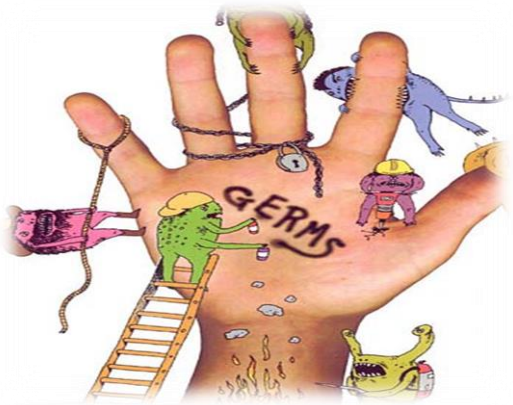
सत्यमेव जयते

NATIONAL INFECTION CONTROL GUIDELINES





Draft version 2017

NATIONAL CENTRE FOR DISEASE CONTROL
Directorate General of Health Services
Ministry of Health & Family Welfare
Government of India

Content

INFECTION PREVENTION AND CONTROL GUIDELINES

1. Guidelines

All health care facilities employees shall adhere to the guidelines as described.

2. Review Cycle

The guidelines shall be reviewed and updated every two years; more often, if warranted.

Chapter 1: INTRODUCTION

1.1 Content

1.1.1. Heath care associated infections (HCAI) can be defined as an infection acquired in hospital by a patient who was admitted for a reason other than that of infection or an infection occurring in a patient in a hospital or other health care facility in whom the infection was not present or incubating at the time of admission. This includes infections acquired in the hospital but appearing after discharge, and also occupational infections among staff of the facility. As a general timeline, infections occurring more than 48 hours after admission are usually considered HCAI. (WHO)

1.1.2. Nosocomial infections occur worldwide and affect both developed and resource-poor countries. Infections acquired in health care settings are among the major causes of death and increased morbidity among hospitalized patients. They are a significant burden both for the patient and for public health.

1.1.3. HCAI is one of the most common complications of health care management. Of every 100 hospitalized patients at any given time, 7 in developed and 10 in developing countries will acquire at least one HCAI (http://www.who.int/gpsc/country_work/gpsc_ccisc_fact_sheet_en.pdf). The endemic burden of HAI is also significantly higher in low- and middle-income than in high-income countries, in particular in-patients admitted to intensive care units and in neonates.

1.1.4. Effective infection prevention and control is central to providing high quality health care for patients and a safe working environment for those that work in healthcare settings. For this reason, urgent need of policies to be formed to monitor, prevent & control the HCAI.

1.1.5. Understanding the modes of transmission of infectious organisms and knowing how and when to apply the basic principles of infection prevention and control are critical to the success of an infection control program. This responsibility applies to all the HCWs and other staff working in the hospital as well as other visitors coming to healthcare facility, Comprehensive infection prevention and control practices are required to be effectively prevent, identify, monitor, and control the spread of infections in all health care facilities.

The following policies/guidelines for effective infection control should be in place in all health care settings.

1. Guidelines for prevention & control of infections
2. Antimicrobial use guidelines
3. HCAI Surveillance guidelines
4. Disinfection
5. Guidelines for patient Isolation
6. Investigation of an outbreak of infection

1.1.6. The overall aim of this document is to provide evidence based information and its implementation in the prevention and control of Hospital Acquired Infection.

1.2 Purpose

The primary objective of infection prevention and control is to prevent the spread of infection in health care facilities and settings; thereby assisting health care workers in the provision of quality health care.

Chapter 2: EPIDEMIOLOGY OF HEALTHCARE ASSOCIATED INFECTIONS

It is important to understand the dynamics of disease transmission in hospitals and health care facilities to control the spread of infections. The spread of infection requires three elements: source of infecting organisms, a susceptible host, and a means of transmission for the micro-organism.

Several classes of microorganisms-including bacteria, viruses, fungi and parasites can be involved in either colonization or infection, depending on the susceptibility of the host.

- With colonization, there is a sustained presence of replicating infectious agents on or in the body, without the production of an immune response or disease.
- With infection, invasion of infectious agents into the body results in an immune response, with or without symptomatic disease.

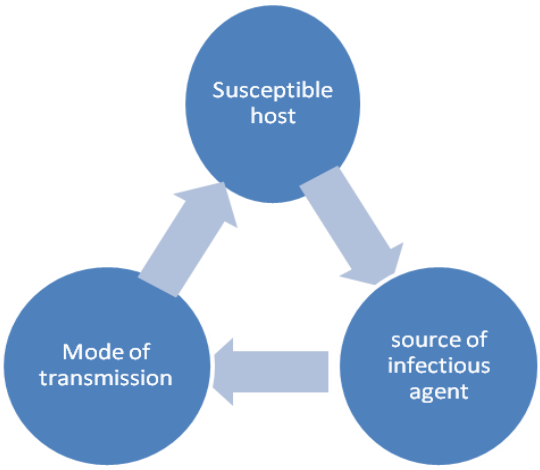
2.1 Most Common HAI sites:

- **Urinary tract infections**: Hospital associated urinary tract infections account for about 35-45% of the nosocomial infections. [Foxman B. Epidemiology of urinary tract infections: incidence, morbidity and economic costs. Am J Med 2002; 113:5s-13s] [Kamat US, Fereirra A, Motghare DD, Kulkarni MS. Epidemiology of hospital acquired urinary tract infections in a medical college hospital in Goa. Indian J Urology 2009; 25(1):76-80.]; 80% of infections are associated with the use of an indwelling urinary catheter. [Emmerson AM et al. The second national prevalence survey of infection in hospitals — overview of the results. J Hosp Infect, 1996, 32:175–190.] [Stamm WE. Catheter-associated urinary tract infections, epidemiology, pathogenesis and prevention. Am J Med 1991; 91(3):S65-S71.]
- **Surgical site infections**: Surgical site infections are also frequent: the incidence varies from 0.5 to 15% depending on the type of operation and underlying patient status. The main risk factor is the extent of contamination during the procedure (clean, clean contaminated, contaminated, dirty), which is to a large part dependent on the site of surgery, length of the operation, and the patient's general condition.
- **Hospital associated pneumonia:** The most important are patients on ventilators in intensive care units, where the rate of pneumonia is 3% per day. There is a high case fatality rate associated with ventilator-associated pneumonia, although the attributable risk is difficult to determine because co-morbidities are high**.**
- **Hospital associated blood stream infection:** Though less frequent than the other types of HAIs, hospital associated blood stream infections result in high case fatality rates- more than 50% for some microorganisms. Infection may occur at the skin entry site of the intravascular device, or in the subcutaneous path of the catheter (tunnel infection).It is considerably dependent on how lines are handled and duration of lines. Even peripheral lines are a potential source of line related infections.
- **Other potential sites of infection:** Skin & Soft tissue, Brain and meninges, gastrointestinal infections, Eye & ear infections (sinusitis, conjunctivitis), Endometrial and other infections of the reproductive organs following childbirth.

2.2. Epidemiological Triad of HAI within a healthcare setting:

- A source or reservoir of infectious agents
  - A mode of transmission
  - A susceptible host.

Fig: 1 Chain of Infection



2.3 Routes of transmission

2.3.1 Contact transmission:

Contact is the most common mode of transmission, and usually involves transmission by touch or via contact with blood or body fluids or secretions. Contact may be direct or indirect.

• Direct transmission occurs when infectious agents are transferred from one person to another — for example, a patient's blood entering a healthcare worker's body through an unprotected cut in the skin.

• Indirect transmission involves the transfer of an infectious agent through a contaminated intermediate object or person—for example, a healthcare worker's hands transmitting infectious agents after touching an infected body site on one patient and not performing hand hygiene before touching another patient, or a healthcare worker coming into contact with fomites. (E.g. bedding) or faeces and then with a patient.

Examples of infectious agents transmitted by contact include multi drug resistant organisms (MDROs) such as MRSA and Carbapenem resistant Gram negative bacteria, Clostridium difficile, norovirus, Ebola virus, HIV, Hepatitis B and C viruses, CCHF and highly contagious skin infections/infestations (e.g. impetigo, scabies) etc.

2.3.2 Droplet transmission:

Droplet transmission can occur when an infected person coughs, sneezes ortalks, and during certain procedures. Droplets are infectious particles larger than 5 microns in size. Droplet distribution is limited by the force of expulsion and gravity and is usually at least 1 metre. However, droplets can also be transmitted indirectly to mucosal surfaces (e.g. via hands).Examples of infectious agents that are transmitted via droplets include influenza virus and meningococcus.

2.3.3 Airborne transmission:

Airborne dissemination may occur via particles containing infectious agents that remain suspended in air over time and distance. Small-particle aerosols (less than 5 microns) are created during breathing, talking, coughing or sneezing and secondarily by evaporation of larger droplets in conditions of low humidity. Certain procedures, particularly those that induce coughing, can promote airborne transmission. These include diagnostic sputum induction, bronchoscopy, airway suctioning, and endotracheal intubation, positive pressure ventilation via face mask and high-frequency oscillatory ventilation. Aerosols containing infectious agents can be dispersed over long distances by air currents.

(E.g. ventilation or air conditioning systems) and inhaled by susceptible individuals who have not had any contact with the infectious person.

Examples of infectious agents that are transmitted via the airborne route include measles (rubeola) virus, chickenpox (varicella) virus and *Mycobacterium tuberculosis*.

2.3.4. Vector-borne Transmission:

Vector-borne transmission refers to transmission by vectors and is prevented by appropriate health care facility construction and maintenance, closed or screened windows, and proper housekeeping. Vector-borne transmission occurs when vectors such as mosquitoes, flies, rats and other vectors transmit micro-organisms.

Chapter 3: INFECTION CONTROL PROGRAMME

Globally over 1.4 million people at any one point of time suffer from infectious complications acquired from health facilities as estimated by the WHO. Patient and health care personnel safety is one of the primary responsibilities of health care set ups. Comprehensive infection prevention and control practices should be adhered to in each health care facility and setting and a well-organized Infection control Programme is required in every health care set up to assist the health care workers in the provision of quality health care. The system should improve quality and outcomes, reducing costs and morbidity and mortality at the same time.

3.1 Rationale & Objectives/Aims

Infection prevention and control and quality standards of health care are essential for the well-being and safety of patients, families, health care workers, and community.

The Infection control Programme has the following objectives:

- To minimize the risk of infection to patients, health care workers and visitors.
- To formulate local guidelines and standard operating procedures (SOPs)for prevention and control of infection.
- To educate and train health care workers.
- To recommend antimicrobial policy for the hospital and formulate antimicrobial stewardship programme.
- To ensure implementation and monitoring of the programme.
- To Conduct outbreak investigations, Environmental Surveillance activities (Air / Water Samples)
- To Ensure compliance to Biomedical Waste disposal

3.2 Organization

3.2.1 An effective Infection Prevention and Control Program would have the following components:

1. Infection Control Committee with defined composition, roles and responsibilities.
2. Infection Control Manual with policies, guidelines, recommendations and working protocols including activities and practices under the programme with hand hygiene and Standard Precautions as key components.
3. Annual Plan for each healthcare setup with prioritization based on risk matrix for that unit and review.
4. Should incorporate Antimicrobial Management programs or Antimicrobial Stewardship programs.
5. Make available supplies and equipment to the health care facility staff to maintain effective infection prevention and control practices.
6. Ongoing educational programmes for all HCWs in the use of such policies and guidelines.
7. Monitoring process for HCWs health to identify and prevent staff-to-patient and patient-to-staff spread of infection
8. Controlling environmental risks for infection.

9. Surveillance of infections, identifying and controlling outbreaks.

3.2.2. Infection Prevention and Control Committee (IPCC)

This committee should have key personnel who are in decision-making positions from the various health care facility departments: Administration, Central Supply and Sterilization, Clinical Laboratory, Dental, Dietary, Epidemiology, Equipment Technicians, Housekeeping, Laundry, Medicine, Microbiology, Mortuary, Nursing, Operating Theatre, Public Health (Public Health Nurses and Environmental Health Officers), Pharmacy, Quality Assurance, Transport Services, X-ray, and other departments. Community representation should be included. Chairperson of the committee to be Head of the institute .However if it is not possible due to certain circumstances then the microbiologists/or head of laboratories/epidemiologist/ physician or other may be a chairperson. He/she should have training and experience in infection prevention and control.

Infection Control Committee

The Committee is an integral component of the patient safety programme of the health care facility, and is responsible for establishing and maintaining infection prevention and control, its monitoring, surveillance, reporting, research and education. This committee should include wide representation from all relevant disciplines or departments in the facility. The committee has one elected chairperson who is the hospital administrator or a person who has direct access to the head of the hospital. The infection control officer is the member secretary of the committee.

The Committee is responsible for establishing and maintaining infection prevention and control, its monitoring, surveillance, reporting, research and education.

Structure

I. **Chairperson**: Head of the Institute (preferably)
II. **Infection Control officer** (Medical Micr**obiologist/ID physician/physician)**
III. **Members**: Rep**resentation from Management/Administ**ration (Dean/Director of Hospital; Nursing Services; Medical Services; Operations)
IV. Relevant **Medical** Faculties
V. **Support Services**: (OT/CSSD, House-keeping/Sanitation, Engineering, Pharmacologist, Store Officer / Materials Department)
VI. **Infection Control Nurse (s)**

Responsibilities of the Hospital Infection Prevention and Control Committee

1. Formulating Hospital *Infection Prevention and Control Policy*. It should be reviewed and updated once a year.
2. Analysis of the surveillance data for health care associated infections (including identifying common sources and routes of entry of infections) on a monthly basis and identifying at-risk patients and taking appropriate actions and implementing recommendations where necessary.
3. Reviewing the levels of HAI and their trends regularly and compare the rates of infections with other health set ups wherever feasible.
4. Verifying the effectiveness of the recommendations implemented for infection prevention and control.

5. Assessing on an ongoing basis whether recommended precautions are being adhered to, i.e., hand washing, decontamination, disinfection and sterilization through audits and quality control activities of infection prevention and control.
6. Planning and conducting ongoing training programmes in order to ensure that all members of staff are sensitized to measures to prevent the transmission of infections.
7. Investigating the spread of infection outbreaks in collaboration with medical, nursing and other staff.

Infection Control Meetings

Periodic meetings at least once in a monthof Infection Control Committee shall take place and MOM documented with clear action points and responsibility to implement on the medical/nursing/operational personnel. A review of last minutes and implementation shall be a part of the next meeting.

Infection Control Officer

Infection control officer is usually a medical microbiologist or a medical epidemiologist or any other physician. Infection control officer may be themember secretary of HICC and is responsible for day-to-day activities of infection prevention and control.

Responsibilities of Infection Control Officer-

- Prepare guidelines for infection control practices.
- Initiates hospital infection surveillance activities and analyzes the surveillance data.
- Provide trends of HAI to the different patient care units.
- Analyze and report data regarding organisms isolated and their resistance pattern (antibiograms).
- Monitor rational use of antimicrobials.
- Investigate the outbreak, if any and advise about control measures.
- Organize regular educational and training activities for HCWs.
- OrganizeIPCCmeeting regularly.

3.3. Infection control responsibility of different stakeholders

- **Role of Hospital Administration**

  The administration and/or medical management of the hospital must provide leadership by supporting the hospital infection programme and has important role in formulating infection prevention and control activities. For this, the head of the hospital should establish a hospital infection control committee (HICC).HICC should appoint Infection control Team (ICT) for carrying out the day to day activities as formulated by the HICC.

Responsibilities of the Hospital administrator-

- Establish a multidisciplinary Infection Control Committee.
- Identify appropriate resources for the programme to monitor infections and apply the most appropriate methods for preventing infection.
- Ensure availability of appropriate infrastructure, financial and human resources.
- Periodically review the status of nosocomial infections and effectiveness of interventions to contain them.
- Approve and review policies and guidelines for infection control practices formulated by the Infection Control Committee.
- Promote educational and training activities for all categories of staff.
- Establish antibiotic stewardship Program.
- Establish Health care workers safety Programme – immunization & PEP.
- Ensure implementation of nosocomial infection surveillance system.
- Ensure availability of safe food and drinking water.

- **Role of the physician**

Physicians have unique responsibilities for the prevention and control of hospital infections:

- By providing direct patient care using practices which minimize infection
- By following appropriate practice of hygiene (e.g. hand washing, isolation)
- Serving on the Infection Control Committee
- Supporting the infection control team.
- Specifically, physicians are responsible for:
- Protecting their own patients from other infected patients and from hospital staff who may be infected
- Complying with the practices approved by the Infection Control Committee
- Obtaining appropriate microbiological specimens when an infection is present or suspected
- Notifying cases of hospital-acquired infection to the team, as well as the admission of infected patients
- Complying with the recommendations of the Antimicrobial Use Committee regarding the use of antibiotics & complying to the antibiotic policy.
- Advising patients, visitors and staff on techniques to prevent the transmission of infection.
- Instituting appropriate treatment for any infections they themselves have, and taking steps to prevent such infections being transmitted to other individuals, especially patients.

- **Role of the microbiologist**

The microbiologist is responsible for:

- Handling patient and staff specimens to maximize the likelihood of a microbiological diagnosis.
- Developing guidelines for appropriate collection, transport, and handling of specimens.
- Developing guidelines for appropriate collection, transport and handling of specimens.
- Ensuring safe laboratory practices to prevent infections among laboratory staff.
- Rapidly diagnose infections, identify pathogens and perform antimicrobial susceptibility testing of isolated pathogens following standard methods.
- Timely communication of results to the Infection Control Committee.

- Analyse and report antimicrobial resistance pattern of relevant pathogens in different units and in different specimens.
- Analyse and report hospital infection rates and trends over a period of time.
- Monitoring sterilization, disinfection and the environment where necessary.
- Conducts epidemiological typing to trace sources and reservoirs of infection during outbreaks and whenever necessary.

➢ **Role of the hospital pharmacist**

Pharmacist should be an active member of the hospital antibiotic stewardship program.

The hospital pharmacist is responsible for:

- Obtaining, storing and distributing pharmaceutical preparations using practices which limit potential transmission of infectious agents to patients.
- Dispensing anti-infectious drugs and maintaining relevant records (potency, incompatibility, conditions of storage and deterioration).
- Obtaining and storing vaccines or sera, and making them available as appropriate.
- Maintaining records of antibiotics distributed to the medical departments.
- Providing the Antimicrobial Use Committee and Infection Control Committee with summary reports and trends of antimicrobial use.
- Having available the following information on disinfectants, antiseptics and other anti-infectious agents:
  - Active properties in relation to concentration, temperature, length of action, antibiotic spectrum;
  - Toxic properties including sensitization or irritation of the skin and mucosa;
  - Substances that are incompatible with antibiotics or reduce their potency, physical conditions which unfavorably affect potency during storage (temperature, light humidity).
  - Harmful effects on materials.

- The hospital pharmacist may also participate in the hospital sterilization and disinfection practices through:
  - Participation in development of guidelines for antiseptics, disinfectants, and products used for washing and disinfecting the hands.
  - Participation in guideline development for reuse of equipment and patient materials.
  - Participation in quality control of techniques used to sterilize equipment in the hospital including selection of sterilization equipment (type of appliances) and monitoring.

➢ **Infection Control Nurse (ICN)**

A full time senior nursing staff should be appointed as ICN and to support her adequate full time or part time nursing. The duties of the ICN are primarily associated with ensuring the practice of infection control measures by healthcare workers. Thus the ICN is the link between the HICC and the wards/ICUs etc. in identifying problems and implementing solutions.

Responsibilities of infection Control Nurse

- The ICN conducts Infection control rounds daily and tracks all positive culture cases and maintains the surveillance data.

- The ICN is involved in education and training of HCWs under the supervision of infection control officer.
- Ensures compliance to hospital's BMW policy.
- Maintains data of Sharps/Needle stick injuries and Post–exposure prophylaxis.

Initiates and ensure proper immunization for Hepatitis B Virus (Immunoglobulin use if needed after exposure, and HBsAg vaccine), annual influenza immunization for the staff especially in high risk areas and typhoid vaccination of kitchen workers.

- In consultation with microbiologist/physician (Member HICC) in case of suspected exposure of any hospital worker.

- **Role of the nursing staff**

Implementation of patient care practices for infection control is the role of the nursing staff. Nurses should be familiar with practices to prevent the occurrence and spread of infection, and maintain appropriate practices for all patients throughout the duration of their hospital stay.

The senior nursing administrator is responsible for:

- Participating in the meetings of Infection Control Committee.
- Promoting the development and improvement of nursing techniques, and ongoing review of aseptic nursing policies, with approval by the Infection Control Committee.
- Developing training programmes for members of the nursing staff.
- Supervising the implementation of techniques for the prevention of infections in specialized areas such as the operating suite, the intensive care unit, the maternity unit and newborns.
- Monitoring of nursing adherence to policies.
- Documentation, reliable reporting and maintenance of records of cases suspected to be suffering from HAI, as per records from ward cases notes, laboratory reports and information collected in routine visits and discussions with staff.
- Empowering nurse-in charge for implementation, monitoring and adherence to IPC practices.

The nurse in charge of a ward is responsible for:

- Maintaining hygiene, consistent with hospital policies and good nursing practice on the ward.
- Monitoring aseptic techniques, including hand washing and use of isolation.
- Reporting promptly to the attending physician any evidence of infection in patients under the nurse's care.
- Initiating patient isolation and ordering culture specimens from any patient showing signs of a communicable disease, when the physician is not immediately available.
- Limiting patient exposure to infections from visitors, hospital staff, other patients, or equipment used for diagnosis or treatment.
- Maintaining a safe and adequate supply of ward equipment, drugs and patient care supplies.
- Identifying nosocomial infections.
- Participating in training of personnel.
- Participating in outbreak investigation.

- **Infection Control Team**

The Infection control team should comprise of at minimum an infection control officer, a microbiologist (if ICO is not a microbiologist), and infection control nurse. ICT takes daily measures for the prevention and control of infection in hospital.

Responsibilities of the Infection Control Team

- Develop a manual of policies and procedures for aseptic, isolation and antiseptic techniques.
- Carry out targeted surveillance of HAIs, data analysis for presentation in HICC meeting and take corrective steps.
- Advise staff on all aspects of infection control and maintain a safe environment for patients and staff.
- Supervise and monitor cleanliness and hygienic practices.
- Oversee sterilization and disinfection and monitor the use and quality control of disinfectants.
- Advise management of at risk patients and supervision of isolation procedures.
- Investigate outbreaks of infection and take corrective measures for control and prevention of outbreak.
- Waste management.
- Provide relevant information on infection problems to management.
- Assist in training of all new employees as to the importance of infection control and the relevant policies and procedures.
- Organize regular training programmmes for the staff to ensure implementation of infection control practices.
- Audit infection control procedures and antimicrobial usage.
- Monitors Health care workers safety Programme.

- **Role of the central sterilization service**

A central sterilization department serves all hospital areas, including the operating suite. An appropriately qualified individual must be responsible for management of the programme. Responsibility for day-to-day management may be delegated to a nurse or other individual with appropriate qualifications, experience, and knowledge of medical devices. The responsibilities of the *central sterilization service* are to clean, decontaminate, test, prepare for use, sterilize, and store aseptically all sterile hospital equipment. It works in collaboration with the Infection Control Committee and other hospital programmes to develop and monitor policies on cleaning and decontamination of:

- Reusable equipment
- Contaminated equipment including:
  - Wrapping procedures, according to the type of sterilization
  - Sterilization methods, according to the type of equipment
  - Sterilization conditions (e.g. temperature, duration, pressure, humidity)

The in-charge of CSST must:

- Oversee the use of different methods like physical, chemical, and bacteriological so as to monitor the sterilization process.

- Ensure technical maintenance of the equipment according to national standards and manufacturers' recommendations.
- Report any defect to administration, maintenance, infection control and other appropriate personnel.
- Maintain complete records of each autoclave run, and ensure long-term availability of records.
- Collect or have collected, at regular intervals, all outdated sterile units.
- Communicate, as needed, with the Infection Control Committee, the nursing service, the operating suite, the hospital transport service, pharmacy service, maintenance, and other appropriate services.

➢ **Role of the laundry service**

The laundry is responsible for:

- Selecting fabrics for use in different hospital areas, developing policies for working clothes in each area and group of staff, and maintaining appropriate supplies.
- Distribution of working clothes and, if necessary, managing changing rooms.
- Developing policies for the collection and transport of dirty linen.
- Defining, where necessary, the method for disinfecting infected linen, either before it is taken to the laundry or in the laundry itself.
- Developing policies for the protection of clean linen from contamination during transport from the laundry to the area of use.
- Developing criteria for selection of site of laundry services:
  - Ensuring appropriate flow of linen, separation of "clean" and "dirty" areas.
  - Recommending washing conditions (e.g. temperature, duration).
  - Ensuring safety of laundry staff through prevention of exposure to sharps or laundry contaminated with potential pathogens.

➢ **Role of the housekeeping service**

The housekeeping service is responsible for the regular and routine cleaning of all surfaces and maintaining a high level of hygiene in the facility in collaboration with the Infection Control Committee. It is responsible for:

- Classifying the different hospital areas by varying need for cleaning.
- Developing policies for appropriate cleaning techniques.
- Procedure, frequency, agents used, etc., for each type of room, from highly contaminated to the most clean and ensuring that these practices are followed.
- Developing policies for collection, transport and disposal of different types of waste (e.g. containers, frequency).
- Ensuring that liquid soap and paper towel dispensers are replenished regularly.
- Informing the maintenance service of any building problems requiring repair: cracks, defects in the sanitary or electrical equipment, etc.
- Caring for flowers and plants in public areas.
- Pest control (insects, rodents).
- Providing appropriate training for all new staff members and, periodically, for other employees, and specific training when a new technique is introduced.
- Establishing methods for the cleaning and disinfection of bedding (e.g. mattresses, pillows).
- Determining the frequency for the washing of curtains, screening curtains between beds, etc.
- Reviewing plans for renovations or new furniture, including special patient beds, to determine feasibility of cleaning.

