



Prevention and Control of Infections

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

Over the last 10 years several new viral pathogens have appeared in human populations in India. We have also seen the emergence of infectious diseases like COVID-19. It is time to reassess our current practice patterns and commit to a 'NEW STANDARD' for infection prevention and control. A two-tiered approach to precautions is used to interrupt the mode of transmission of infectious agents. Standard precautions to work practices that are applied to all patients receiving care in health facilities and Transmission-based precautions are precautions required to be taken based on the route of transmission of organisms like contact precautions, airborne precautions, etc. If successfully implemented, standard and transmission-based precautions prevent any infection from being transmitted.

Keywords: *Infection control; transmission; prevention.*

1. INTRODUCTION

1.1 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 (masks, 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.

1.2 Hand Washing/Hand Antisepsis

1.2.1 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 properly 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.

1.2.2 Different Methods of hand washing

1. **15-second Rule:** When cleansing hands with soap and water, wet hands with water first and apply the manufacturer's recommended amount of product to hands. Avoid using hot water, as repeated exposure may increase the risk of dermatitis. Rub hands together vigorously, covering all surfaces, for at least 15 seconds. Hygiene programs often suggest singing "Twinkle, Twinkle Little Star," or "Happy Birthday" to measure a full 15 seconds. Rinse hands with water, dry thoroughly with a disposable towel and use a disposable towel to turn off the water faucet. Avoid using hot water, because repeated exposure to hot water may increase the risk of dermatitis [1].
 2. **Alcohol Hand Rubs:** Alcohol-based hand rubs are the most effective agents for reducing the number of bacteria on the hands of healthcare personnel [2]. They are recommended for routine decontamination of hands for all clinical indications, unless the hands are visibly soiled or after exposure to spores. When using the alcohol-based hand rub, apply the manufacturer's recommended amount of hand sanitizer to the palm of one hand and rub the hands together, covering all surfaces of hands and fingers, until hands are dry.
 3. **Fingernail Hygiene:** Artificial nails have been shown to harbour gram negative pathogens on their fingertips in healthcare settings, and have been linked to outbreaks in neonatal intensive care units. The Center for Disease Control strongly recommends that artificial nails and extenders not be worn when having direct contact with patients at high risk. Natural nail tips should be less than one-quarter inch long, and while nail polish does not increase the number of bacteria, chipped nails may support the growth of larger numbers of organisms on fingernails [3].
- 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 washing. 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.

1.3 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.
- 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.

1.3.1 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. ICMR guidelines recommend 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 sensitivity.

1.4 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.

1.4.1 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.

1.5 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.

2. TRANSMISSION BASED PRECAUTIONS

2.1 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.

2.2 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 meter 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 [4].

2.3 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 [5].
- 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.

3. 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 [6].

- 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.
- Items that are in contact with intact skin only should have a monitored routine cleaning schedule if cleaning between patients is not feasible.
- 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.

4. 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.

4.1 Office Design

4.1.1 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.

4.1.2 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 1.
- 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.
- 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.
- Linoleum or wood floors are optimal surfaces to keep clean.
- Carpeting in waiting areas and examination rooms is discouraged.

4.1.3 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.

4.1.4 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.

4.1.5 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.
- 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.
4. Other office equipment should be cleaned regularly and whenever contaminated by patient secretions [7].

5. 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 [8].

5.1 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.

5.2 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: [9].
 - 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.

5.3 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.

5.4 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 [10].
- 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 Local / Government sites.
- 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.
- 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.

6. RESULTS AND DISCUSSION

The risk of infection after surgery depends upon many factors including the type and length of surgical procedure; age, underlying conditions and previous history of the patient; skill of the surgeon; diligence with which infection control procedures are applied and the type and timing of preoperative antibiotics prophylaxis.

We can prevent maximum Nosocomial infections by doing proper sterilization of the equipment, which are used for surgery and dressing. For the prevention of Nosocomial infections preventive measures should be taken, protocol should be developed and follow universal precautions and proper waste disposal.

7. CONCLUSION

Preventing healthcare acquired infections by practicing hygiene is not complicated. It requires getting back to the basics, providing on-going education and developing habits that demonstrate that healthcare workers and their institution are committed to the well-being of their patients.

DISCLAIMER

The products used for this research are commonly and predominantly use products in our

area of research and country. There is absolutely no conflict of interest between the authors and producers of the products because we do not intend to use these products as an avenue for any litigation but for the advancement of knowledge. Also, the research was not funded by the producing company rather it was funded by personal efforts of the authors.

CONSENT

As per international standard or university standard, patients' written consent has been collected and preserved by the author(s).

ETHICAL APPROVAL

As per international standard or university standard written ethical approval has been collected and preserved by the author(s).

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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APPENDIX 1

Date:

Name of the Patient / Visitor:

Contact Number:

1. Do you have any communicable disease: Yes/ No/ Don't know
If yes details:
2. Were you or your family members or any of your close contacts diagnosed with any communicable disease: Yes/ No// Don't know
If yes details:
3. Are you coming from high risk zone: Yes/ No/ Don't know
If yes details:
4. Do you or your family members have any travel history (domestic or international) in the last 30 days? Yes/ No// Don't know
If yes details:
5. Are you allergic to any medicines / materials : Yes/ No// Don't know
If yes details:

Performed by:

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