel who do not wear artificial nails. Additionally, hand carriage of Gram-Negative organisms has been shown to be greater among wearers of artificial nails than among non-wearers.
 - l) Cuticles should be kept clean and intact; the cuticles should not be trimmed or cut.
- The intact skin layer is the first line of defence for preventing the entry of microbes into the body. When the skin is damaged by burns, lesions, abrasions, and cuts, it creates an opening for the invasion of microbes, placing the patient and surgical team members at risk for acquiring an infection.
 - a) Additionally, the sterile team member could transfer pathogens, if bodily fluids in the form of exudate from burns, lesions, abrasions, and cuts, come into contact with the patient.
 - b) The skin of the hands and forearms should be intact with no burns, lesions, abrasions, and cuts present.
 - c) The surgical team member should inspect the hands and forearms prior to performing the surgical scrub to confirm the skin is intact.
 - d) If there is a break in the integrity of the skin, the surgical team member should determine if the extent of the damage to the skin prevents performing the surgical scrub and participating as a member of the sterile team.

- All jewellery including rings, bracelets, and watches should be removed prior to performing the surgical scrub.
 - a) Jewellery is not sterile and can harbor microorganisms.
 - b) Studies have reported a significant increase in the bio-load on the hands of personnel who wear rings after performing a hand wash as compared to personnel who perform a hand wash not wearing rings.
 - c) Studies have also demonstrated that the skin underneath rings is more heavily colonized as compared to areas of the skin on the fingers where rings were not worn.
 - d) Studies show that the bio-load and concentration of microorganisms increase exponentially correlated to the number of rings worn.
 - e) Jewellery is removed in order to allow the surgical scrub solution to make contact with the entire skin and sides (planes) of the fingers, hands, and forearms.
- **Scrub solution dispensing containers should be:**
 - a) Scrub solution dispensing containers should not be open containers and have a lid.
 - b) The use of single-use containers is recommended, and they should be discarded when empty according to healthcare facility policy.
 - c) The container should never be refilled or what is referred to as “topping off.” Refilling or topping off without first decontaminating the container can cause contamination of the scrub solution and container, thus contributing to the risk of cross-contamination.
- The healthcare facility should provide a Ministry of Health (MOH)-approved scrub solutions that have immediate, cumulative and persistent antimicrobial action for use by the surgical personnel.
- Alcohol-based solutions are effective scrubbing agents that provide persistent, cumulative activity and the following recommendations of using this product must be maintained:
 - a) Alcohols have rapid activity when applied to the skin, but alone do not have a persistent, cumulative activity; however, when combined with another scrub solution persistent, cumulative activity results.
 - b) it is recommended that the agent be a combination of alcohol and another scrubbing agent (alcohol-based solution).
 - c) Alcohol-based solutions have a greater antimicrobial activity as compared to other scrub solutions. Studies have shown that alcohol-based solutions immediately lower the microbial count on the skin post scrub more effectively than other scrub solutions.

- d) Alcohol-based solutions that contain 0.5% to 1% chlorhexidine gluconate have been found to have a persistent antimicrobial activity that is equal to, or greater than, that of chlorhexidine gluconate alone.
 - e) The next most effective scrubbing agents are chlorhexidine gluconate, iodophors, and triclosan.
 - f) When using an alcohol-based solution or any other scrubbing product, the healthcare facility procedure for performing the surgical scrub should follow the manufacturer's instructions since the instructions can vary according to the solution that is being used.
- The alcohol-based solution should not be used when the hands and/or forearms are visibly dirty or contaminated with proteinaceous materials since that decreases the antimicrobial action of the alcohol.
 - The hands and forearms should be prewashed with a non-antimicrobial soap unless it is suspected that hands are contaminated with Bacillus Anthracis and in that instance, antimicrobial soap must be used.
 - The hands and forearms should be thoroughly dried before using the alcohol-based solution.
 - The surgical team member must allow the hands and forearms to be thoroughly dry before donning the sterile gown and gloves.
 - **Performing the surgical scrub without a brush or sponge is acceptable as:**
 - a) The practice of using a brush can damage the skin resulting in increased shedding of microorganisms from the hands and arms. Scrubbing with a brush also contributes to an increase in the shedding of skin cells.
 - b) Several studies confirm that the use of a brush or sponge is not necessary as well as demonstrating lower bacterial counts when a brushless surgical scrub is performed, as compared to the use of a brush, in particular when an alcohol-based solution is used that consists of 1% chlorhexidine gluconate and 61% to 70% alcohol.