- There should be a continuing programme for staff training. Programme should stress personal hygiene, the importance of frequent and careful washing of hands, and cleaning methods (e.g. sequence of rooms, correct use of equipment, dilution of cleaning agents, etc.).
- Staff must also understand causes of contamination of premises, and how to control this.
- If cleaning staff is having illness of respiratory tract or digestive tract or skin infection including wounds & cuts they must report the same to health staff.

➢ **Role of maintenance**

Maintenance is responsible for:

- Collaborating with housekeeping, nursing staff or other appropriate groups in selecting equipment and ensuring early identification and prompt correction of any defect.
- Inspections and regular maintenance of the plumbing, heating, and refrigeration equipment, and electrical fittings and air conditioning; records should be kept of this activity.
- Developing procedures for emergency repairs in essential departments.
- Ensuring environmental safety outside the hospital, e.g. waste disposal, water sources.
- Additional special duties includes:
  - Participation in the choice of equipment if maintenance of the equipment requires technical assistance.
  - Inspection, cleaning and regular replacement of the filters of all appliances for ventilation and humidifiers. Testing autoclaves (temperature, pressure, vacuum, recording mechanism) and regular maintenance (cleaning the inner chamber, emptying the tubes).
  - Monitoring the recording thermometers of refrigerators in pharmacy stores, laboratories, the blood bank and kitchens.
  - Regularly inspecting all surfaces of walls, floors, ceilings so as to ensure they are kept smooth and washable & monitor repairing of any opening or crack in partition walls or window frames.
  - Maintaining hydrotherapy appliances & notify to infection control in charge of any anticipated interruption of services such as plumbing or air conditioning.

➢ **Infection control manual**

The infection prevention manual should be developed and updated by the infection control team, with review and approval by the committee. It must be made readily available for patient care staff, and regularly updated. An **Infection Control Manual** shall have all written protocols, policies, guidelines and recommendations as outlined above.

3.4 Antimicrobial Management Program

Antimicrobial Management Program shall form another main focus of the Infection Prevention and Control Program. This shall include all components of antimicrobial stewardship so as to stress upon advocacy of safe use of antimicrobials which shall be strengthened with periodic review of antimicrobial guidelines and implementation locally in each of the health care setups.

3.5 Educational programs and strategies

Appropriate educational material should be made available to all. This would be augmented by periodic CME/ CNE or educational interactive programs and awareness drives. Local Health care setup should provide antimicrobial susceptibility patterns, appropriate usage of antimicrobials and have updates on antimicrobials communicated to all relevant personnel in patient care, locally and periodically. Specific infectious diseases and their prevention and control awareness should be made available as and when required to relevant staff locally and may be extended to community if so desired by the health departments of that district/city/area.

3.6 Notification

All relevant information as required by law on communicable diseases would be notified as appropriate to relevant authority (ies). In case of specific reports from public health agencies requiring action on their recommendations, appropriate action should be taken.

3.7 Recommendations and Guidelines

The Infection Control Program and its constituent committee in a healthcare setup should cover all areas of the health care setup and deliberate upon the following aspects of infection control in particular, providing policies, **recommendations, guidelines, protocols** for:

1. **Disinfection and sterilization processes**

2. **Safe Infection Control Practices including**
   - Provision of hand hygiene and practices and protocols related to it.
   - Environmental cleaning and decontamination and fogging.
   - Endoscopes and bronchoscopes- usage and care.
   - Indwelling medical device usage and care.
   - Clean and safe preparation and dispensing of medication.
   - Safe transportation of patients.
   - Management of spills of body fluids and blood and Microbiology cultures.
   - Management of needle-stick injury, accidental inoculation and percutaneous mucus membrane exposure to blood and body fluid substances.
   - Linen and Laundry.
   - Dialysis practices.
   - All relevant engineering processes including mechanical, HVAC of OT, ICU and other critical areas and patient and staff areas etc.
   - Construction, demolition including emergency works and renovation of areas within the organization.
   - Food and Beverages processes and hygienic kitchen management including food procurement, segregation, storage, preparation and handling and distribution.
   - Care of patients with communicable diseases and care of bleeding patients, Protection of immuno-suppressed and immuno-compromised patients, Isolation protocols and procedures, Barrier and Reverse Barrier Nursing.

- Waste management and procedures on discarding and disposal of hospital waste including sharps and needles and waste management in Patient care areas, Laboratory Services, Transfusion Medicine, Radio diagnosis, Nuclear Medicine and Radiotherapy and Physiotherapy units.
- Emerging community based communicable diseases and specific recommendation cases of epidemics and disasters in the community.
- Provision and appropriate usage of personal protective equipment including gloves, gowns, masks, goggles/visors etc. in prevention and control of infections.
- Restricted antimicrobials and antimicrobial prophylaxis guidelines including surgical prophylaxis.
- Mortuary and handling of cadavers.
- Visitors', attendants' and vendors' protocols.

3. Infection Control activities for patient care including

- Monitoring of patients for development of hospital associated infection and health care associated infections and surveillance activity including Device Associated/Related Infections and Surgical Site Infections.
- Monitoring of Disinfectants.
- Sterile Supply and CSSD including Bacteriological monitoring of Autoclaves, Ethylene Oxide, Gas Plasma, cold sterilants, other sterilization/disinfection processes etc.
- Investigation of suspected outbreaks of infection.
- Needle stick and exposure inoculation injury monitoring .
- Screening of food handlers.
- Care of Emergency Transport processes including Ambulances.
- Bacteriological analysis of drinking water in a health care setup.
- Bacteriological analysis of dialysis water.
- Bacteriological monitoring of laminar hoods / Biosafety Cabinets wherever in use.
- Antimicrobial Susceptibility Monitoring.
- Antimicrobial usage monitoring with emphasis on certain restricted antimicrobials.

Risk Assessment

A risk-based approach should be used in establishing the focus of the infection prevention program. Procedures and processes associated with risk of infection to patient and staff should be based upon assessing the risk in the organization.

Annual Plan

Based on the Risk Assessment Matrix, an annual plan of action should be charted out at the end of current year and ratified by the Infection Control Committee. Targets to be achieved on the lines of aims and objectives of the program and strategies to be implemented to achieve these would be emphasized upon.

Chapter 4: PREVENTION OF HEALTHCARE-ASSOCIATED INFECTIONS

Introduction

The four most common nosocomial infections are catheter-associated urinary tract infections (CAUTI), surgical wound infections, ventilator associated pneumonia, and catheter-related bloodstream infection. Specific policies and practices to minimize these infections must be established, reviewed and updated regularly, and compliance should be monitored.

Definition of Healthcare associated infections (HCAIs): These infections earlier called **'nosocomial infections' (NI)** or simply **'hospital infections'** are infections occurring during a stay in hospital that were neither present nor incubating at the time of hospital admission. Mostly, nosocomial infections only appear in patients hospitalized for 48 hours or longer.

These include:

Catheter associated urinary tract infection (**CAUTI):** occurs after the urinary catheter is introduced in the patient. Indwelling urinary catheters are the most commonly used invasive device in hospitalized patients.

Ventilator associated pneumonia **(VAP):** VAP occurs in patients who are intubated and are put on ventilator. This manifests as pneumonia with patch of consolidation in lungs.

Hospital acquired pneumonia **(HAP):** This is acquired by the patient in the hospital but is neither intubated and nor is on ventilator. This manifests as pneumonia with patch of consolidation in lungs.

Ventilator associated tracheobronchitis **(VAT):** VAT occurs in patients who are intubated and/or are put on ventilator. This manifests as tracheobronchitis. There is no consolidation in lungs.

Central line associated blood stream infections **(CLABSI)**: Also known as CRBSI: catheter related blood stream infections. This infection occurs in patients who have various kinds of lines inserted in their veins/arteries (Cannulation and venepuncture, lines like central line, peripheral line, HICC line, permacath in dialysis cases, etc).

Surgical site infection **(SSI):** This infection occurs at the site of surgical incision and may manifest as pain, redness and pus discharge from local site with fever.

Clostridium difficile infections (**CDI):** (necrotizing enterocolitis) in patients on broad spectrum antibiotics mostly in critical care and acute care hospitals.

The organisms that cause HCAIs include:

MRSA: Methicillin resistant *Staphylococcus aureus*.

MDROs: Multi drug (multiple antibiotics) resistant bacteria mostly Gram negative bacteria like Klebsiella, *Esch. coli*, Acinetobacter, Pseudomonas, Chrysobacterium, Stenotrophomonas, etc.

ESBLs: Extended spectrum β lactamases (Gram negative bacteria).

NDMs: New Delhi Metallo enzymes (Gram negative bacteria).

XDRs: Extremely drug resistant microorganisms (Eg. XDR Mycobacterium tuberculosis and XDR Gram negative bacteria).

4.1 Measures for Prevention of Infections of device associated nosocomial infections

In order to minimize infections in a healthcare set-up, certain preventive measures should be carried out in the form of **'Bundles'**.

A bundle is a structured way of improving processes of care and patient outcomes.

A care bundle is a set of evidence based practices that, when applied together collectively, reliably and continuously, have been proven to improve clinical outcomes than when implemented individually.

Compliance with the care bundle should be regularly audited and feedback should be provided to unit staff.

4.1.1 Catheter-associated urinary tract infections

Urinary tract infections (UTIs) are the most common type of nosocomial infections encountered in healthcare facilities accounting for 30-40% of nosocomial infections. 80% of nosocomial UTI are associated with an indwelling urinary catheter. Daily incidence of bacteriuria in catheterized patients is about 3-10% and among patients with bacteriuria, up to 25% have symptomatic UTI and 3-8% develops bacteraemia.
Urinary catheters cause urinary tract infections and are a common cause of blood stream infections. The risk of infectious complications increases the longer they are in use. Therefore urinary catheter care needs to be optimized to prevent catheter associated urinary tract infections.

Measures for preventing urinary tract infection when inserting and maintaining a Urinary Catheter

1. Perform Hand-hygiene before insertion of catheter, before each manipulation of catheter and accessing the catheter drainage system and between each patient contact.
2. Insert catheter only for appropriate medical indication. Avoid catheters for use in incontinence, for obtaining urine for culture or other diagnostic tests, or for prolonged postoperative duration without appropriate indications.
   Alternatives to indwelling catheterization are:
   - Suprapubic catheter may be used in patients requiring long term catheterization for bladder obstruction or urinary retention.
   - Condom catheters are associated with reduced risk of infection and may be used for incontinent men.
3. The need for catherization should be daily assessed. Remove urinary catheters as soon as it is no longer required.
4. Smallest bore urinary catheter should be used for catheterisation.
   Strict aseptic technique need to be practiced for insertion of indwelling urinary catheter. Perform hand hygiene immediately before and after insertion or any manipulation of the catheter device or site. Sterile gloves should be worn after hand washing. Insert the catheter, taking care that the tip of the catheter should not touch any area outside the urethra
   Properly secure catheters after insertion to prevent movement and urethral traction.
5. Maintain a sterile, continuous closed drainage system
6. Maintain unobstructed urine flow
7. Maintain drainage bag below level of bladder at all times to prevent backflow of urine.
8. Do not allow the bag touch the floor.

Empty the collecting regularly taking precaution to prevent contact of the drainage spigot with the non-sterile collecting container.

9. Hands should be washed before and after handling the catheter.
   Educate staff in correct techniques of catheter insertion and maintenance of catheter. Allow only trained healthcare providers to insert catheter.

Collection of Urine Specimen Aseptically

- If small volumes of fresh urine are needed for culture examination, the distal end of the catheter, or preferably the sampling port if present, should be cleansed with a
  with alcohol swab, and urine then aspirated with a sterile syringe and needle .
- Larger volumes of urine for special analyses, not culture examination, should be obtained aseptically from the drainage bag.

Strategies NOT recommended for CAUTI prevention:

- Routine bladder irrigation, antibacterial/antiseptic instillation in urinary drainage bag and vigorous periurethral cleaning with antiseptic agent has not been proven to be effective in preventing CAUTI.
- Routine screening for asymptomatic bacteriuria is not recommended. Routine treatment of asymptomatic bacteriuria may have little clinical benefit and may select out multidrugresistant organisms.
- Do not change indwelling catheters or urinary drainage bags at arbitrary fixed intervals
- Routine systemic antimicrobial prophylaxis to prevent CAUTI in catheterized patients

Surveillance for CAUTI may be carried out and regular feedback may be provided of unit specific CAUTI rates tothe concerned staff.

Fig 1. Sample of Care Bundle for Urinary Catheter care (Source: JIPMER, Puducherry)

Patient Name:……

Hospital No……Ward……

Insertion Bundle for Urinary Catheter Care

Date of Insertion:……

1. Sterile items /equipment used: ☐ Yes ☐ No
2. Catheter inserted using strict aseptic Non-touch technique: ☐ Yes ☐ No
3. Closed drainage system: ☐ Yes ☐ No
4. Catheter of appropriate size: ☐ Yes ☐ No

Signature of the observer

Maintenance Bundle for Urinary Catheter Care

Day	Daily Catheter Care by Aseptic technique (Vaginal care/ Meatal care) + Perineal care			Closed Drainage system (Yes/No)	Drainage bag above floor & below bladder lever (Yes/No)	Catheter Needed (Yes/No)	Signature
	6 am	12 noon	6 pm				
1							
2							
3							
4							
5							
6							
7							
8							
9							
10							
11							
12							
13							
14							
15							
16							
17							
18							

- Sterile gauze/cotton to be used for each care.
- Wash with soap solution/Betadine & dry with wet gauze.
- Single use gloves should be discarded after emptying drainage bag.

1.1.2. Ventilator-associated pneumonia in the intensive care unit:

The term ventilator-associated pneumonia (VAP) refers to pneumonia that arises more than 48–72 h after endotracheal intubation with no clinical evidence suggesting the presence or likely development of pneumonia at the time of intubation. Ventilator-associated pneumonia (VAP) prolongs the length of stay in ICU by three-folds and is associated with high morbidity and mortality. VAP has a cumulative incidence of 10-25% and accounts for approximately 25% of all ICU infections.

Measures for Prevention of VAP:

1. Elevation of the head end of the bed to 30 - 45 degree unless contraindicated rather than supine to prevent aspiration..
2. Minimize the duration of ventilation by Daily interruption of sedation.
3. Daily assessment of readiness to extubate.
4. Prophylaxis for deep vein thrombosis and peptic ulcer disease (Though these componenets used to be a part of the bundle till recently, the 2014 SHEA guidelines have removed PUD and DVT prophylaxis from the bundle)
5. Daily Oro-pharyngeal cleaning and decontamination with an antiseptic solution
6. Adherence to Hand hygiene with soap and water or alcohol based hand rub during intubation
7. Avoid nasogastric intubation and prefer orotracheal intubation. Nasogastric intubation is associated with increased risk of sinusitis and VAP.
8. Avoid intubation and re-intubation, if possible, as it increases the risk of VAP 6–21-fold.
9. Continuous sterile suctioning of subglottic respiratory secretions, whenever feasible.
10. Use aseptic techniques while handling respiratory equipments. Maintain hand hygiene before and after suctioning and use disposable sterile gloves for suctioning. Change gloves between patients and decontaminate hands after removal.
11. **Interventions for Prevention of contamination of equipment**: Appropriate disinfection and in-use care of ventilator tubing, respirators, and humidifiers to limit contamination.Use sterile suction catheter for suctioning every time.
    - Sterile water should be used to rinse reusable non invasive respiratory The ventilator circuit should be changed only if soiled or damaged
    - Condensate accumulating within the ventilator circuit may be contaminated and should be drained and disposed of carefully and prevent it from entering either the endotracheal tube or inline medication nebulizers. The circuit should be managed so that condensate does not drain towards the patient. Wash hands after the procedure.
    - Nebulizers should be filled with sterile water only and should be single patient use only if possible. Otherwise use sterilization or high level disinfection for changing nebulizers in between patients.
    - Aseptic technique must be used when filling the humidifier. Maintain Oxygen flow meter humidifiers and Ventilator humidifier chambers using sterile water which must be changed every 24 hours or sooner, keeping dry when not in use and sterilize humidifiers in between patients.
12. **Education of staff** about hand hygiene compliance and other measures for preventing VAP, to look for any change in the nature of secretions especially purulent or muco-purulent and inform early and cross transmission of MDRO to other patients **,**
13. **Surveillance of VAP** should be carried out in all critical care units caring for mechanically ventilated patients. VAP rates for each unit should be expressed as the number of VAP per 1000 ventilator days. VAP rates should be fed back to the ICU staff and healthcare facility management on a regular basis.

Fig 2. Sample of a Care Bundle for Ventilator (Source: JIPMER, Puducherry)

Patient Name:.....

Hospital No..... ICU .....

Date of Insertion:.....

Maintenance Bundle for Ventilator Care

Day	Adherence to hand hygiene	Assessment of Readiness to Extubate (Done or not)	PUD prophylaxis Needed or not	DVT prophylaxis Given or not	Daily oral care with Chlorhexidine			Suspected VAP	Signature	
					6 am	12 noon	6 pm		Doctor	Nurse
1										
2										
3										
4										
5										
6										
7										
8										
9										
10										
11										
12										
13										
14										
15										
16										
17										
18										
19										
20										
21										
22										
23										

- Hand hygiene before accessing devices
- Use sterile single use antiseptic solution

4.1.3 Intravasular Catheter associated Blood stream Infections

Vascular catheters can cause catheter related blood stream infections by enabling microorganisms to gain direct access to the blood stream. Therefore vascular catheter care needs to be optimized to prevent Catheter related blood stream infections.

Measures for preventing infection when inserting and maintaining a vascular Catheter :

1. Practice high level of **aseptic technique for insertion** of **the** catheter

- Hand hygiene should be practiced before and after inserting, replacing, accessing or dressing an intravascular catheter (IVC) using plain soap and water or alcohol based hand rubs
- Use maximal sterile barrier precautions (i.e., mask, headwear, sterile gown, sterile gloves, and sterile full body drape) while inserting central lines.
- Use 2% chlorhexidine-based preparation preferably for skin antisepsis before catheter insertion, after palpation of catheter site, and during dressing changes thereafter. The antiseptic should be allowed to dry. Tincture of iodine, an iodophor, or 70 % alcohol can be used if 2% chlorhexidine-based preparation is not available.

2. **Selection of the catheter type, insertion technique and insertion site** should be based on its association with lowest risk of complications for the anticipated type and duration of intravenous therapy.

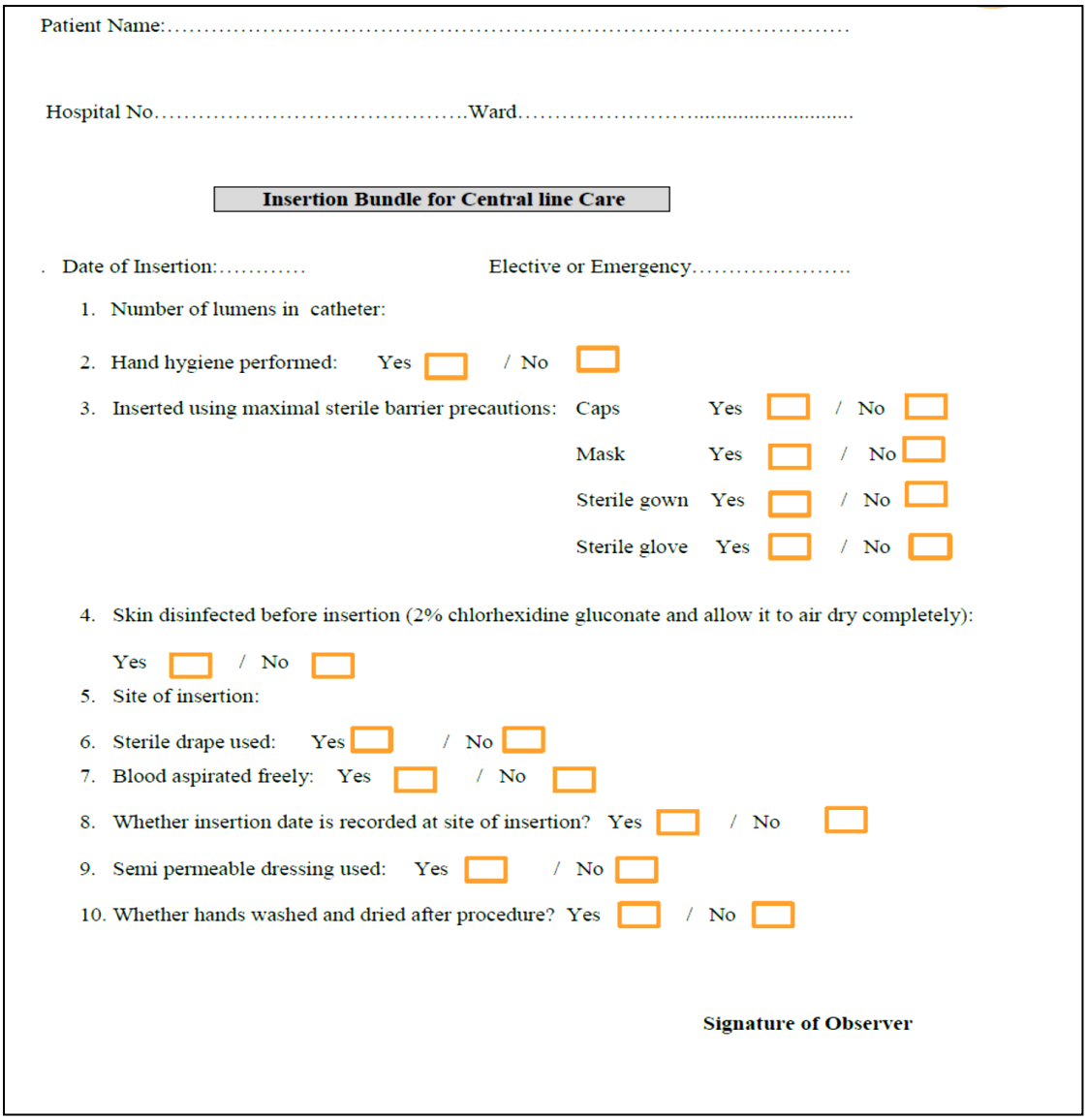
- In adults, an upper-extremity Subclavian site for catheter insertion rather than the lower extremity should be selected. Avoid jugular or femoral site in adults for non-tunnelled CVC insertion.
- In pediatric patients, the upper or lower extremities can be used for catheter insertion.
- In case of haemodialysis or pheresis, jugular or femoral vein should be selected to insert catheter.
- Central venous catheter (CVC), peripherally inserted central catheter (PICC), haemodialysis catheter should not be routine replaced to reduce the incidence of infection unless there are any signs of CRBSI, vascular insufficiency, thrombosis.
- Use a CVC with the minimum number of ports or lumens essential for the management of the patient.

3. Cover the site with sterile, transparent, semi-permeable **dressings** to allow observation of CVC insertion site.
4. **Review need for CVC removal** on daily basis and promptly remove unnecessary central lines.
5. **Vascular catheter care**: Practice strict aseptic precautions while manipulating/repositioning of devices, accessing catheter.

- Adhere strictly to hand hygiene.
- Perform dressing changes under aseptic technique using clean or sterile gloves.
- Inspect catheter site on regular basis for signs of CVC infection and replace dressings that are wet, soiled, or dislodged. If patients have tenderness at the insertion site, fever without obvious source, or other manifestations suggesting local infection or BSI, the dressing should be removed to allow thorough examination of the site.
- Scrub the access port or hub immediately prior to each use with an appropriate antiseptic (e.g., chlorhexidine, povidone iodine, an iodophor, or 70% alcohol).
- Infusates should be prepared using sterile, aseptic techniques and infusate immediately or refrigerate at 4◦C. Use single-dose vials for parenteral additives or medications when possible. Refrigerate multi-dose vials after opening and discard the vials if sterility is compromised.

6. There is no need to replace peripheral catheters more frequently than every 72-96 hours to reduce risk of infection and phlebitis in adults. Replacement need not be done if there is no evidence of phlebitis. Replace peripheral catheters in children only when clinically indicated.
7. Do not routinely replace central venous or routinely change catheters using guide wires to prevent infection. Do not routinely replace venous catheters in patients who are bacteremic or fungemic if the source of infection is unlikely to be the catheter.
8. Do not routinely use antibiotic lock solutions to prevent CRBSI, as emergence of resistant microorganisms can occur.
9. Appropriate nursing staff levels in ICUs may be ensured to minimize the incidence of CRBSIs.
10. **Education and training** of health care workers on central line insertion, handling and maintenance to reduce CLABSI rates.
11. **Surveillance of CLABSI** should be carried out in all critical care units caring for patients with central line. CLABSI rates for each unit should be expressed as the number of CLABSI per 1000 catheter days. CLABSI rates should be fed back to the ICU staff and healthcare facility management on a regular basis.

Fig 3. Sample of Care Bundle for Central Line (Source: JIPMER, Puducherry)



Patient Name:……

Hospital No……Ward……

Insertion Bundle for Central line Care

. Date of Insertion:…… Elective or Emergency……..

1. Number of lumens in catheter:
2. Hand hygiene performed: Yes ☐ / No ☐
3. Inserted using maximal sterile barrier precautions: Caps Yes ☐ / No ☐
   Mask Yes ☐ / No ☐
   Sterile gown Yes ☐ / No ☐
   Sterile glove Yes ☐ / No ☐
4. Skin disinfected before insertion (2% chlorhexidine gluconate and allow it to air dry completely):
   Yes ☐ / No ☐
5. Site of insertion:
6. Sterile drape used: Yes ☐ / No ☐
7. Blood aspirated freely: Yes ☐ / No ☐
8. Whether insertion date is recorded at site of insertion? Yes ☐ / No ☐
9. Semi permeable dressing used: Yes ☐ / No ☐
10. Whether hands washed and dried after procedure? Yes ☐ / No ☐

Signature of Observer

4.1.4 Surgical site infections

1. Preoperative hospital stay should be as short as possible to prevent exposure of the patient to multi-resistant organisms in hospital environment.
2. Adequate pre-operative preparation of the patient- identify and treat all infections prior to elective surgery, adequate control of serum blood glucose levels in all diabetic patients and avoid hyperglycemia peri-operatively, adequate control of blood pressure should be ensured.
3. Preoperative shower with chlorhexidine-based soaps or gels to reduce bacterial count on patient's skin.
4. Perioperative antibiotic prophylaxis should be given at appropriate dose, timings and duration. Drug should be safe, inexpensive, bactericidal and effective against the most probable intra-operative microbes.
5. Initial dose of antibiotics should be administered within 30 minutes prior to the primary incision. A repeat dose may be given in prolonged surgeries.
6. Surgical hand scrub using chlorhexidine or alcohol with proper procedure.

7. As per the WHO global guidelines for the prevention of SSI, alcohol based antiseptic solution, based on CHG should be used for surgical site skin preparation. Antiseptic solutions should be applied from the centre to the periphery of the incision site.
8. Sterile drape should be placed on patient and on any equipment placed in sterile field.
9. Maximal sterile barriers such as sterile gloves (double gloves for procedures with high risk of puncture such as total joint arthroplasty; for operations on patients with HIV, Hepatitis B or C infection), gowns, masks, face shields, surgical caps, footwear should be used. Gloves should be immediately changed after accidental puncture.
10. All personnel entering in the operating suite must remove any jewellery; nail polish or artificial nails must not be worn.
11. Operative room discipline - restricted entry in OR should be ensured and limit unnecessary trafficking in and out of theatre; identify and treat Methicillin Resistant *Staphylococcus aureus* carriers; restrict staff with skin or upper respiratory infection from working in OR.
12. Regular training of all OT staff on safe practices, maintaining sterility of instruments until use.
13. Conventional Operative room ventilation with filtered air using filters with an efficiency of 80-95% to remove airborne particles ≥5µm in conventional ventilated OT. Regular monitoring of the efficiency of ventilation system should be carried out. Air change rates should be satisfactory (20 air changes per hour in clean areas such as OR and preparation room).
14. Ensuring proper cleaning of instrument before sterilizing them.
15. Regular training and monitoring of staff on OT discipline, hand hygiene, use of PPE, strict monitoring of proper sterilization of instruments, cleanliness of OT, sharps management, BMW management.

Table 1. Differential nosocomial infection risk by patient and interventions

Risk of infection	**Type of patients**	**Type of procedures**
Minimal	Not immuno compromised Non-invasive procedure, Minimal underlying disease	No exposure to biological fluids *
Medium	Infected patients, or patients with some Exposure to biological fluids Some risk factors (age, neoplasm	Exposure to biological fluids or Invasive non-surgical procedure (e.g. peripheral venous catheter, introduction of urinary catheter)
High	Severely immune compromised patients, Surgery (<500 WBC per ml); multiple trauma, or severe burns, organ transplant	Surgery or High-risk invasive procedures (e.g. central venous catheter, endotracheal intubation)
***** Body fluids means blood, urine, CSF& fluid from Body cavities.		

4.2 Infection control in dialysis units

- The hospital infection control measures apply to the dialysis unit, but the nature of work possesses special cross infection hazards to both patients and staff. Patients undergoing haemodialysis for chronic renal failure are at risk of intravascular device-related infections associated with haemodialysis catheters.
- The staff working in the Haemodialysis Unit are at increased risk of exposure to blood borne viral infections.
- Contact transmission plays a significant role in transmission of microbial pathogens in the haemodialysis units. Microorganisms, including blood borne viruses, can be transmitted through the contaminated hands of healthcare workers, who do not comply with infection control precautions.
- Less commonly, contaminated environmental surfaces (e.g., bed rails,) can serve as an intermediate reservoir for pathogenic organisms. Hand washing or use of a waterless hand rub, use of non sterile disposable gloves whenever caring for a patient or touching the patient's equipment, and disinfection of environmental surfaces can prevent contact transmission and need to be washed after gloves are removed and between patient contacts, as well as after touching blood, body fluids, secretions, excretions, and contaminated items.
- Standard Precautions are used on all patients and include use of gloves, disposable plastic aprons or gown; mask whenever needed to prevent contact of the health-care worker with blood, secretions, excretions, or contaminated items.
- The infection hazards of hemodialysis can be summarized as:

  Blood borne viral infection e.g. HBV, HCV and HIV.

  Vascular access site related infection.

  Infections related to contamination of the dialyzer with water associated organisms, e.g. Pseudomonas aeruginosa.

A. Infection Control Precautions for All Patients

i. Wear disposable gloves when caring for the patient or touching the patient's equipment at the dialysis station; remove gloves and wash hands between each patient and station.

ii. Items taken into the dialysis station should be either disposed of, used only for a single patient, or cleaned and disinfected before being taken to a common clean area or used on another patient.

iii. Non-disposable items that cannot be cleaned and disinfected (e.g., adhesive tape, cloth-covered blood pressure cuffs) should be dedicated for use only on a single patient.

iv. Unused medications (including multiple dose vials containing diluents) or supplies (e.g., syringes, alcohol swabs) taken to the patient's station should be used only for that patient and should not be returned to a common clean area or used on other patients.

v. When multiple dose medication vials are used (including vials containing diluents), prepare individual patient doses in a clean (centralized) area away from dialysis stations and deliver separately to each patient. Do not carry multiple dose medication vials from station to station.

vi. Do not use common medication carts to deliver medications to patients. Do not carry medication vials, syringes, alcohol swabs, or supplies in pockets. If trays are used to deliver medications to individual patients, they must be cleaned between patients.

vii. Clean areas should be clearly designated for the preparation, handling, and storage of medications and unused supplies and equipment. Clean areas should be clearly separated from contaminated areas where used supplies and equipments are handled. Do not handle and store medications or clean supplies in the same or adjacent area to where used equipment or blood samples are handled.

viii. Use external venous and arterial pressure transducer filters/protectors for each patient treatment to prevent blood contamination of the dialysis machines' pressure monitors. Change filters/protectors between each patient treatment, and do not reuse them. Internal transducer filters do not need to be changed routinely between patients.

ix. Clean and disinfect the dialysis station (e.g., chairs, beds, tables, machines) between patients.

x. Give special attention to cleaning control panels on the dialysis machines and other surfaces that are frequently touched and potentially contaminated with patients' blood.

xi. Discard all fluid and clean and disinfect all surfaces and containers associated with the prime waste (including buckets attached to the machines).

xii. For dialyzers and blood tubing that will be reprocessed, cap dialyzer ports and clamp tubing. Place all used dialyzers and tubing in leak proof containers for transport from station to reprocessing or disposal area.

Hepatitis B Vaccination

1. Vaccinate all susceptible patients against hepatitis B.
2. Test for anti-HBs 1-2 months after last dose.
   - ***If anti-HBs is <10 mIU/mL, consider patient susceptible, revaccinate with an additional three doses, and retest for anti-HBs.***
   - ***If anti-HBs is>10 mIU/mL, consider patient immune, and retest annually.***
   - ***Give booster dose of vaccine if anti-HBs declines to <10 mIU/mL and continue to retest annually***.

B. Management of HBsAg-Positive Patients

- Follow infection control practices for hemodialysis units for all patients.
- HBsAg-positive patients should undergo dialysis in a separate room using separate machines, equipment, instruments, and supplies.
- Staff members involved in care of HBsAg-positive patients should be involved in care for HBV-susceptible patients at the same time (e.g., during the same shift or during patient changeover).

C. Water Treatment in Hemodialysis

i. During each dialysis treatment, a patient is exposed to up to 120 liters of water. Therefore, contaminants are to be purified and filtered and it must be removed from the water used in the dialysis centre.

ii. The water supplied to the dialysis unit is treated by deionization and reverse osmosis.

iii. The filters used in the water treatment system are changed on a regular schedule using system's manufacturer recommendations.

iv. The internal systems of the dialysis machine are cleaned weekly and/or more often if considered to be contaminated.

v. Water samples are taken on a weekly basis for analysis to the laboratory,.

vi. Result of water analysis from Laboratory is handed over to the Unit Supervisor of Haemodialysis Unit. Once results are reviewed, if abnormal, they should be discussed with the Nephrologist and engineering department.

vii. Beginning of water treatment system (colony count must be less than 200 CFU/ML). Pathogens normally cannot enter the patient through the dialyser's membrane, but their presence at the membrane's surface can trigger a pyrogenic reaction.

viii. End of water treatment system (colony count must be less than 100 CFU/ML).

4.4.1 Endotoxin analysis of water has to be done every month and report should be filed with the technician in-charge and with the Infection Control Nurse.

4.4.2 In case of positive endotoxin report, engineering department will be immediately informed and corrective measures will be applied.

Fig 4. Checklist for Dialysis Station Routine Disinfection

Part A: Before Beginning Routine Disinfection of the Dialysis Station

Disconnect and takedown used blood tubing and dialyzer from the dialysis machine	
Discard tubing and dialyzers in a leak-proof container.	
Check that there is no visible soil or blood on surfaces.	
Ensure that the priming bucket has been emptied.	
Ensure that the patient has left the dialysis station.	
Discard all single-use supplies. Move any reusable supplies to an area where they will be cleaned and disinfected before being stored or returned to a dialysis station	
Remove gloves and perform hand hygiene.	

.

Part B: Routine Disinfection of the Dialysis Station – AFTER Patient leaves

Wear clean gloves.	
Apply disinfectant to all the surfaces in the dialysis station using the wiping motion (with friction)	
Ensure surfaces are visibly wet with disinfectant. Allow surfaces to air-dry.	
Disinfect all surfaces of the emptied priming bucket. Allow the bucket to air-dry before reconnection or reuse	
Keep used or potentially contaminated items away from the disinfected surfaces.	
Remove gloves and perform hand hygiene.	

Table 2. Schedule for Routine Testing for Hepatitis B Virus (HBV) and Hepatitis C Virus (HCV) Infections

Patient Status	On Admission	Monthly	Semi annual	Annual
All patients	HBsAg, Anti-HBc (total), Anti-HBs, Anti-HCV, ALT			
HBV-susceptible, including Non responders to vaccine		HBsAg		
Anti-HBs positive (> 10 mIU/mL), anti-HBc negative				Anti-HBs
Anti-HBs and anti-HBc positive		No additional HBV testing needed		
Anti-HCV negative		ALT	Anti HCV	

Injection Safety

Injection safety is an important component of basic infection control. The concept of "standard precautions", with mandatory safe practices, must be routinely applied in all health-care settings, and every person in such settings should be considered a potential source of infection.

PRACTICAL GUIDANCE ON USE OF INJECTION DEVICES

One needle, One syringe, One patient, Only one time

- Use a new device for each procedure, including for the reconstitution of a unit of medication or vaccine;
- Inspect the packaging of the device to ensure that the protective barrier has not been breached;
- Discard the device if the package has been punctured, torn or damaged by exposure to moisture, or if the expiry date has passed.

PRACTICAL GUIDANCE ON GIVING MEDICATIONS

When giving medication:

1. **DO NOT use a single loaded syringe to administer medication to several patients (i.e. ensure one needle, one syringe, one patient!);**
2. **DO NOT change the needle in order to reuse the syringe;**
3. **DO NOT use the same mixing syringe to reconstitute several vials;**
4. **DO NOT combine left over medications for later use.**

Single-dose vials– Whenever possible, use a single-dose vial for each patient, to reduce cross-contamination between patients.

Multi-dose vials

i. Use multi dose vials only if there is no alternative.
ii. Open only one vial of a particular medication at a time in each patient-care area.
iii. If possible, keep one multi dose vial for each patient, and store it with the patient's name on the vial in a separate treatment or medication room.
iv. DO NOT store multi dose vials in the open ward, where they could be inadvertently contaminated with spray or spatter
v. Discard a multi dose vial:

- if sterility or content is compromised;

- if the expiry date or time has passed (even if the vial contains antimicrobial preservatives);

- if it has not been properly stored after opening;

- within 24 hours of opening, or after the time recommended by the manufacturer, if the vial does not contain antimicrobial preservatives;

-if found to be undated, improperly stored, inadvertently -contaminated or perceived to be contaminated, regardless of expiration date.

vi. Pop-open ampoules- Whenever possible, use pop-open ampoules rather than ampoules that require use of a metal file to open.

Preparing injections

Injections should be prepared in a designated clean area where contamination by blood and body fluids is unlikely.

Practical guidance on preparing injections

Three steps must be followed when preparing injections.

- ✓ Before starting the injection session, and whenever there is contamination with blood or body fluids, clean the preparation surfaces with 70% alcohol (isopropyl alcohol or ethanol) and allow to dry.
- ✓ Assemble all equipment needed for the injection: – sterile single-use needles and syringes; – reconstitution solution such as sterile water or specific diluent; – alcohol swab or cotton wool; –sharps container.

Procedure for septum vials

Wipe the access diaphragm (septum) with 70% alcohol on a swab before piercing the vial, and allow to air dry before inserting a device into the bottle.

• Use a sterile syringe and needle for each insertion into a multi-dose vial.

• ***Never leave a needle in a multi dose vial.***

Labeling

After reconstitution of a multi dose vial, label the final medication container with:

- date and time of preparation;
- type and volume of diluent (if applicable);
- final concentration;
- expiry date and time after reconstitution;
- name and signature of the person reconstituting the drug.

For multi-dose medications that DO NOT require reconstitution, add a label with:

- Date and time of first piercing the vial;
- Name and signature of the person first piercing the vial.

Administering injections

An aseptic technique should be followed for all injections.

<u>Practical guidance on administering injections</u>

A General

When administering an injection:

- perform hand hygiene;
- wipe the top of the vial with 60–70% alcohol (isopropyl alcohol or ethanol) using a swab or cotton-wool ball;
- open the package in front of the patient to reassure them that the syringe and needle have not been used previously;
- Using a sterile syringe and needle, withdraw the medication from the ampoule or vial.

B Reconstitution

- If reconstitution using a sterile syringe and needle is necessary, withdraw the reconstitution solution from the ampoule or vial, insert the needle into the rubber septum in the single or multi-dose vial and inject the necessary amount of reconstitution fluid.
- Mix the contents of the vial thoroughly until all visible particles have dissolved.
- After reconstituting the contents of a multi-dose vial, remove the needle and syringe and discard them immediately as a single unit into a sharps container.

C Needleless system

- wipe the rubber septum of the multi dose vial with an alcohol swab;
- insert the spike into the multi dose vial;
- wipe the port of the needleless system with an alcohol swab;

- remove a sterile syringe from its packaging;
- insert the nozzle of the syringe into the port;
- withdraw the reconstituted drug.

D Delay in administration

1. If the dose cannot be administered immediately for any reason, cover the needle with the cap using a one-hand scoop technique.
2. Store the device safely in a dry kidney dish or similar container.

E Important points

- ✓ **DO NOT** allow the needle to touch any contaminated surface.
- ✓ **DO NOT** reuse a syringe, even if the needle is changed.
- ✓ **DO NOT** touch the diaphragm after disinfection with the 60–70% alcohol (isopropyl alcohol or ethanol).
- ✓ **DO NOT** enter several multi-dose vials with the same needle and syringe.
- ✓ **DO NOT** re-enter a vial with a needle or syringe used on a patient if that vial will be used to withdraw medication again (whether it is for the same patient or for another patient).
- ✓ **DO NOT** use bags or bottles of intravenous solution as a common source of supply for multiple patients (except in pharmacies using laminar flow cabinets).

Chapter 5: STANDARD AND TRANSMISSION-BASED PRECAUTIONS

Standard precautions refer to those work practices that are applied to all patients receiving care in hospitals, irrespective, regardless of their diagnosis or presumed infectious statuses so as to minimize the risk of transmission of infectious agents from person to person, even in high-risk situations.

Standard precautions are used by healthcare workers to prevent or reduce the likelihood of transmission of infectious agents from health care worker to patient, patient to health care worker, and from patient to patient.

Successful infection prevention and control involves implementing work practices that prevent the transmission of infectious agents through two-tiered approaches described below:

•**STANDARD PRECAUTIONS**: Basic infection prevention and control strategies applied routinely for care of all patients in hospital to minimize risk to both patients and healthcare workers.

•**TRANSMISSION-BASED PRECAUTIONS;** formerly referred to as additional precautions: Effectively managing infectious agents where standard precautions may not be sufficient on their own—these specific interventions for patients known or suspected to be infected or colonized with epidemiologically important pathogens that can be transmitted by airborne, droplet or contact with dry skin or contaminated surfaces, should be applied to control infection by interrupting the mode of transmission.

If successfully implemented, standard and transmission-based precautions prevent any type of infectious agent from being transmitted.

5.1 STANDARD PRECAUTIONS

Standard Precautions

Use of standard precautions is the primary strategy for minimizing the the risk of transmission of micro-organisms from both recognized and unrecognized sources of infection in health care facilities.

Cardinal rules of Standard precautions:

a. Standard precautions are to be followed in all patient care situations.
b. Standard precautions are to be used for contact with blood, all body fluids, secretions and excretions regardless of whether **contaminated grossly with blood or not**; non-intact skin; and mucous membrane.

Components of standard precautions include:

- Personal hygiene practices, particularly **hand hygiene**, aim to reduce the risk of contact transmission of infectious agents.
- The use of **personal protective equipment**,
- Appropriate **handling and disposal of sharps** assists in preventing transmission of blood-borne diseases to healthcare workers.

- **Spills management.**
- Appropriate handling and reprocessing of reusable **equipment** and instruments, including appropriate use of disinfectants, aims to prevent patient-to-patient transmission of infectious agents.
- Practicing **respiratory hygiene and cough etiquette** reduces risk of transmission of infection.
- **Appropriate handling of waste and linen.**

- **Environment** cleaning

Procedure for standard precautions for infection control:

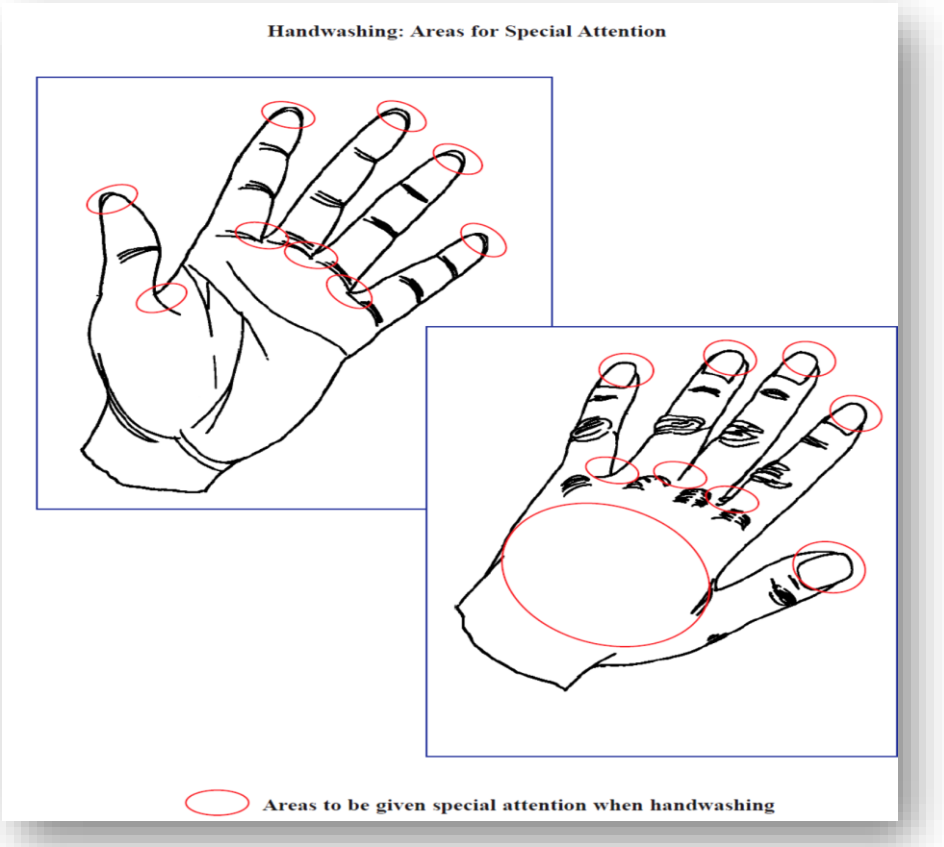
5.1.1. Hand Washing

Hand is the single most important measure in infection control. There has been enough evidence that the hands of the healthcare workers are the most common vehicle for the transmission of healthcare associated pathogens from patient to patient and within the healthcare environment. Studies show a direct correlation of increase adherence to hand hygiene and decrease in HAIs. Hands can become contaminated with infectious agents through contact with a patient, patient surroundings, the environment, or other health care workers. The purpose of hand hygiene is to remove soil, organic material and transient micro-organisms from the skin and reduce the risk of cross-contamination. Hand washing should be done:

- Before and after patient contact
- After using gloves
- Immediately after contact with blood, body fluids, secretions, excretions, non-intact skin, or mucous membranes
    - Before putting on gloves for performing clinical procedures (e.g. insertion of IUD).
    - Before putting on gloves for performing invasive procedures.
    - Between certain procedures on the same patient where soiling of hands is likely, to avoid cross-contamination of body sites.
    - After contact with items known or considered likely to be contaminated with blood, body fluids, secretions, or excretions (e.g. bedpans, urinals, wound dressings) whether or not gloves are worn.
    - Before and after gloves are removed.
    - Before medication preparation.
    - Before preparing, handling, serving or eating food, and before feeding a patient.
    - After diapering or toileting children.
    - When hands are visibly soiled.
    - After personal body functions – such as using the toilet, wiping or blowing one's nose.
    - Before leaving work.

- **How to perform hand hygiene:**
- Wash your hands with soap and water when hands are visibly dirty or visibly soiled with blood or other body fluids or after using the toilet. Or clean your hands by rubbing them with an alcohol-based formulation, as the preferred mean for routine hygienic hand antisepsis if hands are not visibly soiled.
- **Hand washing (40–60 sec):** wet hands and apply soap; rub all surfaces; rinse hands and dry thoroughly with a single use towel or tissue paper
- **Hand rubbing (20–30 sec):** apply enough product to cover all areas of the hands; rub all surfaces until dry.

Fig 1: Important sites which needs special attention while doing hand hygiene**:**



Types of hand hygiene:

a. Hand washing before general procedures called Routine **Hand Washing**.
b. Hand scrubbing before a surgical procedure called**Surgical hand scrub**

.**Wash hands with soap and water when**

- When there is visibly heavy contamination e.g. with proteinaceous material, blood or body fluids
- After using toilet
- Before and after having food

<u>Steps on how to wash hands when visibly soiled</u>(otherwise, use hand rub. Duration of the entire procedure is 40-60 seconds):

0. Wet hands with water

1. Apply enough soap to cover all hand surfaces

2. Rub hands palm to palm

3. Right palm over left dorsum with interlaced fingers and vice versa

4. Palm to palm with fingers interlaced

5. Backs of fingers to opposing palms with fingers interlocked

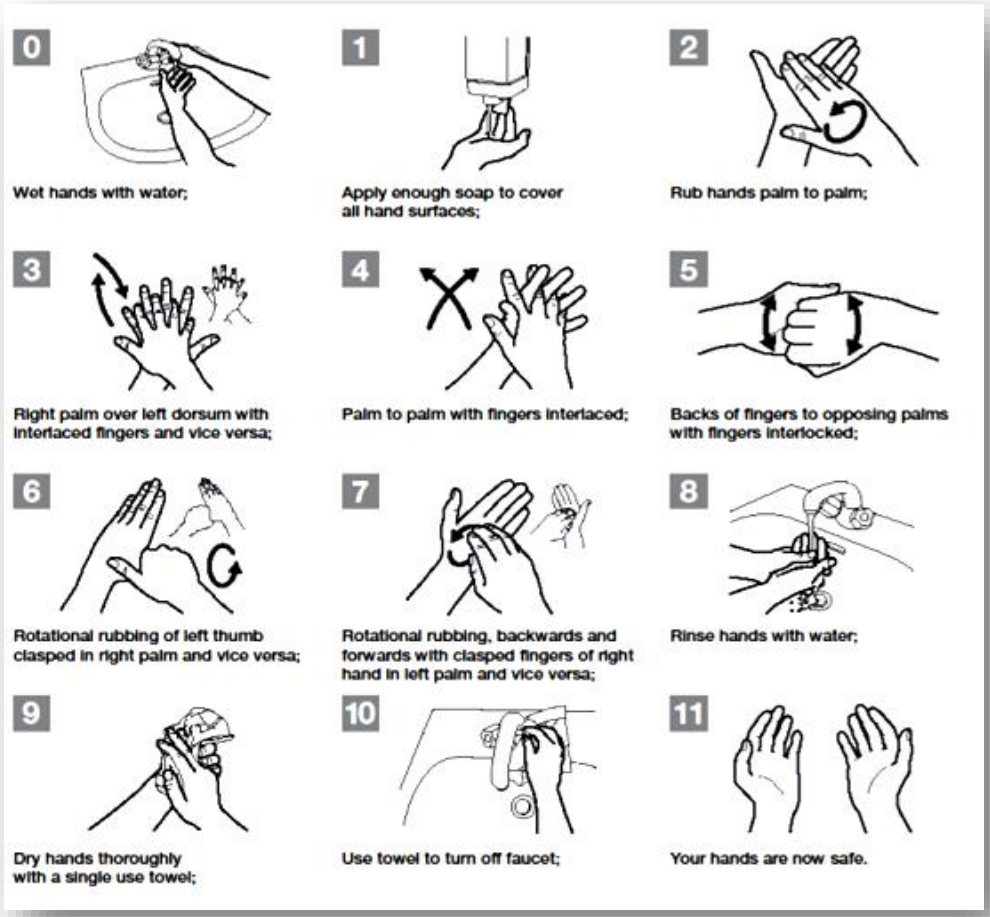
6. Rotational rubbing of left thumb clasped in right palm and vice versa

7. Rotational rubbing, backwards and forwards with clasped fingers of right hand in left palm and vice versa

8. Rinse hands under running water

Do not touch taps with clean hands – if elbow or foot controls are not available, use paper towel to turn off taps.Pat dry hands thoroughly using paper towel

Figure 2: Method of washing hands with soap and water



Alcohol based hand rub:

Use alcohol based hand rubs, when hands are not visibly soiled.