Hand hygiene (surgical antisepsis) considerations:

- Remove rings, watches, and bracelets before beginning the surgical hand scrub.
- Remove debris from underneath fingernails using a nail cleaner under running water.

- Performing surgical hand antisepsis using either an antimicrobial soap or an alcohol-based hand sanitiser with persistent activity is recommended before donning sterile gloves when performing surgical procedures.
- When performing surgical hand antisepsis using an antimicrobial soap, scrub hands and forearms for the length of time recommended by the manufacturer, usually 2–6 minutes.
- Long scrub times (e.g., 10 minutes) are not necessary.
- When using an alcohol-based surgical hand-scrub product with persistent activity, follow the manufacturer’s instructions.
- Before applying the alcohol solution, prewash hands and forearms with a non-antimicrobial soap and dry hands and forearms completely.
- After application of the alcohol-based product as recommended, allow hands and forearms to dry thoroughly before donning sterile gloves.
- Double gloving is advised during invasive procedures, such as surgery, that pose an increased risk of blood exposure.
- Bacteria on the hands of surgeons can cause wound infections if introduced into the operative field during surgery.
- Rapid multiplication of bacteria occurs under surgical gloves if hands are washed with non-antimicrobial soap.
- Bacterial growth is slowed after preoperative scrubbing with an antiseptic agent.
- Reducing resident skin flora on the hands of the surgical team for the duration of a procedure reduces the risk of bacteria being released into the surgical field if gloves become punctured or torn during surgery.

Surgical asepsis and the principles of sterile technique:

- Surgical asepsis is the absence of all microorganisms within any type of invasive procedure.
- Sterile technique is a set of specific practices and procedures performed to make equipment and areas free from all microorganisms and to maintain that sterility
- Sterile technique is essential to help prevent surgical site infections (SSI), an unintended and oftentimes preventable complication arising from surgery.
- SSI is defined as an “infection that occurs after surgery in the area of surgery”
- **These principles include the following:**
 - a) Sterile (scrubbed) personnel are gowned and gloved.
 - b) Sterile personnel operate within a sterile field (sterile personnel touch only sterile items or areas, unsterile personnel touch only unsterile items or areas).

- c) Sterile drapes are used to create a sterile field.
- d) All items used in a sterile field must be sterile.
- e) All items introduced onto a sterile field should be opened, dispensed, and transferred by methods that maintain sterility and integrity.
- f) A sterile field should be maintained and monitored constantly.
- g) Surgical staff should be trained to recognize when they have broken techniques and should know how to remedy the situation.

Environmental Cleaning in the O.R.:

- The Operating Room should be cleaned safely and effectively, in a consistent way using MOH approved product(s).
- Cleaning the operating theatre and its immediate environment minimizes patients' and health care workers' exposure to potentially infectious microorganisms.
- Cleaning happens at various times:
 - a) Every day, before surgery begins.
 - b) Between patients.
 - c) After the last operation of the day (known as terminal cleaning).
 - d) Deeper cleans are carried out once a week and/or once a month.
- All areas must be cleaned: unrestricted, semi-restricted and restricted areas. Start in the operating theatre before moving to the scrub areas, aesthetic and recovery rooms. The toilet should be cleaned last.
- All surgical lights and horizontal surfaces of the furniture, equipment, walls and floors should be cleaned and disinfected with MOH approved intermediate-level disinfectant and according to manufacturer recommendations.

Dealing with Patient with Suspected or Confirmed Airborne Transmission Diseases:

- Only in an emergency or medically necessary surgery is performed on a patient suspected or proven to have the airborne transmitted disease as the O.R. is positive pressure and this patient should be in a negative pressure room to prevent the risk of airborne infection transmission.
- The surgical procedure should be performed at the end of the schedule or at a time with a minimal number of surgeries and patients in the department.
- If clinically possible, the patient should be intubated in a negative pressure room then transferred to the theatre.

- A minimal number of O.R. staff are allowed to attend the surgery.
- A portable HEPA filter should be used during intubation and extubation and should be off during the surgery.
- A bacterial filter should be used in the breathing circuits of anaesthesia.
- The surgery team must wear approved surgical respirators all the time (Respirators with exhalation valves prohibited to use as they compromise the sterile field).
- If possible, post-operative recovery should be in a negative pressure isolation room or at least a single room with a portable HEPA filter.
- Doors should be closed all the time during surgery.
- Never try to change the ventilation parameters of the theatre.

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