- It can be used when hand washing with soap and running water is not possible, as long as hands are not visibly soiled with dirt, blood, or other organic material.
- Before performing invasive procedures, (e.g. the placement and care of intravascular devices, indwelling urinary catheters).
- Before and after direct contact with patients.

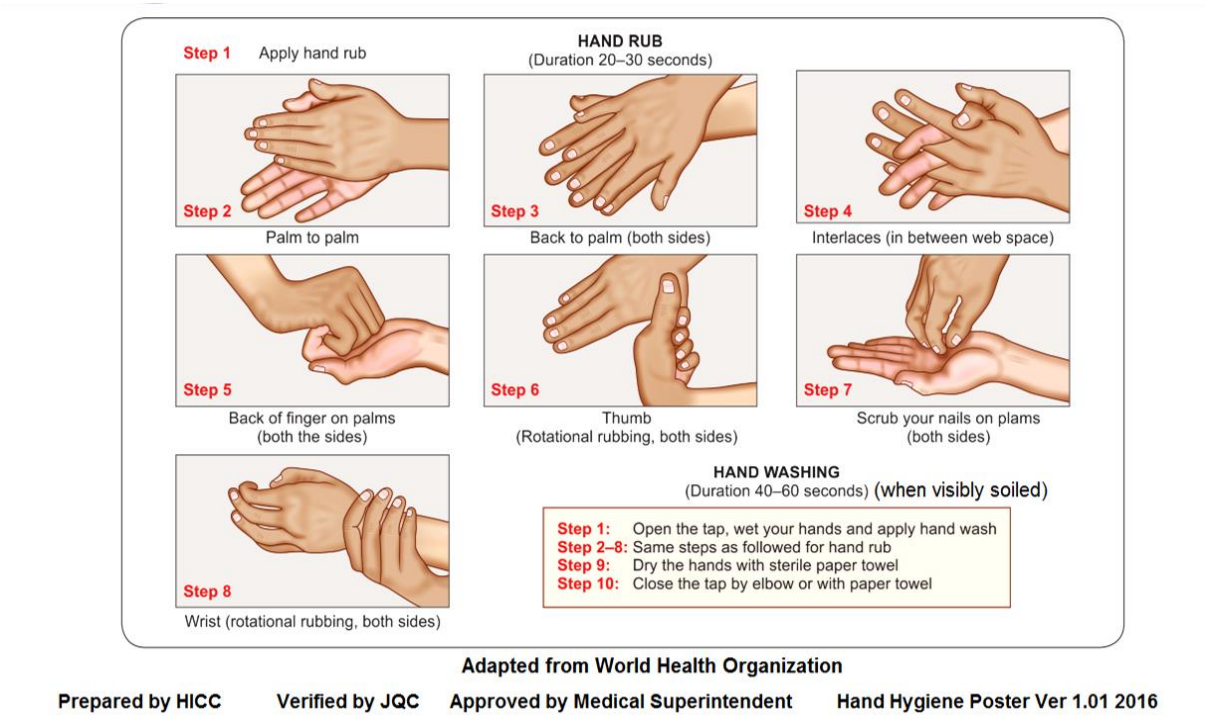
It removes transient micro-organisms and soil and kills or inhibits the growth of resident micro-organisms. It may reduce the risk of infections in high-risk situations.

Steps of hand hygiene using alcohol based hand-rub

Duration of the entire procedure: 20-30 seconds

Step 1 - Apply a palm full of the product in a cupped hand, covering all surfaces.
Step 2 - Rub hands palm to palm.
Step 3 - Right palm over left dorsum with interlaced fingers and vice versa.
Step 4 - Palm to palm with fingers interlaced.
Step 5 - Backs of fingers to opposing palms with fingers interlocked.
Step 6 - Rotational rubbing of left thumb clasped in right palm and vice versa.
Step 7 - Rotational rubbing, backwards and forwards with clasped fingers of right hand in left palm and vice versa.
Once dry, hands are safe.

Figure 3: Poster displaying Steps of Hand Hygiene with Alcohol-based Hand Rub (Source: JIPMER, Puducherry)



Surgical hand scrub

Surgical hand scrubbing with antiseptic agent before beginning surgical procedures minimizes the number of microorganisms helps prevent the growth of micro-organisms on hands under the glovesfor a period of time. It reduces the risk of infections to the patient if the gloves are tornduring the procedure.

The 5 moments for hand hygiene approach for acute settings & also to other health settings:

The '5 moments for hand hygiene' approach is developed by the World Health Organization (WHO 2009)to add value to any hand hygiene improvement
strategy. This includes practicing hand hygiene:

.

a. Before touching a patient
To protect the patient against against acquiring infectious agents from the hands of the healthcare worker.

b. Before performing **clean or aseptic procedure**

To protect patients from infectious agents (including their own) entering their bodies during procedures.

c. After a procedure or body fluid exposure risk
To Protect healthcare workers and the healthcare surroundings from acquiring patients' infectious agents.

d. After touching a patient
To Protect healthcare workers and the healthcare surroundings from acquiring patients' infectious agents.

e. After touching patient surroundings
To Protect healthcare workers and the healthcare surroundings from acquiring patients' infectious agents.

Using alcohol-based hand rubs is more effective against the majority of common infectious agents on hands than hand hygiene with plain or antiseptic soap and water (WHO 2009).

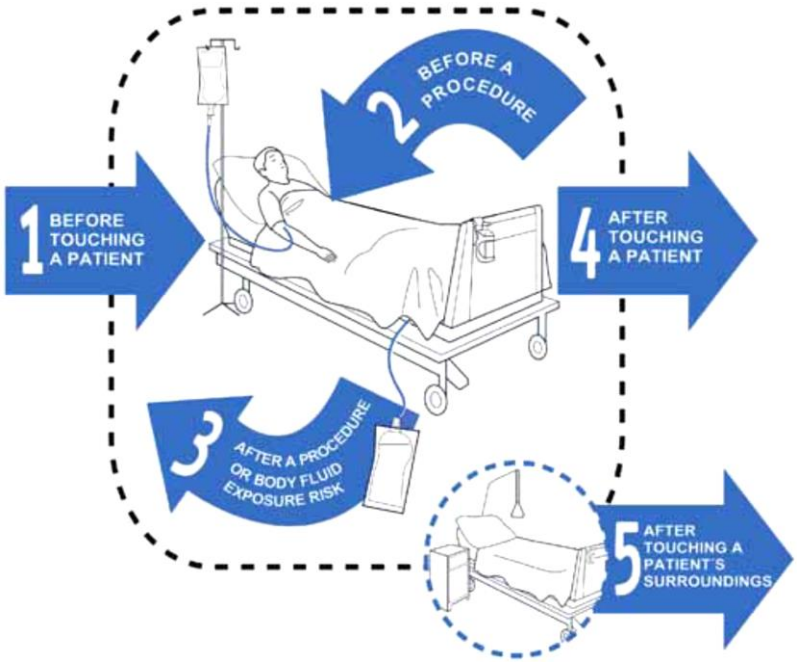
Advantages of alcohol-based hand rubs are that they are -

- Easily accessible at point of care.
- Excellent antimicrobial activity against Gram-positive and Gram-negative vegetative bacteria, *Mycobacterium tuberculosis* and a wide range of fungi.
- Generally good antimicrobial activity against enveloped viruses.
- However, the disadvantages of alcohol based hand rubs are:
- Lesser and/or variable antimicrobial activity against non-enveloped viruses (such as norovirus).
- No activity against protozoan oocysts and bacterial spores (such as *C. difficile*).

The range of antimicrobial activity in alcohol-based hand rubs varies with the alcohol compound (ethanol, isopropanol or n‑propanol) used. Different alcohol species have different levels of activity (60% v/v n-propanol is approximately equivalent to 70% v/v isopropanol and to 80% v/v ethanol) and many commercial formulations consist of blends of different alcohol species.

Source: Grayson et al (2009).

Fig 4. Poster displaying The 5 moments for hand hygiene



Note: *Hand hygiene is also performed after the removal of gloves.*

Compliance with hand washing protocols by health care personnel is a major problem in health care facilities. The reasons for non-compliance are many and include elements of lack of knowledge about the importance of hand washing, as well as perceived obstacles such as understaffing, lack of supplies, equipment and water which is important in a resource constraint areas.

It is important to provide regular training to all healthcare workers on the importance of hand hygiene, and the correct procedures for hand rubbing and hand washing. Compliance with proper hand hygiene practices should be monitored regularly in different units and feedback should be provided to the staff.

WHO Hand –Hygiene audit tool is available at http://www.who.int/gpsc/5may/tools/en/. The healthcare units may use this tool or may develop local tool as shown below:

Fig 5a. Sample of a Hand Hygiene Audit form (Source: JIPMER, Puducherry)

HAND HYGIENE AUDIT

Ward /ICU: HH Audit round no- Time: Date:

Availability of hand rubs at

- ICU entrance- Yes/No
- Bed side- _____no. of hand rubs available out of _____ opportunities
- Dressing trolley-_____no. of hand rubs available out of _____ opportunities
- Injection trolley-_____no. of hand rubs available out of _____ opportunities

Near the wash basin-

- Availability of hand wash :Y/N,
- Availability of paper towel : Y/N, Cloth towel- Y/N
  If YES, then quantity for 1 week: ENOUGH / NOT ENOUGH

WHO five moments of HH

1. Before touching patient
2. Before a procedure
3. After a procedure
4. After touching patient
5. After touching patient's surrounding

HCW undergoing auditing-

1.
2.
3.
4.

S.No	HCW type	Hand hygiene moments available	Hand hygiene steps followed		
			Not followed	Followed , partial	Followed, all steps
1					
2					
3					
4					
5					
6					
7					
8					
9					
10					
11					
12					
13					
14					
15					
16					
17					
18					
19					
20					

Fig 5 b. Sample of a Hand Hygiene Audit form (Source: JIPMER, Puducherry) …continued

S.No	HCW type	Hand hygiene moments available	Hand hygiene steps followed		
			Not followed	Followed , partial	Followed, all steps
21					
22					
23					
24					
25					
26					
27					
28					
29					
30					
31					
32					
33					
34					
35					
36					
37					
38					
39					
40					
41					
42					
43					
44					
45					
46					
47					
48					
49					
50					
51					
52					
53					
54					
55					
56					
57					
58					
59					
60					

ICN

5.1.2 Personal protective equipment

Any infectious agent transmitted by the contact or droplet route can potentially be transmitted by contamination of healthcare workers' hands, skin or clothing. Cross-contamination can then occur between the healthcare worker and other

patients or healthcare workers, or between the healthcare worker and the environment. Infectious agents transmitted through droplets can also come into contact with the mucous membranes of the healthcare worker.

Personal protective equipment (PPE) refers to physical barriers, that are used alone or in combination, to protect mucous membranes, airways, skin and clothing from contact with infectious agents.

Personal protective equipment should be used by:

- Healthcare workers who provide direct care to patients and who may come in contact with blood, body fluids, excretions, and secretions.
- Support staff including cleaners, and laundry staff in situations where they may have contact with blood, body fluids, secretions, and excretions.
- Laboratory staff, who handle patient specimens.
- Family members who provide care to patients and are in a situation where they may have contact with blood, body fluids, secretions, and excretions.

Decision-making for selection of personal protective equipment:

Selection of protective equipment need to be based on assessment of the risk of transmission of infectious agents to the patient or caregiver, and the risk of contamination of the clothing or skin of healthcare workers or other staff by patients' blood, body substances, secretions or excretions.

Local policies and current health and safety legislation should also be taken into account

Factors to be considered are:

• Probability of exposure to blood and body substances

• Type of body substance involved

• Probable type and probable route of transmission of infectious agents.

How to use PPE safely and effectively

Although PPE is the most visible control used to prevent transmission, it must be used in conjunction with administrative and engineering controls. PPE must be correctly selected according to risk assessment and used in a safe manner, and they must be available and accessible to health workers.

Before putting on PPE

- Health workers should be trained on the use of PPE as part of their comprehensive IPC training.
- The training should address the protocols adopted by a specific facility and include practicing both donning and doffing procedures and performing care-related activities while wearing PPE.
- Their competency in using PPE should be assessed and tested and, ideally, properly documented.
- Adequate resources (human, material and financial) must be made available.
- Management of the resources should include stock management, availability of different sizes and shapes of PPE, placement of items for easy access, quality of items purchased and line management for reporting shortages.

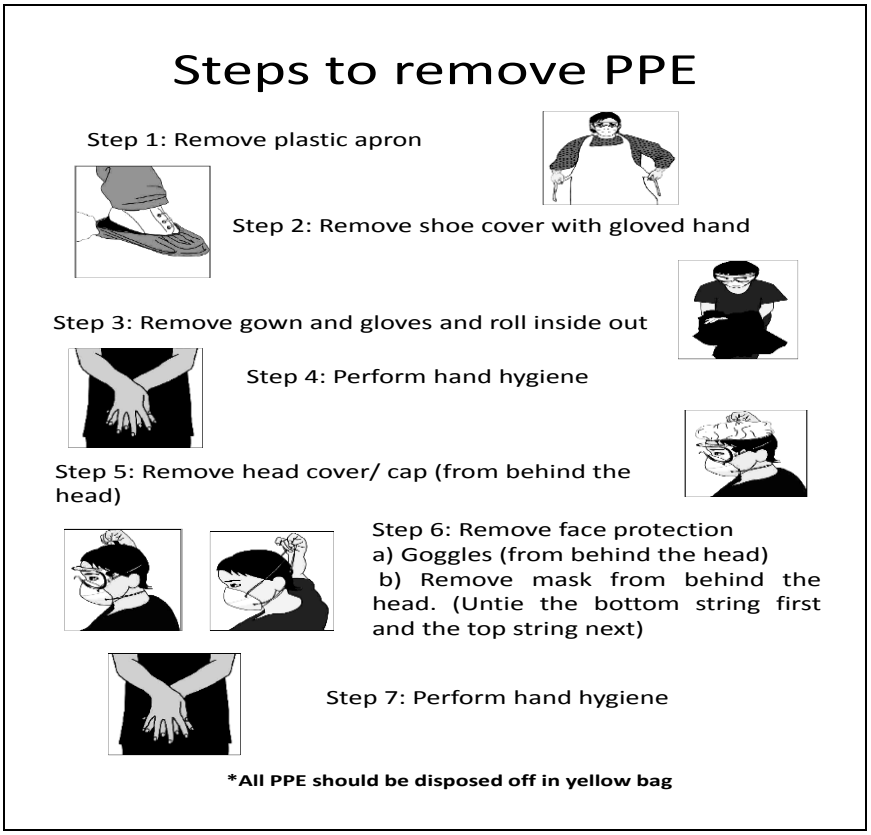
- Written protocols need to be in place for donning and doffing stepwise procedures, management of used and potentially contaminated PPE and associated medical devices, including safe discard and decontamination.
- Appropriate spaces should be designated so that PPE can be donned and doffed in separate areas.
- Use of trained observers to monitor for correct PPE donning and doffing is essential.

When putting on PPE

PPE must be put on in the proper order in the donning area as the PPE cannot be modified while in the patient care area. An observer should check the integrity of the PPE, making sure it is well adjusted, and write the name and role of the person as well as the time of entry into the high-risk zone on the apron.

Although the precise sequence of putting on PPE is less important than for the doffing (removing) procedure, it should mirror the reverse order of the removing sequence as closely as possible. It is important also to remember that protecting mucosae is essential, and so eye protection should be put on in a way that it can be taken off as late as possible during the PPE removal process.

Fig 6: SEQUENCE FOR REMOVAL OF PERSONAL PROTECTIVE EQUIPMENT (PPE)



Where to wear PPE:

- PPE is designed and issued for a particular purpose in a protected environment and should not be worn outside that area.
- Protective clothing provided for staff in areas where there is high risk of contamination (e.g. operating suite/room) must be removed before leaving the area.

- Even where there is a lower risk of contamination, clothing that has been in contact with patients should not be worn outside the patient-care area.
- Inappropriate wearing of PPE (e.g. wearing operating suite/room attire in the public areas of a hospital or wearing such attire outside the facility) may also lead to a public perception of poor practice within the facility.

Personal protective equipment includes:

- Gloves
- Protective eye wear (goggles)
- Mask
- Apron
- Gown
- Boots or shoe covers
- Cap or hair cover

Gloves

a. Gloves shall be worn as an additional measure, not as substitute for hand washing.
b. Gloves are **not** required for routine care activities in which contact is limited to a patient's intact skin.
c. Wear GLOVES when touching blood, body fluids, secretions, excretions, mucous membranes, non-intact skin.
d. Change GLOVES between tasks and procedures on the same patient after contact with potentially infectious material.
e. If gloves become torn or heavily soiled and additional patient care tasks must be performed, then change the gloves before starting the next task.
f. Remove gloves immediately after completion of care or a specified task, at point of use before touching non-contaminated items and clean environmental surfaces and before moving to another patient
g. Single-use disposable gloves shall not be washed, decontaminated and reused but disposed off as per waste management policy.
h. Perform hand hygiene immediately after removing gloves.
i. Gloves shall not be worn while walking in corridors and travelling in elevators.

There are three types of gloves:

1. **Clean, non-sterile gloves** shall be worn:
    - For examinations and non-surgical procedures.
    - For contact with blood, body fluids, secretions and excretions, mucous membranes, draining wounds or non-intact skin (open skin lesions or exudative rash).
    - For handling items visibly soiled with blood, body fluids, secretions or excretions when the health care worker has open skin lesions on the hands.
    - When the health care worker has non-intact skin on his/her hands.
2. **Sterile single use gloves** to be used for aseptic procedures.

3. **Heavy duty/utility gloves** used for decontamination of large equipment, cleaning of floors, walls, health care facility furniture such as beds, etc. These gloves can be reused after cleaning.

The use of gloves does not eliminate the need to perform hand hygiene.

a) Aprons and gowns

International guidelines recommend that protective clothing (apron or gown) be worn by all health care workers when:

• Close contact with the patient, materials or equipment may lead to contamination of skin, uniforms or other clothing with infectious agents.

• There is a risk of contamination with blood, body substances, secretions or excretions (except sweat).

The type of apron or gown required depends on the degree of risk, including the anticipated degree of contact with infectious material and the potential for blood and body substances to penetrate through to clothes or skin:

- A clean non-sterile apron or gown is generally adequate to protect skin and prevent soiling of clothing during procedures and/or patient-care activities that are likely to generate splashing or sprays of blood or body substances.
- A fluid-resistant apron or gown should be worn when there is a risk that clothing may become contaminated with blood, body substances, secretions or excretions (except sweat).
- Gowns and aprons preferably must be changed between patients.
- Gowns shall be worn to protect uncovered skin and to prevent soiling of clothing during procedures and patient care activities likely to generate splashes or sprays of blood, body fluids, secretions, or excretions. Plastic aprons are recommended where splashes are likely to occur.

Table 1: C**haracteristics of apron and gowns**

Plastic apron	• Impervious /fluid resistant • Single-use, for one procedure or episode of patient care • Disposable • Worn when there is a risk that clothing may become exposed to blood or body substances (usually from the environment) during low-risk procedures and where there is low risk of contamination to the healthcare worker's arms • Worn during contact precautions when contact with the patient or the patient environment is likely
Gown	• Single-use* • Disposable • Worn to protect skin and prevent soiling of clothing during procedures and/or patient-care activities that are likely to generate splashing or sprays of blood or body substances • Choice of sleeve length depends on the procedure being undertaken and the extent of risk of exposure of the healthcare worker's arms
Full body gown	• Fluid resistant • Single-use*

	• Long sleeved • Worn when there is a risk of contact of the healthcare worker's skin with a patient's broken skin, extensive skin to skin contact (e.g. lifting a patient with scabies or non-intact skin), or a risk of contact with blood and body substances which are not contained (e.g. vomiting, uncontrolledfecal matter) • Worn when there is the possibility of extensive splashing of blood and body substances • Worn when there is a risk of exposure to large amounts of body substances e.g. in someoperative procedures
Sterile Gown	Pre-packaged • Used for procedures requiring an aseptic field

some gowns quality is better & is reusable. But under that circumstances it need to be laundered & and sterilized before it is reused. However if handling risk group 4 organism then one should adopt for single usage

b) Facial protection

Wear facial protection, including a medical mask and eye protection (face shield or goggles), to protect the conjunctivae and the mucous membranes of the nose, eyes and mouth during activities that are likely to generate splashes or sprays of blood, body fluids, secretions or excretions. When providing care in close contact with a patient with respiratory symptoms (e.g. coughing or sneezing), use eye protection, because sprays of secretions may occur.

i. Surgical Masks

Types of Masks

- The tie-back mask, which has four ties to fasten the mask around the mouth and nose. The side of the mask with the flexible metal tab is worn away from the face with the metal tab placed above the bridge of the nose to help secure the mask and minimize air escape from the sides (venting).
- The ear-loop mask is similar to the tie-back mask except that it has two elastic bands used for fastening.
- Surgical masks with attached face shields to help provide a protective barrier against splashes and spatters of blood or other potentially infectious material are also available. These masks are fluid resistant, lightweight, and are adequate for most procedures and isolation precautions in which the use of mask is indicated.
- Specialized mask like N95, N99, NBC respirator etc.

Masks shall be worn where appropriate to protect the mucous membranes of the nose and mouth during procedures and patient care activities likely to generate splashes or sprays of blood, body fluids, secretions, and excretions.

Note: A surgical mask becomes ineffective as a barrier if the integrity is damaged or if it becomes wet (i.e., from perspiration, or if splashed with blood or other potentially infectious material). If this occurs, remove mask and replace with another.

ii. Protective Eye Wear

Types of Eye Wear

- Plastic glasses with solid side shields
- Goggles

- Masks with clear visors
- Chin-length face shields

Protective eye wear shall be worn where appropriate to protect the mucous membranes of the eyes during procedures and patient care activities likely to generate splashes or sprays of blood, body fluids, secretions, and excretions.

- Use protective eye wear that is appropriate for the particular procedure.

Note: If plastic eye wear or goggles are visibly soiled with blood or other potentially infectious material, then decontamination, cleaning and disinfection is indicated.

- Single use protective barriers should be discarded into the appropriate receptacle(s).
- Re-usable protective barriers should be decontaminated, cleaned, and disinfected, according to the appropriate guidelines.
- Wash hands and dry after removal of protective barriers.
- Ensure sufficient supplies of appropriate PPE. If resources are limited and disposable PPE items are not available, use reusable items (e.g. cotton gowns) and disinfect properly after each use to avoid wastage, critically evaluate situations in which PPE is indicated, and maximize the provision of clinical care during each entry to the patient's room. However only use disposable PPE while handling risk group four organisms or infection due to the same.
- Avoid reuse of disposable PPE items. It is not known whether reusing disposable PPE is as safe and effective as using new PPE, and reuse may increase the risk of infection for health-care workers.

c) Respiratory protection

- Ensure that users receive training on how to put on a particulate respirator, and that they understand the need to perform the seal check every time the respirator is worn, to avoid contamination during use, and to remove and dispose of the respirator. If patients with known or suspected airborne infections (e.g. pulmonary TB) are cohorted in a common area or in several rooms on a nursing unit, and if multiple patients are to be visited sequentially, it may be advisable to wear a single particulate respirator for the duration of the activity. This type of use requires that the respirator not be removed at any time during the activity, and that the user does not touch the respirator. If the respirator gets wet or dirty with secretions, it must be changed immediately.
- If supplies are limited, prioritize the use of particulate respirators for workers who provide care to patients with obligate and preferentially airborne-transmitted diseases, and who are performing aerosol-generating procedures that have been consistently associated with increased risk of pathogen transmission. If a particulate respirator is not available, whenever possible, avoid performance of aerosol-generating procedures associated with an increased risk of pathogen transmission in patients with ARIs of potential concern.

i. Medical masks

• Wear medical masks fitted tightly to the face, and discard immediately after use. If the mask gets wet or dirty with secretions, it must be changed immediately.

d) Eye protection

- Reusable eye protective equipment can be used (e.g. goggles or face shield), but may pose a risk of cross-infection if not cleaned and decontaminated properly according to the manufacturer’s instructions after each

use. Ensure that equipment is thoroughly cleaned before disinfection. Perform hand hygiene after disposal or cleaning of eye protection equipment that may be contaminated with splash or spray.

- Do not use conventional eye glasses as eye protection, because they are not designed to protect against splashes to the eye mucosa.

PPE is meant to provide additional protection for the user but should not result in increased risk for other individuals or the environment. PPE supplies may be limited, and reuse of PPE items unavoidable; however, items should be reused under safe conditions. Avoid use of unnecessary PPE.

Donning & doffing of PPE is to be done as in annex-*II*. Health care worker needs to be trained for wearing (donning) and removal (doffing) of PPE.

5.1.3. Patient Care Equipment

- Reusable equipment and linen that has been in contact with a patient shall be cleaned and reprocessed before use in the care of another patient.
- Patient care equipment soiled with blood or body fluids shall be decontaminated and cleaned to prevent transfer of micro-organisms to others and the environment.
- Items that are routinely shared among the patients needs to be cleaned between patients.
- A routine cleaning schedule shall be prepared and monitored for items that are in contact only with intact skin, if cleaning between patients is not feasible.
- Procedures shall be adopted for assigning responsibility and accountability for routine cleaning of all patient-care equipment. There should be dedicated personnel to carry out this task.
- Any equipment that is being sent for repair or service shall be cleaned with a hospital approved disinfectant policy.
- Bedpans and urinals shall be decontaminated and disinfected between patient uses routinely.
- Toilets and commodes shall be cleaned regularly and when soiled.
- Soiled patient-care equipment shall be handled in a manner that prevents exposure of skin and mucous membranes and contamination of clothing and environment.
- Mouth pieces, resuscitation bags, or other ventilation devices shall be provided for usein health care facilities where the need to resuscitate is likely to occur .
- Disposable patient care equipment shall **not** be re-used and shall be discarded into a patient waste receptacle for disposal.
- Patient-care supplies, (e.g. lotion, creams, soap) **shall not** be shared between patients.

➢ **Sharps**

- Sharps (needles, scalpels, etc.) shall be handled with extreme caution to avoid injuries during use, disposal, or reprocessing.
- Used needles shall not be recapped by hand; if necessary, use the single hand “scoop” method 3. Used needles shall **not** be bent or broken after use.
- Used sharps shall be disposed of immediately in designated puncture-resistant containers (Labeled with a biohazard symbol) located in the area where the items were used, for transport to the incinerator/pit or as

per health care facility procedure for waste disposal. These containers shall not be located in areas which are easily accessible to the public.

- Used syringes and needles shall be discarded as a unit in the designated puncture-resistant container.
- Reusable syringes, needles, or sharps should not be used.
- Handful of sharp instruments shall not be picked up simultaneously.
- Caution shall be exercised when rotating instruments are in use.
- Sharp end of instruments shall be positioned away from oneself and others.
- Used needles shall not be broken, recapped or otherwise manipulated by hand.
- Heavy duty/strong utility gloves shall be worn during decontamination, cleaning, and disinfection of instruments.
- If injured by sharps, the supervisor shall be contacted immediately for further management.

Reducing risks if a sharps injury is sustained

- ***Seek care immediately if you sustain a sharps injury***
- ***If skin is penetrated, wash the affected area immediately with soap and water. Alcohol-based handrub can be used to clean the area if soap and water are not available.***
- ***Do not squeeze the affected area.***
- ***Report the incident immediately to your supervisor.***
- ***Ask about follow-up care, including post-exposure prophylaxis, which is most effective if implemented soon after the incident.***
- ***Complete an accident / incident report form, including the date and time of theexposure, how it happened and name of the source individual (if known).***
- ***If a sharps injury happens to you, you can be reassured that only a small proportion of accidental exposures result in infection. Taking immediate action will lower the risk even further.***

Patient's placement in health care facility:

- Single rooms or segregated patient accommodation shall not be used for routine patient care.
- Single rooms shall not be used for children in diapers unless they have uncontained diarrhoea and cannot be confined to their designated bed space.
- Infectious patients shall be managed using barrier nursing in single isolation room.
- Appropriate placement for patients who visibly contaminate the environment, or whom appropriate hygiene cannot be maintained shall be provided. This includes mobile patients with faecal incontinence if stools cannot be contained in diapers, and patients with draining wounds who do not keep their dressings in place.

5.1.4. Urine and Feces

- Urine and feces shall be flushed carefully down the toilet.
- Contaminated commodes and bedpans shall be disinfected regularly.

5.1.5 Environment Control

- Guidelines & procedures shall be established for routine care, decontamination, cleaning, disinfection and sterilization of patient care equipment, housekeeping, laundry and waste management.
- Environmental cleaning shall be done by workers wearing personal protective equipment in accordance with the policies and procedures of the housekeeping department.
- Surfaces soiled with blood, body substances, or other potentially infectious material shall be cleaned immediately and require special handling.
- Training programme for sub-contracted workers on infection prevention and control, with a focus on disinfection shall be developed and implemented and regular training programme will be conducted for new recruits.

5.1.6. Patient Transport

- Health workers who are likely to have contact with either blood or other potentially infectious material shall wear personal protective equipment.
- When transporting patient/dead body to various areas/mortuary, health care workers shall adhere to infection prevention and control measures.

5.1.7 Laboratory Specimens

- The validity of test results is as much a function of the laboratory analysis as of the proper collection and handling of specimens.
- Specimens from all patients shall be treated as potentially infectious.
- All specimens for laboratory examination shall be carefully collected using Standard operating procedures/ precautions.
- Precautions in their collection, and transported to the laboratory in such a manner to prevent breakage or spillage. The caps of all containers shall be tightly sealed and the requisition forms placed in a separate envelope rather than wrapped around the specimen container. This separation will prevent the forms getting contaminated.
- Specimens shall be collected in designated containers with a secure lid to prevent leakage during transport.
- All specimens submitted to the laboratory shall be accompanied by a completed requisition form issued by the department for which testing will be done. Requisition forms shall be completed properly so that all data required by the headings on the forms are provided.
- Additional information relevant to the nature of the specimen, time of collection, treatment regimen of the patient, which may impact on the testing and reporting, shall be supplied.
- Requisition sheets shall be affixed to, but not stapled to, the outside of the plastic bag.

- Transportation of specimens to the laboratory shall be under the conditions required for preservation of the specimen's integrity and protection of the health care worker.
- Gloves shall be worn when handling and processing specimens.
- Laboratory procedures shall minimize splashing, spattering and generation of droplets.
- Laboratory workers shall follow mechanical pipetting procedures.
- Work areas shall be decontaminated after spills of blood, body fluids, or other potentially infectious material and after completion of work.
- Contaminated equipment needing servicing or repair shall be decontaminated externally and internally.
- Disposable specimen containers shall be encouraged where ever feasible.

5.1.7. Spill management

5.1.8 Wastes

Policy Statements

- Wastes from the following locations shall be considered potentially infectious and shall be handled as per waste guidelines of Pollution Control Board of States.
    - Clinical laboratories
    - Diagnostic laboratories
    - Transfusion area
    - Anatomic pathology
    - Patient care areas
    - Post mortem areas.
- Disposable sharps shall be placed in puncture-resistant disposable containers and handled as medical pathological waste, placed in the appropriate boxes and labeled with a biohazard symbol designed specifically for this purpose.
- Biohazard liquid waste (blood, body substances, or other potentially infectious material) shall be carefully disposed of to avoid accidental spills and be autoclaved/ incinerated/burned.

- All biohazard liquids and trash shall be handled with PPE and transported carefully.

5.1.9. Laundry

Collection and handling

- Soiled linen shall be sluiced.
- Soiled linen with blood, body fluids, secretions, or excretions shall be handled in a manner that prevents skin or mucous membrane exposure, contamination of clothing, and transfer of micro-organisms to other patients and the environment.
- Soiled linen is considered to be contaminated and shall be bagged at the point of origin and placed in the soiled linen container.
- Wet linen shall be placed in a fluid impervious bag for soiled linen or a regular plastic trash bag before deposited in a cloth bag for soiled linen.
- Never place soiled linen on the floor or any clean surfaces.
- Linen from persons with a diagnosis of viral hemorrhagic fevers (e.g. Lassa, Ebola, Marburg) requires special handling and proper guidelines for the same to be followed.
- Linen shall be handled with a minimum of agitation and shaking. Sorting and rinsing of linen shall not occur in patient care areas, except in facilities that use color coded, compartment soiled linen bag carts into which different types of linen are sorted, e.g. personal clothing, towels, reusable incontinence products, bedding.
- In community or home settings where clothes and linens are not often soiled with blood or body fluids, sorting of linen may take place in care areas.
- Heavily soiled linen shall be rolled or folded to contain the heaviest soil in the centre of the bundle. Large amounts of solid soil, faeces or blood clots shall be removed from linen with a gloved hand and toilet tissue and placed into a bedpan or toilet for flushing. Excrement shall not be removed by spraying with water, (e.g. from clothing, reusable incontinence pads).
- Commercial laundries used for laundering health care facilities linen shall comply with the infection prevention and control policies and guidelines.
- Tender procedures shall indicate special requirements for hospital laundry including the need to provide immunization against Hepatitis B.
- **Bagging and containment**
- Soiled wet linen shall be placed in strong impervious plastic bags to prevent leakage.
- Dry linen shall be transported in sealed plastic bags to the laundry.
- Laundry carts or hampers used to collect or transport soiled linen shall be covered. The practice of placing lids on soiled linen carts is not necessary from an infection prevention and control perspective.
- Bags shall be tied securely when three-quarters full and transported to the laundry area.
- When linens are commercially laundered, adequate separation of clean and dirty laundry in the truck is essential to ensure that there is no opportunity for mixing clean and dirty linens.
- Separate carts shall be used for dirty and clean linens. Carts used to transport soiled linens shall be cleaned with the recommended cleaning product used in the health care facility after each use.
- Linen transported by cart shall be moved in such a way that the risk of cross contamination is minimized.

- Clean linen shall be transported and stored in a manner that prevents its contamination and ensures its cleanliness

Washing and drying

- If low temperature water is used for laundry cycles, chemicals suitable for low temperature washing at the appropriate concentration shall be used.
- High temperature washes (>71.1°C) are necessary if cold water detergents are not used.
- Use of a commercial laundry detergent with household bleach (according to product instructions and where suitable for fabrics) and a normal machine wash and machine dry are sufficient to clean soiled linen in a community living or home care setting.
- Machine drying or hanging clothing and linens on a clothesline at the home care site is also a suitable method for drying.

Sterile linen

Surgical gowns and linens used in sterile procedures shall be sterilized by steam after the normal washing and drying cycle to destroy any residual spores. Disposable items for use in sterile procedures may be more cost-effective in some situations. The need for sterilizing linens for nurseries and other areas has not been substantiated.

Colour Coding System

- **Red:** for linen from patients with infectious conditions. Linen shall be disinfected first before placed in bags. Linen shall be placed in a strong impervious plastic bag to avoid leakage on the linen bag.
- **Yellow**: for soiled linen. Sluice first before placing in plastic bag then in the linen bag.
- **White:** for used dirty linen from wards and departments and for clean linen from the laundry.
- **Green:** for linen from special departments such as operating theatre, labour and delivery ward, to be transported to the laundry.

Protection of laundry workers

- Workers shall protect themselves from potential cross-infection from soiled linen by wearing appropriate personal protective equipment, such as gloves and gowns or aprons, when handling soiled linens. Reusable gloves shall be washed after use, allowed to hand dry, and discarded if punctured or torn. Hand washing facilities shall be readily available.
- Personnel shall wash their hands whenever gloves are changed or removed.
- Staff in care areas needs to be aware of sharps when placing soiled linen in bags. Workers are at risk from contaminated sharps, instruments or broken glass that may be contained with linen in the laundry bags.
- All care givers and laundry workers shall be trained in procedures for handling of soiled linen.
- Laundry workers, as other health care workers, shall be offered immunization against vaccine preventable diseases specially Hepatitis B.

5.1.10. Visitors

- Visitors shall take special precautions, depending on the area being visited.
- Restrict the entry of visitors to the health facility specifically to isolation area, ICU.

Recommendations for care of the deceased:

Removal of the body from the isolation room or area:

- Ensure proper use of PPE, according to Standard Precautions, to avoid direct contact with body fluids.
- Apply principles of cultural sensitivity. If the family of the patient wishes to view the body after removal from the isolation room or area, they may be allowed to do so with the application of Standard Precautions.

The following types of Transmission-Based infections in health care facilities:

- **Airborne transmission**: primarily for patients diagnosed or suspected of having pulmonary or laryngeal tuberculosis, particularly those who are acid-fast bacilli (AFB) positive, chicken pox and measles.

- **Droplet transmission**: for pediatric patients with a variety of pediatric respiratory diseases, meningitis. When healthcare workers' hands become contaminated with respiratory droplets and are transferred to susceptible mucosal surfaces such as the eyes, when infectious respiratory droplets are expelled by coughing, sneezing or talking, and come into contact with another's mucosa (eyes, nose or mouth), either directly into or via contaminated hands.

- **Contact transmission**: for patients being colonized or infected with epidemiological important organisms such as diarrheal diseases. When healthcare worker hands or clothing become contaminated, patient-care devices are shared between patients, infectious patients have contact with other patients, or environmental surfaces are not regularly decontaminated.

These types of precautions may be combined for diseases that have multiple routes of transmission. When used either singularly or in combination, they are to be used in addition to standard Precautions.

When one is suspecting infections due to infectious agents that are transmitted due to contact, droplet or airborne routes. This should be applied to all suspects or probable & confirmed cases.

In the acute-care setting, this will involve a combination of the following measures:

- Continued implementation of standard precautions.
- Appropriate use of PPE (including gloves, apron or gowns, surgical masks or P2 respirators, and protective eyewear).
- Patient-dedicated equipment.
- Allocation of single rooms or cohorting of patients as per guidelines & at least 3 ft apart.
- Appropriate air handling requirements.
- Enhanced cleaning and disinfecting of the patient environment.
- Restricted transfer of patients within and between facilities.

5.2.1 Contact precautions

There is clear evidence that certain infectious agents are transmitted by direct or indirect contact during patient care.

- **Direct transmission** occurs when infectious agents are transferred from one person to another person without a contaminated intermediate object or person. For example, blood or other body substances from an infectious person may come into contact with a mucous membrane or breaks in the skin of another person.
- **Indirect transmission** involves the transfer of an infectious agent through a contaminated intermediate object (fomite) or person. Contaminated hands of healthcare workers have been shown to be important contributors to indirect contact transmission.

Other opportunities for indirect contact transmission include:

- When clothing becomes contaminated after care of a patient colonized or infected with an infectious agent, which can then be transmitted to subsequent patients.
- When contaminated patient-care devices are shared between patients without cleaning and disinfection between patients.
- When environmental surfaces become contaminated.

Direct or indirect contact transmission of microorganisms during patient care is responsible for the majority of healthcare-associated infections in patients and healthcare staff. Contact precautions are used when there is a risk of direct or indirect contact transmission of infectious agents (e.g. MRSA, *C. difficile,* or highly contagious skin infections/infestations) that are not effectively contained by standard precautions alone.

The key aspects of applying contact precautions are:

• Standard precautions

• Use of appropriate PPE

• Special handling of equipment

• Patient placement

• Minimizing patient transfer or transport.

Hand hygiene and PPE

- Effective hand hygiene is particularly important in preventing contact transmission and the 5 moments for hand hygiene should be followed at all times.
- When the presence of *C. difficile* or non-enveloped viruses is known or suspected, use of alcohol-based hand rubs alone may not be sufficient to reduce transmission of these organisms. We recommend hand washing with Soap and Water.
- Putting on both gloves and gown upon entering the patient-care area helps to contain infectious agents, especially those that have been implicated in transmission through environmental contamination (e.g. VRE, MRSA, *C. difficile*, norovirus and other intestinal tract pathogens, respiratory syncytial virus)
- A surgical mask and protective eyewear must be worn if there is potential for generation of splashes of blood and body fluids into the face and eyes.

Hand hygiene and PPE to prevent contact transmission

- ***Perform hand hygiene;***
- ***Put on gloves and gown upon entry to the patient-care area;***
- ***Ensure that clothing and skin do not contact potentially contaminated environmental surfaces;***
- ***Remove gown and gloves and perform hand hygiene before leaving the patient-care area.***

Single-use or patient-dedicated equipment

Standard precautions concerning patient-care equipment are very important in the care of patients on contact precautions. If patient-care devices (e.g. blood pressure cuffs, nebulizers, mobility aids) are shared between patients without being reprocessed between uses, they may transmit infectious agents.

Patient placement:

A single-patient room is recommended for patients who require contact precautions. Rooms with attached bathroom /toilet and anterooms are preferred .one also should follow the following practices:

- Place the patient in an Airborne Precaution room.
- If a ventilated isolation room is not available, place patients in separate well-ventilated rooms.
- If single rooms are not available, cohort patients according to the same etiological diagnosis in well-ventilated places.
- To perform any aerosol-generating procedures associated with pathogen transmission, use appropriate PPE in an Airborne Precaution room.
- keep patient record sheet outside the room
- keep patient bedside charts outside the room
- disinfect hands upon leaving room and after writing in the chart
- keep doors closed
- make sure rooms are clearly labeled

However when a single-patient room is not available, consultation with infection control professionals is recommended to assess the various risks associated with other patient placement options (e.g. cohorting).

If it is necessary to place a patient who requires contact precautions in a room with a patient who is not infected or colonized:

- Avoid placing these patients with patients who are at increased risk of an adverse outcome from infection (e.g. patients who are immuno-compromised, have open wounds or have anticipated prolonged lengths of stay).

Do not place confirmed patient of a case needing contact precautions with the one who is still a suspect case of similar disease.

- Change PPE and perform hand hygiene between contact with patients in the same room, regardless of whether one or both patients are on contact precautions.
- Limit patient movement and ensure that patients wear medical masks when outside their room or area.

5.2.2 Droplet precautions

A number of infectious agents are transmitted through respiratory droplets (i.e. large-particle droplets >5 microns in size) that are generated by a patient who is coughing, sneezing or talking. Transmission via large droplets requires close contact as the droplets do not remain suspended in the air and generally only travel short distances. There is also the potential for infectious agents transmitted by the droplet route to be transmitted by contact.

Droplet precautions are based on evidence which shows that:

- Hand hygiene is effective in preventing transmission of viruses and reducing the incidence of respiratory infections both within and outside healthcare settings.
- Surgical masks protect the wearer from droplet contamination of the nasal or oral mucosa.
- Physical proximity of less than **one metre** has long been associated with an increased risk for transmission of infections via the droplet route (e.g. *N. meningitides* and group A streptococcus.
- Placing masks on coughing patients can also prevent infected patients from dispersing respiratory secretions into the air.

Droplet precautions are intended to prevent transmission of infectious agents spread through close respiratory or mucous membrane contact with respiratory secretions. Because these microorganisms do not travel over long distances, special air handling and ventilation are not required. Respiratory pathogens that are transmitted through large droplets include adenovirus, avian influenza A (H5N1), human influenza and SARS-CoV. Adenovirus infections are more common among children, and influenza and SARS-CoV can affect both adults and children. During an influenza pandemic, the circulating human virus is expected to be transmitted in the same manner as seasonal influenza viruses; hence, Droplet Precautions should be applied in addition to Standard Precautions.

Droplet Precautions include:

- **PPE**– Use a medical mask if working within 1 m of the patient. For practical purposes, it is advisable to use a medical mask (triple layer surgical mask) when entering the patient's room. When entering the isolation room or area, or when providing care to a patient with an obligate or preferential airborne infectious disease in other settings, use a particulate respirator that is at least as protective as a NIOSH-certified N95 or equivalent.

- **Patient placement –** Place patients in single rooms, or cohort those with the same etiological diagnosis. If an etiological diagnosis is not possible, group patients with similar clinical diagnosis and based on epidemiological risk

factors, with a spatial separation of at least 1 m. If it becomes necessary to place patients who require droplet precautions in a room with a patient who does not have the same infection.

- Avoid placing patients on droplet precautions in the same room with patients who have conditions that may increase the risk of adverse outcomes from infection or that may facilitate transmission (e.g. those who are immuno-compromised, have anticipated prolonged lengths of stay, have cystic fibrosis, cardiac conditions or muscular dystrophy).
- Ensure that patients are physically separated (> 1 metre apart) from each other and draw the privacy curtain between beds to minimize opportunities for close contact.
- In all cases, the importance of respiratory hygiene and cough etiquette should be explained to patients on droplet precautions.

❖ **Patient transport–** Limit patient movement and ensure that patients wear medical masks when outside their rooms. Patients should follow respiratory hygiene and cough etiquette. Children should wear a correctly fitting mask when they are outside an isolation room.

5.2.3. Airborne precautions

Certain infectious agents are disseminated through airborne droplet nuclei or small particles in the respirable size range that remain infective over time and distance.

Airborne pathogens are transmitted through inhalation of droplet nuclei that remain infectious over a long distance (e.g. > 1 m), and require special air handling. Their transmission is further classified as obligate or preferential:

- **Obligate airborne transmission** applies to agents naturally transmitted exclusively through droplet nuclei deposited in the distal part of the lung (e.g. Mycobacterium tuberculosis causing pulmonary TB); and
- **Preferential airborne transmission** applies to pathogens (e.g. measles) that are transmitted by droplet nuclei deposited in the airways but can also be transmitted by other routes.

Transmission of droplet nuclei at short range may also occur with SARS-CoV, human influenza, and perhaps with other viral respiratory infections, during special circumstances; for example:

- Performance of aerosol-generating procedures associated with pathogen transmission in rooms that are inadequately ventilated;
- Lack of adequate/or improper use of PPE (e.g. as happened with SARS).
- This type of transmission has been referred to as opportunistic airborne transmission.

Airborne precautions are based on evidence which shows that:

- The use of P2 respirators prevents the inhalation by healthcare workers of small particles that may contain infectious agents transmitted via the airborne route.
- The use of negative pressure rooms may also reduce the transmission of infection.
- Wearing of correctly-fitted surgical masks by coughing patients prevents dispersal of respiratory secretions into the air.

Infection prevention and control precautions for airborne diseases

For airborne pathogens supplement Standard Precautions with additional precautions, as given below.

- **Personal Protective Equipment (PPE)**

When entering the isolation room or area, or when providing care to a patient with an obligate or preferential airborne infectious disease in other settings, use a particulate respirator that is at least as protective as a NIOSH-certified N95.

- **Patient placement**
  - Place the patient in an Airborne Precaution room
  - If a ventilated isolation room is not available, place patients in separate well-ventilated rooms.
  - If single rooms are not available, cohort patients according to the same etiological diagnosis in well-ventilated places.
  - To perform any aerosol-generating procedures associated with pathogen transmission, use appropriate PPE in an Airborne Precaution room.

- **Patient transport**

  Limit patient movement and ensure that patients wear medical masks when outside their room or area.

Table 2: Infection prevention and control precautions for airborne diseases

Type of precautions	Examples of infectious agents	Singleroom /cohorting of pts.	Gloves	Gowns	Mask	Eye protection	Handling of pt care equipment	Visitor
Standard	Standard precautions for all health care facilities & for all health practices for all type of infections.							Hand hygiene/ respiratory hygiene including cough etiquettes.
Contact	MRSA, VRE, Carbapenem resistant Gram negative bacteria, intestinal pathogens or other skin contagious infections,	Yes	Yes	Yes	Surgical triple layer mask if sputum is infected.	**As required based on procedures and site of infections	Single use disposable or if non disposable then reprocess including disinfection before use for second pts.	Same precautions as health care provider
Droplet	Respiratory viral or bacterial pathogens (RSV, influenza, ,whooping cough diphtheria etc)	Yes	Yes	Yes	Surgical triple layer mask	**As required based on procedures and site of infections	Single use disposable or if non disposable then reprocess including disinfection before use for second pts.	Restrict no. of visitor & Same precautions as health care provider
Airborne	SARS, pulmonary TB	Single room				**As required based on	Single use disposable or	Restrict no. of visitor &

	(MDR/XDR)chicken pox, MERS CoV etc	under negative pressure				procedures and site of infections	if non disposable then reprocess including disinfection before use for second pts.	Same precautions as health care provider

*** If there is direct contact with blood or body fluids then double Gloves , Gown including impermeable gown ,shoe cover & eye protection goggles to be worn & there should be no skin show.Also note that environment cleaning is an essential component of this IPC.*

Healthcare worker education

Healthcare facilities should provide specific education and training for all healthcare workers about infection prevention and control principles, policies and procedures that are relevant to the facility. The aim is to inform and educate healthcare workers about the infectious hazards they will face during their employment, and their role in minimizing the spread of infection toothers. Special attention should be given to advice about hand hygiene.

At a minimum, all staff should be educated about:

- Modes of transmission of infectious agents.
- Risk identification, assessment and management strategies including transmission-based precautions.
- Orientation to the physical work environment with a focus on its risks for infection.
- Safe work procedures.
- Correct use of standard precautions
- Correct choice and use of PPE, including procedures for putting on and removing PPE and fit checking of respirators.
- Appropriate attire (shoes/hair/nails/jewellery).
- Hand hygiene practices.
- Levels of cleaning required for clinical areas and equipment.
- How to deal with spills.
- Safe handling and disposal of sharps.
- Reporting requirements of incidents such as sharps injuries and exposures.
- Waste management.
- Antibiotic policy and practice.

Healthcare workers may also require job or task-specific education and training, such as:

- Instrument cleaning and sterilization competency testing.
- Insertion and management of central and peripheral lines.
- Risks and prevention of MRO transmission.

<u>The use of standard precautions is the primary strategy for minimizing the transmission of healthcare-associated infections</u>

- Transmission-based precautions are used in addition to standard precautions, where the suspected or confirmed presence of infectious agents represents an increased risk of transmission.
- The application of transmission-based precautions is particularly important in containing multi-resistant organisms (MROs) and in outbreak management.
- Medical and dental procedures increase the risk of transmission of infectious agents. Effective work practices to minimize risk of transmission of infection related to procedures require consideration of the specific situation as well as appropriate use of standard and transmission-based precautions.

Chapter 6: ENVIRONMENT

This chapter deals with Hospital environment including building features, ventilation, water, food and the wastes generated that impact the occurrence of infections.

6.1 Buildings: Health services — including public and private hospital services — must meet quality standards (ISO 9000 and ISO 14000 series). It is recognized that older facilities and facilities in developing countries may not be able to achieve these standards. However, the principles underlying these standards should be kept in mind for local planning and, wherever possible, renovations should attempt to achieve the required standard Building structure should also take in account the type of health facility (General Hospital, Superspeciality/Tertiary care Hospital or Speciality Hospital, etc.).

6.2 Segregation of different areas in the hospitals based on risk of infections:

It is useful to stratify patient care areas keeping in mind, risk to the patient population for acquisition of infection. For some units, including oncology, neonatology, intensive care, and transplant units where high risk and immuno-compromised patients are cared for special ventilation ensuring lower particulate count as per standards for such areas is desirable to control HCAIs. Central sterilization unit or in a hospital kitchen, contaminated areas must not compromise non-contaminated areas. Infected patients must be separated from immune-compromised patients. Positive pressure rooms are recommended for bone marrow transplant patients and patients with severe neutropenia. Negative pressure rooms are recommended for patients with airborne infections like open case of pulmonary tuberculosis.

Degrees of risk for HCAIs in a health care facility:

A – Low-risk areas: e.g. administrative sections, cafeteria, visitor's waiting lounges
B – Moderate-risk areas: e.g. routine patient units, clean surgery-post surgical units
C – High-risk-areas: e.g. isolation unit, intensive care units, post-transplant units

A room or space, whatever its purpose, must not be ever in a completely separate area. However, a distinction can be made between high movement and less movement areas. One can consider general services like food and laundry, sterile equipment, and pharmaceutical distribution, or specialized services like anesthesiology, medical imaging, medical or surgical intensive care and other areas. A hospital with well-defined areas for specific activities can be described using flowcharts depicting the flow of in- or outpatients, visitors, staff (physicians, nurses and paramedics), supplies (expendable, sterile, catering, clothing, etc.) as well as the flow of air, liquids and wastes. Building or rebuilding a hospital requires consideration of all physical movements and communications, and where contamination may occur.

As far as possible in already built hospital and always for new hospitals being built follow NABH Facility Management and Safety standard detailed in NABH Standards 4th ed, 2014.

Materials used for construction especially internal surfaces are very important. In the entire patient environment the floor coverings and walls must be easy to clean, disinfect and resistant to disinfection procedures.

Airborne contamination and transmission:

Most important factors to control infection in OTs include: traffic control; appropriate cleaning processes before and after each case; maintenance of environment that includes air changes, particulate count, temperature, pressure and humidity.

Infection may be transmitted over short distances by large droplets (>5µ) and at longer distances by droplet nuclei(<5µ) generated by coughing and sneezing. Droplet nuclei remain airborne for long periods, may disseminate widely in an environment such as a hospital ward or an operating room, and can infect patients directly or indirectly through contaminated medical devices. Housekeeping activity such as sweeping, using dry dust mops or cloths, or shaking out linen, can aerosolize settled particles that may contain microorganisms and transmit infection. Wet mopping is recommended.

6.3 Ventilation:

Fresh filtered air, appropriately circulated, will dilute and remove airborne bacterial contamination. It also eliminates smells. Desirable ventilation rates, expressed in air changes per hour, vary with the requirement of a particular area.

6.4 Operation theatres:

Modern operating rooms which meet current air standards are virtually free of particles larger than 0.5 µm (including bacteria) when there are no persons in the room. Activity of operating room personnel is the main source of airborne bacteria, which originate primarily from the skin of individuals in the room. The number of airborne bacteria depends on eight factors.

Superspeciality OT: Super-specialty OT means operations of Neurosciences, Orthopedics (Joint Replacement), Cardiothoracic and Transplant Surgery (Renal, Liver etc). Air change rate 25-30 Pascals/hr recommended.

General OT: This includes Ophthalmology and all other basic surgical disciplines.
District hospital OTs and FRU OT would fall under this category. Air change rate about 20pascals/hr.

The air changes (how many times the air within a defined space is replaced) in OTs, post transplant units, immuno-compromised patient areas/units need to be regulated.

Air handling in the OT including Air Quantity: Air is supplied through HEPA filters in the AHU. All the parameters are monitored and documented daily.

Factors influencing airborne contamination in operation theatres:

1. **Type of surgery**
2. **Quality of air provided**
3. **Rate of air exchange**
4. **Number of persons present in operating theatre**
5. **Movement of operating room personnel**
6. **Level of compliance with infection control practices**
7. **Quality of staff clothing**
8. **Quality of cleaning process**

Validation of OT system to be done as per ISO 14664 Standards and to necessarily include:

- Temperature and Humidity check
- Air particulate count
- Air Change Rate Calculation
- Air velocity at outlet of terminal filtration unit /filters
- Pressure Differential levels of the OT wrt ambient / adjoining areas
- Validation of HEPA Filters by appropriate tests like DOP (density of particles), etc.

6.5 Ultra-clean air:

For minimizing airborne particles, air must be circulated into the room with a velocity of at least 0.25 m/sec through a high-efficiency particulate air (HEPA) filter, which excludes particulate matter of defined size. If particles 0.3 microns in diameter and larger are removed, the air entering the room will be essentially clean and free of bacterial contaminants. This principle has been applied to microbiology laboratories, pharmacies, special intensive care units, and operation theatre Particulate count in OTs 100/cubic feet and about 1000 /cubic feet in post transplant areas.

Air sampling may be conducted during periods of construction and on a periodic basis to determine indoor air quality. Particulate sampling using an electronic air sampler is a practical method. Microbiologic sampling of air in health-care facilities remains controversial due to unresolved technical limitations. But use of slit sampling devices could be considered. Settle plates are not useful in HEPA filtered environments. Surface swab cultures are not useful except in outbreak scenarios.

No routine fogging is recommended, but may be considered (though usefulness not proven) after any civil or engineering works or as one of the corrective measures based on air sampling report.

6.6 Water:

The physical, chemical and bacteriological characteristics of water used in health care institutions must meet local regulations. The institution is responsible for the quality of water once it enters the building. Criteria for drinking water are usually not adequate for medical uses of water. Drinking-water should be safe for oral ingestion. National norms and international recommendations define appropriate criteria for clean drinking-water.

Unless adequate treatment is provided, faecal contamination may be sufficient to cause infection through food preparation, bathing, and during the general care of patients.

6.7 Food:

Quality and quantity of food are key factors for patient convalescence. Ensuring safe food is an important service delivery in health care. Bacterial food poisoning (acute gastroenteritis) is an infection or intoxication manifested by abdominal pain and diarrhoea, with or without vomiting or fever. The onset of symptoms may range from less than one to more than 48 hours after eating contaminated food. Usually, large numbers of organisms actively growing in food are required to initiate symptoms of infection or intoxication. Water, milk, and solid foods are all vehicles for transmission.

6.8. Waste

Health care waste is a potential reservoir of pathogenic microorganisms, and requires appropriate handling. The only waste which is clearly a risk for transmission of infection, however, is sharps contaminated with blood. Recommendations for classification and handling of different types of waste should be followed.

Biomedical Waste Management Rules should be followed to manage different types of infectious waste generated in the Hospital to prevent infections. [Published in the Gazette of India, Extraordinary, Part II, Section 3, Sub-section (i)] GOVERNMENT OF INDIA, MINISTRY OF ENVIRONMENT, FOREST AND CLIMATE CHANGE, NOTIFICATION, New Delhi, the 28th March, 2016 –Refer Chapter 11]

Chapter 7: INFLUENCE OF FACILITY DESIGN ON HEALTHCARE-ASSOCIATED INFECTION

Infection prevention and control requirements are critical to the planning of a healthcare facility. It has to be incorporated into plans and specifications. Different areas of a healthcare facility should be designed, constructed, furnished and equipped to minimize the risk of transmission of infection. In particular, the design and layout of the facility should facilitate the application of standard and transmission-based precautions by all staff. Many studies indicate that infection rates are lower when there is very good air and water quality, greater physical separation of patients and greater space per patient (with isolation where required).

Reducing airborne transmission:

Reservoirs for airborne pathogens include:

- Dust (e.g. spores of C. difficile or Aspergillus or Anthrax)
- Aerosols (e.g. TB specially MDR/XDR, severe acute respiratory syndrome [SARS], influenza etc)
- Skin scales shed by patients infected with MRSA.
- Most pathogens in healthcare settings originate from patients, staff, environment and visitors within the health care facilities.
- Other pathogens can enter buildings from outside air through dust that harbors spores of pathogens such as Aspergillus and organisms like Streptococci or Staphylococci.

How to reduce airborne transmission in health care facilities:

Approaches to reducing airborne transmission include:

- Installation of effective air filtration.
- Specifying appropriate ventilation systems and air change rates wherever applicable (e.g. Negative airflow pressure)
- Monitoring and control mechanism during construction or renovation
- Using single-bed rooms instead of multi-bed rooms whenever possible. If essential cohorting of patients with proper spacing of beds.
- In dental practices, engineering rules state there must be separation between inlet air for compressors and air conditioning outlets.

7.1 Filtration system:

An effective way to prevent infections is to control the source of pathogens.

- Heating, ventilation and air-conditioning systems control the concentration of airborne particulates in high risk areas, to minimize the risk of infection by means of air pressure, flow control and air filtration (the physical removal of particulates from air).
- The level of control should be proportional to the risk to patient. In acute healthcare settings, a commonly used approach to filtration is the use of HEPA filters.

- There is evidence that there is a lower incidence of infection when immune compromised and other high-acuity patients are housed in HEPA-filtered isolation rooms.

7.2 Ventilation systems and airflow control:

How to minimize spread of infection

- **Optimal ventilation rates**: The ventilation rate is a measure used to control indoor air quality, and in healthcare facilities is usually expressed as room air changes per hour (ACH). The peak efficiency for particle removal in the air space often occurs between 12 ACH and 15 ACH. Isolation rooms should have minimum of 12 ACH per hour.
- **Airflow patterns:**
  - Negative airflow pressure is preferred for rooms housing infectious patients to prevent the dispersion of pathogen-laden aerosols (e.g. MERS CoV, SARS etc.) dust and skin scales from the infected patient to other areas.
  - Positive airflow pressure is desirable to safeguard them from airborne pathogens entering from adjacent spaces in the care of immuno-compromised patients (e.g. surgical patients, patients with underlying chronic lung disease, or dialysis patients) or immune suppressed patients (e.g. transplant patients or cancer patients).
- Laminar air flow (LAF) is HEPA-filtered air blown into a room at a rate of 27 ± 3 m/min in a unidirectional pattern with 100–400 ACH). Laminar airflow (LAF) systems are thought to minimize contamination of the surgical field with airborne microbes and thus to contribute to reducing surgical site infections (SSI). However recent publications have questioned whether LAF ventilation confers any significant benefit.
- **Humidity:** needs to be controlled in the special areas like OTs.
- **Maintenance systems:** Ventilation and airflow control systems need to be monitored and maintained regularly by suitably qualified staff & should be under comprehensive annual maintenance contract.
- **What to do if in some part of health facility some construction or renovations are going on**: Effective control and prevention measures are necessary because such activities have been frequently implicated in outbreaks of airborne infection. The key to eliminating infections is to minimize the dust generated during the construction activity and to prevent dust infiltration into patient-care areas near the construction. One can install barriers between patient-care areas and construction/ renovation areas or generate negative air pressure for construction/renovation areas relative to patient-care areas by using portable HEPA filters and sealing patient windows.

Reducing infections spread through the physical environment:

The prevention of contact-spread of infections is of paramount importance in healthcare facilities. Contact contamination is generally recognized as the important transmission route of healthcare acquired infections, including pathogens such as MDROs, MRSA, *C. difficile* and VRE, which survive well on environmental surfaces and other reservoirs.

Environmental routes of contact-spread infections include direct person-to-person contact and indirect transmission via contaminated environmental surfaces.

- **Reducing surface contamination through hand-hygiene compliance: Most important key to prevent direct & indirect transmission via health care workers.**

- Facility for hand washing should be available & facility should be designed in such a way to have compliance with hand hygiene.
- Accessibility to alcohol based dispenser, sinks & basin along with soap will promote health care provider for compliance.
- Hand-hygiene compliance can be increased by providing a greater number of alcohol-based product dispensers, particularly if they are placed in appropriate locations (where clinical care is provided [e.g. bedside] or where indirect care tasks are performed). Hand hygiene products like hand rub should be available in each patient cabin/care area.

➢ **Personal protective equipment**

- It is also essential that all areas of the facility are designed to facilitate appropriate use of PPE.
- All rooms should have dedicated and accessible areas for storage of gowns, aprons, gloves, masks and protective eyewear.

➢ **Control of surface contamination through material selection**

- Cleaning of surface should be a key consideration while selecting appropriate floor and furniture in the health care facilities.
- Several design-related factors should be considered to minimize the risk of infection arising from contaminated surfaces. One needs to see the nature and type of contamination that is likely to occur and feasibility of its cleaning.
- Areas that may be in direct contact with blood and body substances (e.g. surfaces such as floors and bench tops) need to be made of impervious material that is smooth and easy to clean.
- **The high touched areas should be identified for more frequent cleaning.**

7.3 Health care flooring & furnishing:

Floor covering materials used in healthcare settings include but are not limited to: ceramic tiling, linoleum, rubber, textile floor covering, vinyl, sheet terrazzo, cork, timber laminates, mats and matting, cementinous toppings, seamless coatings and outdoor flooring.

Consider the following while selecting floor covering for a health care setting:

• Who is at risk of acquiring infection?

• What is the risk of exposure to the infectious agents?

• What is the nature of the possible infectious agents?

• How can the agent be transmitted? (e.g. airborne; through cleaning procedures or through contact especially in environments in which there are young children)

For infection prevention and control, the advantages of hard floor coverings include:

- Being easier to clean.
- Being easier to disinfect as required.
- Allowing use of the most appropriate disinfectant, rather than a product that is suitable for use on carpet.
- Costing less, as disinfectant is less expensive than steam cleaning, and steam cleaning may not be readily available.

- There is less surface area so hard floor coverings are less likely to act a as reservoir of infectious agents than carpet.
- When additional cleaning is required, hard floor surfaces are easier to clean than carpet.
- Surfaces near infected patients quickly become contaminated, creating numerous reservoirs that can transfer pathogens to patients and staff.
- Single-bed rooms can facilitate greater frequency of cleaning and decontamination, as there is limited impact on neighboring patients.
- Hand-hygiene compliance is likely to be improved through greater prominence of sinks or hand hygiene dispensers.

7.4 Furniture and furnishing: The CDC/HICPAC guidelines recommend minimizing the use of upholstered furniture in areas housing immuno-compromised patients. Blinds and curtains should be easy to clean and discourage the accumulation of dust. The VRE pathogen survived less well or for shorter periods on vinyl. Same should be adopted in India also.

7.5 **Reducing water-borne transmission**:

Contaminated water systems in healthcare settings (such as inadequately treated wastewater) may lead to the pollution of municipal water systems, enter surface or ground water, and affect people in the community.

7.5.1 Water supply system

- It should be designed and maintained with proper temperature and adequate pressure;
- Stagnation and back flow should be minimized and dead-end pipes should be avoided.
- To prevent the growth of *Legionella* and other bacteria, the CDC/HICPAC guidelines recommend that healthcare facilities maintain cold water at a temperature below 20°C, store hot water above 60°C, and circulate hot water with a minimum return temperature of 51°C.
- When the recommended standards cannot be achieved because of inadequate facilities that are unable to be renovated, other measures such as chlorine treatment, copper-silver ionization, or ultraviolet lights are recommended to ensure water quality and prevent infection.

7.5.2. Point-of-use fixtures

- Water fixtures such as sinks, faucets, aerators, showers, and toilets have been identified as potential reservoirs for pathogenic microorganisms.
- Regular cleaning, disinfection and preventative maintenance protocols should be followed, especially in areas housing immuno-compromised patients.

Summary:

The design of a healthcare facility can influence the transmission of healthcare-associated infections by air, water and contact with the physical environment.

Identify high risk areas:

High risk areas include : Intensive care units, High Dependency Unit Operation theatre, Emergency, Heart command, CSSD, Blood bank, Mortuary, Dialysis, Isolation rooms, Transplant ward Laboratory, Endoscopy unit, Kitchen.

Appropriate protocols to maintain these areas should be developed, implemented and monitored; any lapse in maintaining these areas can result in infection.

Key design features that minimize the transmission of infection include:

- Surface finishes that are easy to maintain and clean (floors, walls, benches, fixtures and fittings);
- Ventilation, air conditioning, cooling towers and water systems that meet the standards for the facility they are to service;
- The ability to isolate patients:
  - In a single room (infectious patients) or negative pressure room (to prevent transmission of airborne pathogens).
- Positive pressure rooms or use of laminar airflow filtration (LAF) for immuno- compromised patients;
  - Triaging of patients in waiting rooms with separate area for infectious patients;

- Appropriate work place design:
  - Separation of procedural and clean areas
  - Movement of work flow systems
  - Ready access to hand hygiene facilities
  - Adequate storage for all patient-care items;
  - Easily accessible storage for PPE;
- Adequate waste management procedures and linen handling;
- Involvement in demolition, construction and renovation projects of a multidisciplinary team that includes representation of infection prevention and control staff to coordinate preventive measures.
- Dedicated washrooms are a key factor in preventing the spread of *C. difficile* or SARS or pandemic influenza or Ebola, etc and other infectious agents that spread via enteric and contact mechanisms.

Chapter 8: HEALTHCARE ASSOCIATED INFECTION SURVEILLANCE

HOSPITAL ACQUIRED INFECTION SURVEILLANCE

Hospital acquired infection (HAI) Surveillance is a system that monitors the Hospital Associated infections in a hospital. HAI Surveillance encompasses collection, collation, analysis, interpretation and dissemination of relevant data related to HAI or the risk of acquiring HAIs and thereby it helps to guide corrective action based on accurate information on HAIs.

Role of Surveillance in reducing HCAI:

The healthcare associated infection (HCAI) rates among patients in a health care facility are an indicator of quality and safety of care. Surveillance of **HCAIs is a basic requirement for organizing and maintaining** an effective infection control program. Appropriate surveillance can substantially reduce healthcare-associated infections, morbidity and mortality.

The development of a surveillance process to monitor this rate is an essential first step to identify local problems and priorities, and evaluate the effectiveness of infection control policy/strategies. Thus there is need for active surveillance to monitor changing infection risks and identify needs for changes in control measures.

All healthcare facilities require to develop healthcare-associated infection surveillance system/program/protocol that aims at local data collection that results in timely feedback and action.

Aim & objectives:

The ultimate aim is the reduction of HCAIs, and therefore the costs for prevention. The specific objectives of a surveillance programme include:

- To provide baseline endemic information on the frequency and types of HCAI.
- To Identify outbreaks once endemic rates are known
- To identify trends manifested over a finite period, such as shifts in microbial pathogen spectrum, infection rates, etc.
- To detect and identify the breakdowns in infection prevention and control practices.
- To improve education and awareness of clinical staff and other hospital workers (including administrators) about HCAIS, antimicrobial resistance, costs and outcomes resulted from HCAIs, so that they appreciate the need for preventive actions.
- To establish priorities for infection control activities by monitoring trends/ incidence and distribution of HCAIs,
- To identify the need if any for new or intensified prevention programmes/protocols,
- To evaluate the impact of control and prevention measures so as to identify possible areas for improvement in patient care, and for further epidemiological studies (i.e. risk factor analysis).

The surveillance for infection acquired in the hospital may be passive or active.

- Passive surveillance consists of the reporting of any occurrence of suspected HAI by clinicians. This is poor and not an efficient method to track HAIs.

- Active surveillance is the systematic collection of data by a designated surveillance team. This is the method recommended by CDC.

ACTIVE HAI SURVEILLANCE

Active surveillance includes:

- Prevalence study (cross-sectional/transverse)
- Incidence study (continuous/longitudinal)

Prevalence study (cross-sectional/transverse)

Infections in all patients hospitalized at a given point in time are identified (point prevalence) in the entire hospital, or on selected units. Typically, a team of trained investigators visits every patient of the hospital on a single day, reviewing medical and nursing charts, interviewing the clinical staff to identify infected patients, and collecting risk factor data. The outcome measure is a prevalence rate. Repeated prevalence surveys can be useful to monitor trends by comparing rates in a unit, or in a hospital, over time.

Incidence study (continuous/longitudinal)

Prospective identification of new infections (incidence surveillance) requires monitoring of all patients within a defined population for a specified time period. Patients are followed throughout their stay, and sometimes after discharge (e.g. post-discharge surveillance for surgical site infections).

- It is more effective in detecting differences in infection rates, to follow trends, to link infections to risk factors, and for inter-hospital and inter-unit comparisons. It is usually undertaken only for selected high-risk units on an ongoing basis (i.e. in intensive care units), or for a limited period, focusing on selected infections and specialties (i.e. 3 months in surgery) as this surveillance is more labour-intensive than a prevalence survey, more time-consuming, and costly.

Active HAI Surveillance is done by either-

- Manual data collection by using HAI Surveillance forms and then entry into excel for statistical analysis or
- Use of special infection control software or self formatted spread sheets or databases- To collect data, followed by statistical analysis, graphical representation and report generation.

HAI Surveillance by Manual data collection:

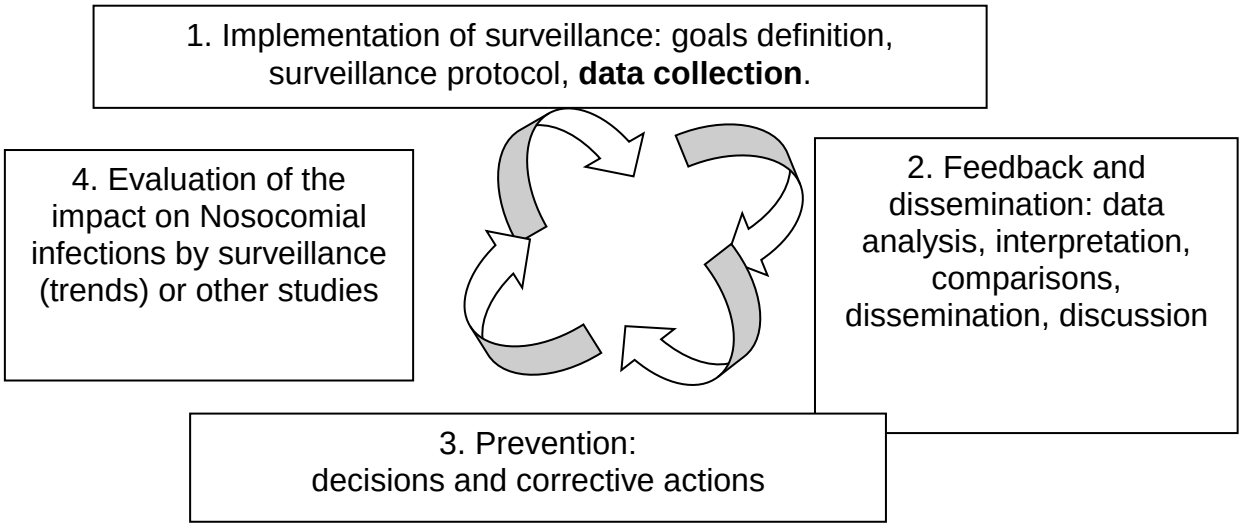
The health care facility should adopt an Active HAI Surveillance System targeting on both) High risk areas i.e. the intensive care units (ICU's) and other high dependency units and ii) Low risk areas i.e. general wards (table-1).

1. **Where it is done-** Surveillance should be performed daily by designated ICNs (Infection Control Nurses) on all patients in the ICU's & wards. If the patient is shifted from ICU to another ICU/ward, then the follow up should be done in the second place.
2. **HAI Surveillance Form:** Data should be collected manually by using HAI Surveillance Form (figure-1). Separate HAI Surveillance forms should be followed for adult and pediatric patients. Data regarding the following HAIs should be documented.
    a. Catheter Associated Urinary Tract Infections (CAUTI)
    b. Ventilator Associated Pneumonia (VAP)
    c. Central Line Associated Blood Stream Infections (CLABSI)
    d. Surgical Site Infections (SSI)

3. **Daily Appraisal Form-** This form should be used to determine the denominators of infection rates such as :
   - Monthly catheter days
   - Monthly central line days
   - Monthly ventilator days
4. **Data Entry-** Data should be entered into excel on daily basis for a month and the data should be analyzed at the end of the month, to find out the four standard HAI rates.
5. **Definitions-**The standard CDC / NSHN definition of HAIs should be followed. The incidence of CAUTI, CLABSI and VAP are calculated for 1000 device days and the prevalence of SSI is calculated for 100 surgeries done. (table-2)
6. **Data Analysis-** The data should be analyzed to generate a monthly report of HAI rate of the hospital. Monthly HAI Surveillance report is used for:
   - Comparison between two consecutive months or
   - Between ICUs of same month or
   - To observe the trend of HAI's over a specified period of time.
   - TO compare the HAIs rates of the hospital with that of CDC / NSHN HAI rate (75% percentile).
7. **Feedback & Dissemination**: The mostly HAI surveillance report should be shared with all clinical departments as well as to the Director, Medical Superintendent and the Nursing Superintendent.
8. HICC calls a meeting with the concerned ICUs and Wards after the dispatch of the reports. The interventions planned by each ICU/ward on the basis of the HAI rates should be monitored by HICC.

Prevention: The final aim of surveillance is to decrease nosocomial infections and reduce costs. An effective surveillance system must identify priorities for preventive interventions and improvement in quality of care. By providing quality indicators, surveillance enables the infection control programme, in collaboration with patient care units, to improve practice, and to define and monitor new prevention policies.

Fig 1: Surveillance is a circular process



Source: WHO 2002

Table-1: List of ICU/Wards where HAI Surveillance may be done

ICU/HIGH RISK AREA		WARDS/LOW RISK AREA	
Medical ICU- 1. Critical care unit (CCU) 2. Cardiac Critical care unit (CCCU) 3. Medicine ICU (MICU) 4. Medicine stepped down ICU 5. Neuromedicine ICU 6. Medical Oncology ICU 7. Neonatal ICU (NICU) 8. Pediatric PICU **Transplantation** 1. Bone marrow transplantation unit (BMT) 2. Kidney transplantation unit (KTP) 3. Liver transplantation unit	**Surgical ICU-** 1. Surgery ICU (SICU) 2. Neurosurgery ICU 3. Pediatric Surgery ICU 4. Plastic Surgery ICU 5. Surgical Gastroenterology ICU 6. Urology ICU 7. Trauma care ICU (TC ICU) 8. CTVS ICU 9. Obstetric and Gynecology ICU **Others-** Burns wards	**Medical wards-** 1. Skin ward 2. Infectious Diseases ward 3. Causality ward 4. Medicine ward 5. Cardiology ward 6. Endocrine ward 7. Immunology ward 8. Nephrology ward 9. Neuromedicine ward 10. Medical Oncology ward 11. Medical Gastroenterology ward 12. Stroke recovery ward 13. Pediatrics ward	**Surgical wards-** 1. Surgery ward 2. Orthopedics wards 3. Plastic surgery ward 4. Surgical Gastroenterology ward 5. Surgical Oncology ward 6. Urology ward 7. Eclampsia ward 8. Antenatal ward 9. Postnatal ward 10. Gynaecology ward 11. LSCS Post operative ward 12. Gynaecology Post-operative ward 13. Trauma Care ward 14. CTVS ward 15. Neurosurgery ward 16. Paediatric Surgery ward

Table 2: Formulae for Calculation of HAI Infection Rates

HAI Infection Rates		Formulae
VAP Rate	=	No. of VAP cases/ total no. of ventilator days X 1000
CLABSI Rate	=	No. of CLABSI cases/ total no. of central line days X 1000
CA-UTI Rate	=	No. of CA-UTI cases/ total no. of catheter days X 1000
SSI Rate	=	No. of SSI/ No. of surgeries done X 100

Figure-1a: Sample of a HAI Surveillance form (Adult), Source: JIPMER, Pondicherry (front side)

HOSPITAL ACQUIRED INFECTION SURVEILLANCE FORM (ADULT) Page-1

Patient Name:	H. No	Age:	Sex: M / F	ICU/Ward
Department	Admitting Unit:	Dt. of Adm.		Dt. Of Adm.to ICU-
Provisional Diagnosis:		Final Diagnosis		

Outcome:	Transfer out to ward/unit name with date	LAMA on:	Discharged on	Expired on :

Risk factors/Co-morbidities: (Circle features present at admission)

DM	HTN	CLD	CKD	HIV	TB	Transplantation	Immunosuppressant	any other

Type of Surgery - **Date of Surgery:**

Type of device used and Device Days

Intervention	Date of Insertion	Date of Removal	Device days
Urinary Catheter			
Mechanical Ventilation/ ET tube			
Tracheostomy			
Central Venous Line- Femoral/ Brachial/ Jugular/ Subclavian			
Intercostal or Surgical Site Drainage tube			
Dialysis Sheath			

Daily Monitoring

	D-1	D-2	D-3	D-4	D-5	D-6	D-7	D-8	D-9	D-10	D-11	D-12	D-13	D-14	D-15
Date															
Fever & Chills															
Hypotension (SBP ≤ 90)															
Worsening gas exchange															
1. Purulent sputum or 2. ↑secretions															
1. Discharge or 2. abscess at surgical															
1.Cough 2. Tachypnea or 3. dyspnea															
WBC count/mm^3															
X-ray:-New Patch/ Cavitation/Consolidation															

Microbiology Culture Report

Date	Sample	Organism isolated

Fig 1b.Sample of a HAI Surveillance form (Adult), Source: JIPMER, Pondicherry (Continued.., back side of the form)

HOSPITAL ACQUIRED INFECTION SURVEILLANCE FORM (ADULT) Page-2

CAUTI(CATHETER ASSCOCIATED UTI) YES/NO, If Yes, Date Of Onset-

1.	Patient has indwelling urinary catheter in place for >2 calendar day						Yes/No
2.	Urinary catheter was in place on the day of sample collection or the day before						Yes/No
3.	At least one of the following	Fever (>100.4ºF)	Dysuria	Frequency	Urgency	Suprapubic tenderness	Loin pain
4.	Positive culture (Not more than two organisms with at least one organism having $\geq 10^5$CFU/ml)						Yes/No

CLABSI (CENTRAL LINE ASSCOCIATED BLOODSTREAM INFECTION) YES/NO, If Yes, Date Of Onset-

1.	Patient has central line in place for 2 days or more				Yes/No
2.	Central line was in place on the day of sample collection or the day before				Yes/No
3.	Organism identified from blood (Not related to infection at any other site)				Yes/No
4.	At least one of the following	Fever (>100.4ºF)	Chills	Hypotension (SBP $\leq$ 90)	Children <1 year:- Hypothermia (<37 ºC) or apnea or bradycardia

VAP (VENTILLATOR ASSOCIATED PNEUMONIA) YES/NO, If Yes, Date Of Onset-

1.	Imaging (Chest X-Ray)		
	Underlying pulmonary / cardiac disease		Yes/No
	If the above mentioned condition is Yes $\geq$ 2 / No $\geq$ 1 CXR - shows at least ***one*** of the following		
	New or progressive and persistent infiltrate / Consolidation / Cavitation		Yes/No
2.	Clinical (Signs and symptoms)		
a)	Major - At least ***one*** of the following:		
	Fever (>38.0°C or >100.4°F)		Yes/No
	Leukopenia (<4000 WBC/mm3) or leukocytosis (>12,000 WBC/mm3)		Yes/No
	For adults >70 years old, altered mental status with no other recognized cause		Yes/No
b)	Minor - At least ***one/ two*** of the following		
	New onset of purulent sputum, or increased respiratory secretions		Yes/No
	New onset or worsening cough, or dyspnea, or tachypnea		Yes/No
	Rales or bronchial breath sounds		Yes/No
	Worsening gas exchange (e.g.,O2 desaturations, PF ratio < 240, increased oxygen requirements)		Yes/No
3.	Lab findings – At least ***one*** of the following:		
	Positive bacterial culture report (BAL, Pleural fluid, Tracheal aspirate, Biopsy)		Yes/No
	Positive histopathology report		Yes/No
	Positive test for Virus / Legionella / Chlamydia/Mycoplasma/fungal		Yes/No
*	CXR + 1 Major + 2 Minor		PNU1
**	CXR + 1 Major + 1 Minor + 1 Lab finding		PNU2

SSI (SURGICAL SITE INFECTION) YES/NO, If Yes, Date Of Onset-

1.	Patient had a surgery within past 30 days or Surgery within 90 days if implant in place or breast, cardiac surgery or herniorrhaphy				Yes/No
2.	Signs developed how many hrs/days after surgery				
3.	Wound class (Tick appropriate)	Clean	Clean contaminated	Contaminated	Dirty
4.	PATOS (Present At the Time Of Surgery)				Yes/No
5.	Any one of the following				
	SISSI*	Purulent drainage from superficial incision / positive culture (pus/ tissue)			Yes/No
	DISSI*	Abscess involving the deeper layers / positive culture / imaging evidence			Yes/No
	Organ/space SSI	Purulent drainage from drain through the organ or space/ positive culture/ imaging evidence			Yes/No

*SISSI - Superficial Incisional SSI; DISSI- Deep Incisional SSI;

Name & Signature of the ICU/Ward Liaison **Name & Signature of the ICN**

Fig 2. Sample of HAI surveillance form (Infant) (Source: JIPMER, Puducherry)

HOSPITAL ACQUIRED INFECTION SURVEILLANCE FORM (Infant <1 yr) Page-1

Patient Name:	H. No	Age: NB	Sex: M / F	ICU: NICU /
Department	Admitting Unit:	Date of Admission		Dt. of Adm. to ICU-
Provisional Diagnosis:		Final Diagnosis		

Outcome:	Transfer out to ward/unit name with date	LAMA on:	Discharged on	Expired on :

Risk factors/Co-morbidities: (Circle features present at admission)

DM	HTN	CLD	CKD	HIV	TB	Transplantation	Immunosuppressant	any other

Type of Surgery - **Date of Surgery:**

Type of device used and Device Days

Intervention	**Date of Insertion**	**Date of Removal**	**Device days**
Urinary Catheter			
Mechanical Ventilation/ ET tube			
Tracheostomy			
CVC-Femoral/Brachial/ Jugular/ Subclavian/PICC/UVC			
Intercostal or Surgical Site Drainage tube			
Dialysis Sheath or Suprapubic /Nephostomy catheter			

Daily Monitoring

	D-1	D-2	D-3	D-4	D-5	D-6	D-7	D-8	D-9	D-10	D-11	D-12	D-13	D-14	D-15
Date															
1. Fever or 2. Hypothermia															
Hypotension (SBP ≤ 90)															
Worsening gas exchange															
1.Purulent sputum or2.↑ secretions															
1.Apnea or 2.Tachypnea															
1.Brady or 2.Tachycardia															
1. Lethargy or 2. Vomiting															
WBC count / mm^3															
1.Discharge or 2.Abscess at surgical site															
X-ray:-New Patch/ Cavitation/Consolidation/ Pneumatoceles															

Microbiology Culture Report

Date	**Sample**	**Organism isolated**

Fig 2. Sample of HAI surveillance form (Infant) (Source: JIPMER, Puducherry)(Continued.., back side of the form)

HOSPITAL ACQUIRED INFECTION SURVEILLANCE FORM (Infant <1 yr) Page-2

CA-UTI(CATHETER ASSCOCIATED UTI)- YES/NO, If Yes, Date Of Onset-

1.	Patient has indwelling urinary catheter in place for >2 calendar day						Yes/No
2.	Urinary catheter was in place on the day of sample collection or the day before						Yes/No
3.	At least one of the following	Fever/ hypothermia	Apnoea*	Bradycardia*	Lethargy*	Vomiting*	Suprapubic tenderness*
4.	Positive culture (Not more than two organisms with at least one organism having $\geq 10^5$CFU/ml)						Yes/No

*With no other recognized cause

CLABSI (CENTRAL LINE ASSCOCIATED BLOODSTREAM INFECTION)- YES/NO, If Yes, Date Of Onset-

1.	Patient has central line in place for 2 days or more				Yes/No
2.	Central line was in place on the day of sample collection or the day before				Yes/No
3.	Organism identified from blood (Not related to infection at any other site)				Yes/No
4.	At least one of the following	Fever (>100.4°F)	Chills	Hypotension (SBP ≤ 90)	Children <1 year:- Hypothermia (<37 °C) or apnea or bradycardia

VAP (VENTILLATOR ASSOCIATED PNEUMONIA)- YES/NO, If Yes, Date Of Onset-

1.	Worsening gas exchange (e.g., O2 desaturations [e.g. pulse oximetry <94%], increased oxygen requirements, or increased ventilator demand)	
2.	And at least ***three*** of the following:	Yes/No
	Temperature instability	Yes/No
	Leukopenia (<4000 WBC/mm3) or leukocytosis (>15,000 WBC/mm3) and left shift (>10% band forms)	Yes/No
	New onset of purulent sputum or change in character of sputum, or increased respiratory secretions, or increased suctioning requirements	Yes/No
	Apnea, tachypnea , nasal flaring with retraction of chest wall or nasal flaring with grunting	Yes/No
	Wheezing, rales, or rhonchi	Yes/No
	Cough	Yes/No
3	Chest X Ray shows at least ***one*** of the following	
	New or progressive and persistent infiltrate	Yes/No
	Consolidation	Yes/No
	Cavitation	Yes/No
	Pneumatoceles	Yes/No
	Bradycardia (<100 beats/min) or tachycardia (>170 beats/min)	

SSI (SURGICAL SITE INFECTION) YES/NO, If Yes, Date Of Onset-

1.	Patient had a surgery within past 30 days or Surgery within 90 days if implant in place or breast, cardiac surgery or herniorrhaphy				Yes/No
2.	Signs developed how many hrs/days after surgery				
3.	Wound class (Tick appropriate)	Clean	Clean contaminated	Contaminated	Dirty
4.	PATOS (Present At the Time Of Surgery)				Yes/No
5.	Any one of the following				
	SISSI*	Purulent drainage from superficial incision / positive culture (pus/ tissue)			Yes/No
	DISSI*	Abscess involving the deeper layers / positive culture / imaging evidence			Yes/No
	Organ/space SSI	Purulent drainage from drain through the organ or space/ positive culture/ imaging evidence			Yes/No

*SISSI - Superficial Incisional SSI; DISSI- Deep Incisional SSI;

Name & Signature of the ICU/Ward Liaison **Name & Signature of the ICN**

CDC NHSN 2015 surveillance definitions for HAIs

Ventilator Associated Event (VAE):

VAE: According to the latest guidelines of Centre for Disease Control National Healthcare Safety Network (CDC-NHSN), Ventilator Associated Event (VAE) includes

Ventilator Associated Condition (VAC):

Patient has a baseline period of stability or improvement on the ventilator, defined by ≥ 2 calendar days of stable or decreasing daily minimum FiO2 or PEEP values. The baseline period is defined as the 2 calendar days immediately preceding the first day of increased daily minimum PEEP or FiO2

And
After a period of stability or improvement on the ventilator, the patient has at least one of the following indicators of worsening oxygenation:
Daily min FiO2 increase ≥0.20(20 points) for≥2 days (*after 2+ days of stable or decreasing daily minimum values)*
OR
Daily min PEEP increase ≥ 3 cm H2O for ≥ 2 days

IVAC – Infection-related Ventilator-Associated Complication:
Patient meets criteria for VAC AND
On or after calendar day 3 of mechanical ventilation and within 2 calendar days before or after the onset of worsening oxygenation, the patient meets both of the following criteria:

1.Temperature >38°C or <36°C, OR white blood cell count ≥12,000 cells/mm3 or ≤4,000 cells/mm3

and
2. a new antimicrobial agent is started and is continued for ≥ 4 days

Possible VAP – Possible Ventilator-Associated Pneumonia

Patient meets criteria for VAC and IVAC
and
on or after calendar day 3 of mechanical ventilation and within 2 calendar days before or after the onset of worsening oxygenation, ONE of the following criteria is met:

Criterion 1: Positive culture of one of the following specimens, meeting quantitative or semi-quantitative thresholds, without requirement for purulent respiratory secretions:
(i) Endotracheal aspirate, ≥ 105 CFU/ml or corresponding semi-quantitative result

(ii) Bronchoalveolar lavage, ≥ 104 CFU/ml or corresponding semi-quantitative result

(iii) Lung tissue, ≥ 104 CFU/g or corresponding semi-quantitative result

(iv) Protected specimen brush, ≥ 103 CFU/ml or corresponding semi-quantitative result.

Criterion 2: Purulent respiratory secretions (defined as secretions from the lungs, bronchi, or trachea that contain >25 neutrophils and <10 squamous epithelial cells per low power field [lpf, x100]) plus a positive culture of one of the following specimens (qualitative culture, or quantitative/semi-quantitative culture without sufficient growth to meet criterion #1)

i) Sputum

(ii) Endotracheal aspirate

(iii) Bronchoalveolar lavage

(iv) Lung tissue

(v) Protected specimen brush

C. Criterion 3: One of the following positive tests:

(i) Pleural fluid culture (where specimen was obtained during thoracocentesis or initial placement of chest tube and NOT from an indwelling chest tube)

(ii) Lung histopathology, defined as:
1. abscess formation or foci of consolidation with intense neutrophil accumulation in bronchioles and alveoli;

2. evidence of lung parenchyma invasion by fungi (hyphae, pseudohyphae or yeast forms);

3. evidence of infection with the viral pathogens listed below based on results of immunohistochemical assays, cytology, or microscopy performed on lung tissue.

(iii) Diagnostic test for *Legionella* species

(iv) Diagnostic test on respiratory secretions for influenza virus, respiratory syncytial virus, adenovirus, parainfluenza virus, rhinovirus, human metapneumovirus, coronavirus.

Patient on mechanical ventilation > 2 days
and
Baseline period of stability or improvement, followed by sustained period of worsening oxygenation =Ventilator-Associated Condition (VAC)
+
General, objective evidence of infection/inflammation = Infection-Related Ventilator-Associated Complication (IVAC)
+
Positive results of laboratory/microbiological testing = Possible VAP

<u>Central line-associated BSI (CLABSI):</u>

A laboratory-confirmed bloodstream infection (LCBI) where central line (CL) was in place for >2 calendar days on the date of event, with day of device placement being Day 1,

and

A CL was in place on the date of event or the day before. If a CL was in place for >2 calendar days and then removed, the date of event of the LCBI must be the day of discontinuation or the next day.

As per latest (January 2015) guidelines of Centre for Disease Control National Healthcare Safety Network (CDC-NHSN), criteria for Laboratory-Confirmed Blood Stream Infection (LCBI) are as follows:

LCB1: Patient has a recognized pathogen cultured from one or more blood cultures and organism cultured from blood is not related to an infection at another site.

LCB2: Patient has at least one of the following signs or symptoms:

Fever (>38oC), chills, or hypotension

and

positive laboratory results are not related to an infection at another site

and

the same common commensal (i.e., diphtheroids [*Corynebacterium* spp. [not *C. diphtheriae*], *Bacillus* spp. [not *B. anthracis*], *Propionibacterium* spp., coagulase-negative staphylococci [including *S. epidermidis*], viridans group *Streptococci*, *Aerococcus* spp., and *Micrococcus* spp.) is cultured from two or more blood cultures drawn on separate occasions.

Criterion elements must occur within the Infection Window Period (the seven-day time period which includes the date the positive blood culture was collected, the 3 calendar days before and the 3 calendar days after).

Catheter Associated Urinary Tract Infection (CAUTI):

Definition:

(As per CDC-NHSN January 2015) Catheter Associated Urinary Tract Infection (CAUTI): A laboratory-confirmed urinary tract infection (UTI) as per either criteria listed below:

Criterion A includes 1,2 and 3 below

1. Patient has an indwelling urinary catheter in place for the entire day on the date of event and such catheter had been in place for >2 calendar days, on that date (day of device placement = Day 1)
2. Patient has at least one of the following signs or symptoms
Fever (>38.0°C)
• Suprapubic tenderness*
• Costovertebral angle pain or tenderness*
3. Patient has a urine culture with no more than two species of organisms, at least one of which is a bacteria of ≥105 CFU/ml.

Criterion B includes 1, 2, and 3 below:

1. Patient had an indwelling urinary catheter in place for >2 calendar days which was removed on the day of, or day before the date of event

2. Patient has at least one of the following signs or symptoms :

- Fever (>38◦C)
- suprapubic tenderness
- Urgency
- Frequency
- Dysuria
- Suprapubic tenderness
- Costovertebral angle pain or tenderness

3. Patient has a urine culture with no more than two species of organisms, at least one of which is a bacteria of ≥105 CFU/ml.

How to calculate the Device days?

Total number of days of exposure to the device (central line, ventilator, or urinary catheter) by all of the patients in the selected population during the selected time period at the same time each day. (One or more central lines in a patient are to be taken as one)

Figure-3: Sample of a Daily appraisal form, Source: JIPMER, Pondicherry

DAILY APPRAISAL FORM FOR THE MONTH……..

Ward/ICU- **Bed strength-**

Date	Occupied beds	No. of Patients on catheter	No. of Patients on central line	No. of Patients on ventilator	No. of newly operated Patients ICU/Ward
1					
2					
3					
4					
5					
6					
7					
8					
9					
10					
11					
12					
13					
14					
15					
16					
17					
18					
19					
20					
21					
22					
23					
24					
25					
26					
27					
28					
29					
30					
31					

Chapter 9: INVESTIGATION OF AN OUTBREAK

An outbreak may be defined as the occurrence of infections at a rate greater than that expected within a specific geographical area and over a defined period of time. In the HAI outbreak context, geographical area may be hospital, wards, or operation theatres. When there are more cases of infection with the same organism than would normally be expected in one area or period of time, this constitutes an outbreak. It is important to investigate an outbreak immediately, as the availability and quality of microbiological evidence and epidemiological data diminishes rapidly with time between illness and investigation.

Commonly detected outbreaks involve:

- MRSA
- Multi-resistant *Enterbacteriacae* or *Pseudomonads*
- Diarrhoeal pathogens (e.g. Salmonella, Campylobacter, norovirus)
- Respiratory pathogens (e.g. influenza, RSV)
- Measles (rubeola), chickenpox (varicella)
- Hepatitis A
- C. difficile enterocolitis
- Legionnaires' disease.

9.1 Objectives:

i. Prompt investigation of an Outbreak of hospital acquired infection.

ii. To prevent morbidity, cost and institutional image due to nosocomial infection.

iii. To sustained improvement in patient care practices.

In practice many steps are taken more or less simultaneously, while the results of investigations and implementation of strategies to contain and control will vary with the availability and timeliness of information and seriousness of the outbreak. The steps for investigating outbreaks in healthcare facilities are the same as for community based outbreaks. All outbreaks, however minor, should be investigated promptly and thoroughly and the outcomes of the investigations documented.

The outbreak response may differ according to the nature of disease, the virulence of the organism and the vulnerability of the patients concerned, however the principles that underlie an outbreak investigation are similar: identification of the etiological agent; the route(s) of transmission; exposure factors and the population at risk.

9.2 Steps in investigation of an outbreak:

- Identifying an outbreak
- Planning the investigation
- Case definition
- Preparing formats & data collection
- Describing the outbreak

- Preparing Report
- Formulating a hypothesis
- Testing hypothesis
- Implement ongoing control measures and follow-up
- Communication

9.2.1 Early identification of an outbreak is important to limit transmission among patients by health care workers or through contaminated materials. A potential problem may be initially identified by nurses, physicians, microbiologists, or any other health care worker. Outbreaks can be identified through following approach:

- Establish background rate of disease.
- Consider if observed number of cases is in excess of the usual number and cases are typical.
- Examine surveillance data.

Every outbreak identified must be verified and confirmed for the presence of an outbreak.

9.2.2 Notification & confirmation of an outbreak: When an outbreak is identified by health care worker, notify the appropriate individuals and departments in the institution of the problem. It may include the in charge unit, superintendent, infection committee team incharge, or any designated authority immediately.

Once the outbreak is reported to the designated authority,Rapid Response Team (RRT) needs to be formulated. This will vary according to location/ resources, made up of one or more people. In general, it consist of Administrator from medical and nursing wing, infection control team member secretary, epidemiologist, clinical microbiologist ,others as defined by circumstances.

Verify outbreak by reviewing preliminary information on the number of potential cases, available microbiology, severity of the problem, and demographic data of person(s), place and time. Confirm the clinical diagnosis based on the symptoms and laboratory reports with the help of clinicians and microbiologist. Additional laboratory tests if necessary, e.g. molecular typing of organisms to confirm locality.

To confirm the outbreak, the number of cases or isolates observed during the putative outbreak period is compared with the number of cases (or isolates) reported during the previous period, or with the number of cases (or isolates) reported in the same period of time one month or one year earlier.

9.2.3 Case definition: A case definition should be developed. Establish a set of standard criteria to decide whether or not a person has the disease of concern. It must include a unit of time and place and specific biological and/or clinical criteria. Clinical Microbiologist & senior physician should be responsible for finalizing the case definition. A gradient of definition (as lab confirmed, probable or suspected case) is often helpful. Identification of the index case should be stressed.

9.2.4 Preparing data formats & Data collection:

A data collection form for case-finding should be developed for finding the cases. Collect the following type of information:

- Demographic characteristics (e.g. age, sex, area of address, admission area).

- Clinical information (e.g. cause of admission/leading diagnosis, date of admission, date of any surgery, prior antimicrobials onset of symptoms and signs, frequency and duration of clinical features associated with the outbreak, treatments, devices).
- Risk factor information.
- Diagnostic sample collection information.
- Any other potentially relevant data.

Depend upon the outbreak; data collection form may vary with the content.

The form must be straightforward to use. It is completed with information extracted from medical records, microbiology reports, pharmacy reports and log books of affected wards. The data collected must also be checked for validity. It may be appropriate to store selected biological materials for future analysis in anticipation that new diagnostic methods may become available.Line listing of the cases including death if any should be prepared

9.2.5 Describing the outbreak

RRT should review descriptive epidemiology from the collected data as per the line list. The detailed description includes:

- Time (date and time of onset; admission wise details in various wards, record relevant events in a timeline),
- Place (information that provides information on possible source of agent and nature of exposure),
- Persons (Age, Sex. Occupation, residence)

The graphic representation of the distribution of cases by time of onset is an epidemic curve. The epidemic curve should distinguish between confirmed and probable cases. The shape of the epidemic curve may suggest a single point source, ongoing transmission, or an intermittent source.
These data allow the calculation of an attack rate, defined by:

$$\frac{\text{Number of people at risk who are infected}}{\text{Total number of people at risk}}$$

The attack rate can also be calculated stratified by relevant characteristics such as sex, age, location, or specific exposure (ventilation, catheterization, operating rooms, and occupational exposure).

At the end of the descriptive analysis, it should be possible to:

- Identify group at risk: number of people affected, time of onset and place of onset and personal characteristics.
- Tentatively identify the source and route of infection: This information will help to suggest the intervention so as to control the outbreak or hating of occurring of new cases
- Initial precautionary measures: initial precautionary measure suggested by the RRT should be implemented immediately.
    - ✓ Use of standard precautions and appropriate transmission-based precautions
    - ✓ Increase frequency and efficiency of environmental cleaning using appropriate products;
    - ✓ Prophylactic treatment/immunization
    - ✓ Antibiotic restrictions
    - ✓ Exclusion of cases from high risk activities
    - ✓ Isolation and/or cohorting of patients

- ✓ Restricting movement of patients, staff and visitors
- ✓ Screening of patients with isolation of patients and cohorting of contacts;
- ✓ Provision of health information and advice

- Formulate a hypothesis on the type of infection (exogenous, endogenous).
- Suggest and implement initial control measures.

9.2.6 Formulating a hypothesis: Develop hypotheses from the factual information gathered to date on potential source, vector, pathogen and route of transmission.

This includes identifying a potential exposure (type and route) for the outbreak, common links from the collected information. A review of the current literature may help identify possible routes of infection for the suspected or known infecting agents. Environmental test result where appropriate should take into consideration.

9.2.7 Testing a hypothesis: Perform epidemiological study for testing the formulated hypothesis with the help of epidemiologist form the RRT. A case-control study is the most common approach to hypothesis testing. This compares the frequency of a risk factor in a group of cases (i.e. individuals with the nosocomial infection) and in a group of controls (i.e. individuals without the infection). Controls must be carefully selected to limit bias. Two or more controls for each case may be necessary to provide sufficient statistical power. The strength of association between exposure and disease is quantified by the odds ratio in case control studies with a 95% confidence interval. The role of chance, confounding, and bias should be considered in interpreting results. The appropriate statistical methods can be applied as per the requirement.

Carry out further studies if necessary to support the hypothesis or if analytic studies do not confirm the hypothesis; Further study to refine case definition, may involve testing of environmental samples, food samples or environmental screening.

9.2.8 Implement ongoing control/ preventive measures:

The aims are:

- To control the current outbreak by interrupting the chain of transmission.
- To prevent future occurrence of similar outbreaks.

Review the measures initiated for immediate control (step 14.2.5.) for its adequacy to reduce the risk of transmission.

Implement appropriate ongoing control measures and strategies to prevent further illness:

- ✓ Restrict spread from the case
- ✓ Interrupt chain of infection
- ✓ Interrupt transmission or reduce exposure
- ✓ Reduce susceptibility to infection
- ✓ Assessment of policy, regulations, standards

Communicate and coordinate with all stakeholders: Reinforcement of infection control precautions to staff, patients and visitors.

Make plans to evaluate their effectiveness

- ✓ Document type and time of implementation of infection control measures.
- ✓ Monitor factors contributing or affected by outbreak and any associated changes.

This is also an opportunity to initiate or improve a surveillance system to facilitate evaluation of the efficacy of the control procedures instituted. Continuous surveillance may be implemented in high-risk units as per HAI surveillance chapter.

9.2.9 Communication

During the investigation of an outbreak, timely, up to- date information must be communicated to the hospital administration, public health authorities, and, in some cases, to the public. Information may be provided to the public and to the media with agreement of the outbreak team, administration and local authorities.

A final report on the outbreak investigation should be prepared. It should describe the outbreak, interventions, and effectiveness, and summarize the contribution of each team member participating in the investigation. It should also make recommendations to prevent future occurrence. This report can be published in the medical literature, and may be considered as a legal document.

Table 1: Immediate control measures for outbreak management

Type of transmission suspected	Suggested action
Cross-transmission (transmission between individuals)	Patient isolation and barrier precautions determined byinfectious agent(s)
Hand transmission	Improvements in hand washing; cohorting.
Airborne agent	Patient isolation with appropriate ventilation.
Agent present in water, waterborne agent	Checking of water supply and all liquid containers. Use of disposable devices.
Food borne agent	Elimination of the food at risk.

Health-care facility preparedness planning for acute respiratory infection epidemics

The SARS outbreak of the early 2000s, and the influenza pandemic (H1N1) 2009, highlighted the importance of preparedness to reduce the spread of potentially epidemic or pandemic ARIs. Health-care facilities should prepare for communicable disease emergencies by (*185-188*):

• Organizing permanent IPC activities, surveillance and training of dedicated personnel and clinical staff;

• Creating a multidisciplinary group within the health-care facility to develop a preparedness plan;

• Developing a preparedness plan in the health-care facility;

• Performing a plan evaluation and monitoring exercise, and updating the plan as necessary;

• Strengthening liaison with other levels of the health-care system and public health authorities.

Rationale

Most of the population will have no immunity against a new respiratory virus that could potentially cause an epidemic or pandemic. Thus, if the initial containment fails, a substantial proportion of the population, including health-care workers, may fall ill and require health-care services. There may be a need to manage large numbers of ill patients requiring various levels of health care, and to contain the spread of ARIs of potential concern associated with heath care. Preparedness of health-care facilities is considered an essential part of general emergency preparedness plans (*189, 190*). The main goals are to:

- Identify, isolate and report early cases of a putative epidemic or pandemic ARI virus;
- Keep the health-care system functioning for pandemic and non-pandemic patients; and

- Reduce the risk of pandemic ARI transmission associated with health care.

The capacity of the health-care facility to respond efficiently to epidemic or pandemic threats at any given moment is highly dependent on existing standards of practice.

Components of health-care facility pandemic acute respiratory infection preparedness plans

These plans should take into account the geographical location of the facility and the progress of the ongoing pandemic, if any. The strategy should include actions to be taken Health-care facility preparedness planning for acute respiratory infection epidemics before, during, and after the epidemic or pandemic event and be part of the overall Emergency Response Plan, based on the health-care facility's risk assessment. Issues related to communication, IPC, occupational health, patient flow and discharge planning, mortuary and promotion of outpatient care.

- **Surveillance**
  - As a priority, establish within the health-care facility processes for the early recognition and investigation of possible pandemic ARI patients.
  - Connect the hospital and public-health infectious diseases surveillance systems, and immediately report any essential information about possible pandemic ARI cases to public health authorities. The reporting should occur through the local surveillance system& assure that activities comply to IHR 2007.
  - Public-health authorities should keep health-care facilities informed about ongoing epidemics.
  - In the case of pandemic influenza:
    - Enhance ILI/SARI surveillance.
    - Define criteria that would shift surveillance of episodes of influenza of potential concern (e.g. human cases of avian influenza) from passive to active.

- **Triage**

  - Define IPC measures for triage, flow, and placement of patients, and early reporting and treatment.
  - Organize front-line services (e.g. emergency department) for triage of patients with respiratory symptoms.
  - Promptly initiate IPC precautions when a possible epidemic or pandemic ARI episode is suspected.

- **Surge capacity**
  - Plan for surge capacity according to the estimated impact of a potential pandemic on health care.
  - Identify the supplies and infrastructures needed to implement IPC measures.
  - Outline the limits of the health-care facility's surge capacity to provide care, and suggest thresholds at which alternative sites for provision of health care (i.e. off-site care facilities) should be implemented.

Also surge capacity in relation to:

- Supplies of pharmaceuticals and PPE etc;
- Ventilators and supplemental oxygen;
- Staff – to have sufficient personnel to carry out all different types of activities (e.g. by planning alternative shifts or staffing assignments, and having a supplemental staffing plan);
- Infrastructure including space;
- Laboratory and diagnostic capacity; and

- Security policies to handle an unexpected increase in demand for services.

- **Access**

Establish policies for access to the health-care facility for: doctors, health care workers, patients, visitors and maintenance staff, cleaners and vendors.

- **Risk communication policy**

Develop a risk communication policy to cover communication for

- Health-care facility including the health care providers.
- Other public health bodies, government agencies and ministries;
- Other societal bodies (e.g. media, professional societies and nongovernmental & communities.

- **Infection prevention and control**

Undertake IPC measures, as follows:

- Engage health-care workers & give priority to the ones having training in IPC(e.g. use of PPE).
- Engage health-care workers in the process of implementing the IPC measures to decrease the infection risk.
- For all staff members involved in IPC, work Sheets describing their roles and tasks in an emergency situation are to be kept ready. Ensure they participate in refresher training and mock drills to test knowledge about pandemic, ARI diseases about common infectious agents and waste management are regularly carried out.
- Reinforce Standard Precautions, to promote a culture of safe practices.
- Plan which areas and how in health-care facilities isolation facility will be developed during the event of pandemic / ARI outbreaks.
- Apply IPC precautions according to the risk group of organism.
- For specimen collection, transport and handling within the health-care facility clearly spell out.
    - When & what to collect specimens, and where to transport.
    - Use IPC precautions according to the according to the risk group of organism.
    - When handling specimens, follow appropriate biosafety practices as per guidelines.

• Define procedures for safe transport of patients both within the health-care facility and between facilities.

Chapter 10: CLEANING, DISINFECTION AND STERILIZATION

CLEANING, DISINFECTION AND STERILIZATION

Cleaning, disinfection and sterilization of equipment, instruments or surfaces is based on the classification devised by E.H. Spaulding more than three decades ago.

Table 1. Spaulding's classification of medical devices

Clinical device	Definition	Example	Infectious risk	Reprocessing procedure
Critical device	Medical device that is intended to enter a normally sterile environment, sterile tissue, or the vasculature	Surgical instruments	High	Sterilization by steam, plasma, ethylene oxide (ETO)
Semi-critical device	Medical device that is intended to come in contact with mucous membranes or minor skin breaches	Flexible endoscope	High, intermedia te	Sterilization desirable; high-level disinfection acceptable
Non-critical device	Medical device that comes in contact with intact skin	BP cuff, ECG electrodes	Low	Intermediate or low level (hospital disinfectant with tuberculocidal claim)

Selection of disinfectant

There is no single ideal disinfectant. Different grades of disinfectants are used for different purposes. It is important that it is stored correctly and according to the manufacturers' instructions. Be sure not to contaminate the solution when pouring for use.

It is extremely important that meticulous mechanical cleaning must always precede sterilization or disinfection procedures.

Cleaning of hospital surfaces

- Regardless of the agent used for cleaning, the following protocol must be followed:
- Staff should be properly trained on the practices of cleaning and decontamination of hospital surfaces.
- Appropriate PPE should be donned and a proper log of all cleaning procedures must be maintained
- All housekeeping surfaces (floors/ tabletops/counters) should be cleaned on a regular basis, when visibly soiled and when spills occur. Either hot water or a neutral detergent may be used or a disinfectant may be used. In specific high-risk areas (ICUs, transplant units, isolation rooms, burns wards, OTs, emergency rooms, or when there is suspected spills of blood/body fluids) and rooms and other areas that have patients with known transmissible infectious diseases should be cleaned with a detergent/ disinfectant solution at least daily. All horizontal surfaces and all toilet areas should be cleaned daily. Administrative and office areas with no patient contact require normal domestic cleaning.
- Fresh detergent/ disinfectant solutions must be prepared every day according to manufacturers' instructions. These solutions must be replaced with fresh solutions frequently.

Diluted disinfectant solutions may become contaminated with resistant pathogens. Therefore, after the days use, remaining solutions must be discarded and containers must be inverted to dry.

High-touch surfaces must be cleaned and disinfected more frequently than minimal touch surfaces.

- The methods of cleaning floors include wet mopping, and vacuum cleaning with filters attached. **Avoid dry mopping with brooms, which generate dust aerosols**. Horizontal surfaces must be wet dusted with a cloth moistened with a hospital disinfectant (or detergent). Contamination of cleaning solutions and mops must be minimized. For wet mopping, a two bucket method should be used. When a single bucket is used, the solutions should be changed more frequently. Used cleaning solutions must be discarded in the sluice. The buckets should be cleaned with detergent and kept inverted to assist drying.
- Mop heads must be changed after cleaning spills and at the beginning of the day. Mop head and cleaning cloths must be decontaminated regularly by laundering (heat disinfection) with detergent and drying at 80°C for 2 hours daily or immersing in hypochlorite solution (4000 ppm) for 2 minutes.
- Walls, blinds and window curtains must be cleaned when visibly soiled or contaminated.
- Disinfectant fogging is not recommended for routine patient care areas.
- Bacteriological testing of the environment is NOT RECOMMENDED unless seeking a potential source of an outbreak.

Management of spills of blood/body substances

- Use PPE (gloves, face masks and fluid-resistant gowns) for cleaning blood spills. Wear protective shoe covers/boots when cleaning large spills.
- For decontamination of small spills (<10 ml), if sodium hypochlorite solution is selected, use a 1:100 dilution (525-615ppm of available chlorine). If spills involve larger amounts of blood, or involve a culture spill in the laboratory, a 1:10 dilution of hypochlorite solution for first application (before cleaning) reduces the risk of infection during cleaning. After the first application, remove the visible organic matter with absorbent material (e.g., disposable paper towels discarded into leak-proof, labeled container) and then terminal disinfection with 1:100 sodium hypochlorite may be done.

Table 2: Dilution of hypochlorite solution to different concentrations

Product	**Available chlorine**	**How to dilute to 0.5%**	**How to dilute to 1%**	**How to dilute to 2%**
Sodium hypochlorite – liquid bleach	3.5%	1 part bleach to 6 parts water	1 part bleach to 2.5 parts water	1 part bleach to 0.7 parts water
Sodium hypochlorite – liquid	5%	1 part bleach to 9 parts water	1 part bleach to 4 parts water	1 part bleach to 1.5 parts water
NaDCC (sodium dichlorosiocyanurate) powder	60%	8.5 grams to 1 litre water	17 grams to 1 litre water	34 grams to 1litre water

NaDCC (1.5g/tablet) tablets	60%	6 tablets to 1litre water	11 tablets to 1 litre water	23 tablets to 1 litre water
Chloramine – powder	25%	20 grams to 1 litre water	40 grams to 1 litre water	80 grams to 1 litre water

Note: bleach solution becomes unstable rapidly hence it needs to be **freshly prepared daily** or changed on becoming dirty/turbid. Chlorine bleach can be corrosive. Protect metal instruments by thoroughly rinsing them with water after soaking for 10 minutes.

Cleaning of medical equipment

Cleaning alone (physical scrubbing with detergents and surfactants followed by rinsing with water) effectively removes a large number of micro-organisms from the contaminated equipment and surfaces. Therefore, after an instrument has been used, prior to its drying, it should be washed to remove any gross soiling.

1. Manual cleaning

All surfaces of the instrument/equipment must be cleaned taking care to reach all channels and bores of the instrument. If instruments are being washed manually, the following procedure should be followed:

Wear personal protective equipment (plastic apron, thick rubber gloves, eye protection, surgical mask and/or face shield).Remove any gross soiling on the instrument by rinsing in tepid water.

Take instrument apart – fully and immerse all parts in warm water with a biodegradable, non-corrosive, non-abrasive, low foaming and free rinsing detergent or use an enzymatic cleaner if necessary.

Ensure that all visible soil is removed from the instrument – follow manufacturers' instructions, rinse in hot water (unless contraindicated).

dry the instrument either in a drying cabinet, or hand dry with clean lint-free cloth inspect to ensure the instrument is clean.

2. Enzymatic cleaners

Used for fibreoptic instruments and accessories, and other items those are difficult to clean. These products are hazardous and care should be taken when in contact with them.

3. Ultrasonic cleaners and automated washers

Ultrasonic cleaners and automated washers are recommended for cleaning basic instruments that can withstand this process. Using a machine to wash the instruments will cut down on the handling of the instruments. These cleaners must be compliant with national guidelines and standards, and must be used according to the manufacturers' instructions.

Ultrasonic cleaners do not disinfect the instruments. By causing high frequency, high-energy sound waves to hit the instrument/equipment, the soiling matter drops off the instrument, or becomes easy to remove during the rinsing process.

These cleaners are not appropriate for use on cannulated instruments (they cannot clean inside the instrument), plastic materials, two or more different metals, or some glass instruments, syringes and lenses.

Daily efficiency tests should be done.

Table 3. Cleaning and disinfection of non-critical items:

Article	**Standard procedure**	**Alternative procedure/Comment**
Ambu bag and mask	Clean with detergent, dry and send to CSSD for thermal disinfection	Disposable preferred Change mask after each patient
Baby equipment (feeding bottles and teats)	If reusable, return to CSSD for heat sterilization *Or* Wash in hot water and detergent and rinse.	Disposable preferred
Baby weighing scale/changing table	Fresh liner should be used for each baby Clean tray with detergent and water after use If visibly soiled, clean first with friction and then wipe down with LLD	
Bed pans and urine bottles	Preferable wash in machine with heat disinfection cycle. Alternatively, clean and disinfection with 0.5% sodium hypochlorite or phenolic germicide. Dry completely before reuse	Disposable preferred Wash hands thoroughly after handling.
Bed and couch frames	Clean with detergent and water between patients Wipe with LLD like 70-90% alcohol/phenolic germicide if disinfection is necessary For isolation rooms, after cleaning wipe with disinfectant (sodium hypochlorite or phenolic germicide)	
Bedding	Heat disinfection	
BP apparatus and cuff	Clean cuff, tubings, bulb if manual with 70-90% alcohol or other LLD after each use. If visibly soiled, wash in soap/detergent and water rinse and hang to dry.	Disposable preferred. After use in isolation room, launder cuffs in washing machine.
Brushes Nail (avoid use) Toilet	If reusable, heat sterilize Dispose off frequently, rinse well in flushing water. Shake off excess water and store dry	Disposable nail brushes preferred
Boots	Clean with detergent and water. If visibly soiled, disinfect with LLD	
Canes, walkers, crutches, wheelchairs	Clean with detergent and water.	

and rehabilitation equipments	If visibly soiled, clean patient contact surface by wiping with sodium hypochlorite (1%) or 70-90% alcohol or phenolic germicide at concentration recommended for LLD.	
Cap and shoe cover	Use of disposable is recommended. If reusable, launder in hot water (70-80°C) or soap in water with 0.5% bleaching powder. Wash with detergent and water to remove bleach. Dry in sun or clothes dryer.	If disposable, dispose in appropriate waste bags.
Commode/toilet seats	Clean with detergent and water and dry at least once a day and when used by patients with GI infections or when visibly soiled. Preferably clean after each use. If soiled, disinfect with sodium hypochlorite (1 - 2%) or phenolic germicide at LLD concentration.	
Crockery and cutlery/food utensils	Wash after each use with detergent and hot water.	Heat disinfect in dish washer (80°C for 1 minute/71°C for 3 minutes) especially for patients with enteric infection/open tuberculosis.
Curtains	Clean when visibly soiled or contaminated. If an area occupied by a disperser of epidemic strain of MRSA is to be re-occupied by a susceptible patient within 24 hours, the curtains in the vicinity must be changed.	Change as part of terminal cleaning
Drainage bottles	If reusable, rinse and return to CSSD for heat disinfection	Disposable preferred
Drip stand	Clean with detergent and water and dry	After use in isolation, wipe with sodium hypochlorite (1 - 2%) and dry after cleaning
Ear pieces for otoscopes	Clean with detergent and water and dry	To be returned to CSSD after use for sterilization
Examination tables, gurneys (patient trolleys)	Clean patient contact area with 70-90% isopropyl alcohol/sodium hypochlorite(1%)/phenolic germicide/quarternary ammonium compounds for LLD If soiled, clean first with friction and then wipe down with LLD. If blood contaminated, sodium hypochlorite is preferred. If faecal contamination is suspected, phenolic compounds are preferred	See Screen 1 for cleaning if contaminated with blood or other potentially infectious material (OPIM)
Eye protection, goggles, face shields	If reusable, clean with detergent and water, dry and disinfect with sodium hypochlorite (1%) or 70-90%	Disposable recommended.

	alcohol for 20 minutes.	If disposable, dispose in appropriate waste bags.
Floors	Clean on a regular basis, when visibly soiled and when spills occur. Either hot water or a neutral detergent may be used or a disinfectant may be used. In specific high-risk areas (ICUs, transplant units, isolation rooms, burns wards, OTs) floors should be cleaned with a detergent/ disinfectant solution at least daily.	For blood splashes, blood spillage policy should be followed
Furniture and fittings	Damp dust with detergent and water	If contaminated with spills, disinfect with sodium hypochlorite or phenolic germicide diluted according to manufacturers' instructions
Gowns	Use of disposable recommended If reusable, launder in hot water (70-80°C) or soap in water with 0.5% bleaching powder. Wash with detergent and water to remove bleach. Dry in sun or cloth drier.	If disposable, dispose in appropriate waste bags.
High-touch surfaces (door knobs, phones, keyboards, light switches, bedside tables, drawer pulls)	Clean at least twice daily and when soiled Clean with 70-90% alcohol/sodium hypochlorite (1%)/phenolic germicide/quarternary ammonium compounds/ some iodophors. If visible soiled clean first with friction	If contaminated with spills, disinfect with sodium hypochlorite or phenolic germicide diluted according to manufacturers' instructions
Humidifiers	Change together with ventilator circuit, wash thoroughly and sterilize by autoclaving/ low temperature sterilization.	
IV monitoring pumps and feed pumps	Clean with detergent and water and dry Disinfect with LLD (70-90% alcohol/ sodium hypochlorite)	After use in isolation, wipe with sodium hypochlorite 2% and dry after cleaning
IV stands	Clean with detergent and water and dry	
Incubator Infant incubator	Clean with detergent and water and thoroughly dry After discharge of a patient, the inner surface of the incubator should be thoroughly cleaned with a moist paper wipe and detergent and dried. Special attention should be paid to the humidifier, ports and the mattress. Disinfect if needed with chlorine releasing agent (125 ppm). Alternatively, surfaces can be wiped with 70 per cent alcohol. However, care should be taken as alcohol is	Avoid using phenolic disinfectants.

	flammable, and the incubator must be aired thoroughly before reuse.	
Locker tops	Damp dust with detergent and water	
Leads and monitors	Disassemble, clean with alcohol based disinfectants	
Masks (Surgical/N95)	Use N95 according the manufacturers' instructions. Discard after recommended time of use. Autoclave cloth masks after washing and packing (similar to surgical drapes)	
Mattresses and pillows	Cover mattresses and pillows with protective water-proof plastic materials which should be replaced if torn. Clean with neutral detergent and water and dry between patients and as required. If disinfection is required, use a chlorine-releasing (1000 ppm available chlorine) solution and then rinse well. All mattresses should be routinely inspected for damage. Stained/damaged mattress covers should be changed.	If contaminated, blood spills policy should be followed
Mops	Disposable: use for 1 day Reusable: hot launder (detergent wash followed by drying at 80°C for two hours) or immerse in hypochlorite (4000 ppm) for 2 hours.	
Otoscope handle	Wipe all surfaces with 70-90% alcohol/any other LLD	
Otoscope speculum	If reusable, eash and disinfect after each use. Soak for 20 minutes in 70-90% isopropyl alcohol	Disposable preferred
Pulse oximeter probe	Wipe inside and outside with 70-90% isopropyl alcohol or any other LLD	Disposable preferred
Razors Electric razors	Preferably use disposable single use. If reusable, autoclave. Disinfect with 70-90% alcohol, immerse head only	
Reflex hammer	Wipe handle and head after each use with IPA or LLD	
Stethoscope	Wipe bell and tubing after each use with 70-90% alcohol or any other LLD.	See screen 6.1 for cleaning if contaminated with blood/OPIM
Shaving brush	Do not use unless supplied by patient for own use. Use brushless cream or foam.	
Soap dispensers and dishes	Clean nozzle and outside daily and dry. Clean inside of the container with detergent before refilling. Do not top up soap.	Avoid use of soap dishes. Use liquid soap dispensers
Sputum	Use disposable only, with close filling lid.	

pots/containers	Discard into clinical waste for incineration. If reusable, empty with extreme caution and heat sterilize	
Suction bottles	If disposable, seal when 75% full and place and yellow plastic bag. If reusable, clean with sodium hypochlorite and dry. Must be heat disinfected/sterilized. Change daily and between each patient. Store dry when not in use.	
Telephone	Disinfect with 70% alcohol	
Thermometer	Cover with disposable seal before use and store dry in individual holder (inverted). Clean and wipe with 70-90% alcohol after every use.	Use individual thermometer. Do not mix oral and rectal thermometers
Toys	Use only washable toys or give child 3-4 crayons in a bag with individual sheets of pictures to colours and keep the child keep after each use. Clean with detergent and water and dry If contaminated, disinfect with heat/70-90% alcohol or sodium hypochlorite (> 100 ppm)	Preferably avoid use in wards/isolation/heavily contaminated toys may be destroyed
Trolleys (dressing)	Clean daily with detergent and water. After each use, wipe with 70-90% alcohol/sodium hypochlorite (> 100 ppm available chlorine)	
Urine measuring jugs	Heat disinfect after each use in bedpan washer. Simple cleaning with hypochlorite can also be considered sufficient.	
Walls	Clean with detergent and water	Decontaminate and manage spills
Wash basins	Clean with detergent. Use cream cleaners for stains, scums etc.	Disinfection may be needed if contaminated. Preferably disinfect with sodium hypochlorite
Wheelchairs	Patients own: clean with detergent and water Hospitals: clean between patients with detergent and water.	
X ray equipment	Damp dust with detergent and water. Switch off, do not over wet, allow to dry before use	Wipe with 70-90% alcohol/any other LLD

Table. 4 Cleaning and disinfection of semi-critical items

Article	**Standard procedure**	**Alternative procedure/** **Comment**
Anaesthesia equipment (airways, endotracheal tubes. etc)	These are single use devices. If manufacturers advise- sterilize by heat	High-level disinfection with disinfectants (see section on reprocessing of respiratory apparatus)
Applinators (tonometer prisms)	Wipe tips clean Immerse in sodium hypochlorite (500 ppm available chlorine) for 10 minutes Disinfect with 3% H_2O_2/70-90% IPA	Prepare fres solution of hypochlorite at the startr of the day After disinfection, rinse thoroughly in tap water and dry
Breast pumps	Wash with detergent and water, immerse in freshly made sodium hypochlorite (>100 ppm available chlorine)	
Cervical caps	Wash with soap and hot water; dry Soak in 70-90% alcohol for 20 minutes, store dry	
Cryosurgical probes	Autoclave if possible If heat labile, use low-temperature sterilization or EtO	Less than acceptable alternative: immerse in 2% glutaraldehyde
Cryotherapy equipment	Ensure that liquid nitrogen canisters do not become contaminated when used for removal of warts, decant sufficient amount into Styrofoam cup	
Diagnostic ultrasound transducers (transvaginal/ transrectal/ transesophageal/ endobronchial)	Sterilization with H_2O_2/peracetic acid based systems if compatible/EtO/HLD	Transducer heads may be disinfected with 70-90% alcohol. Activity of alcohol against HPV not known
Diaphragm fitting rings and pessaries	Wash with soap and water, followed by immersion in 70-90% alcohol for 15 minutes	
Ear suction tips	Heat sterilize/boil	Immerse in 2% glutaraldehyle
Ear syringe nozzle and ear speculum	Sterilize with heat, boil/immerse in glutaraldehyde, chlorine (if plastic) iodophors or alcohol	Immerse in 2% glutaraldehyle
Endoscopes coming in contact with mucous membranes; bronchoscopes,	Sterilize by autoclaving scopes (if heat stable) If heat labile, use low-temperature sterilization	

sinoscopes, laryngoscopes, oesophagoscopes, nasopharyngoscopes, urethroscopes, otoscopes	or EtO (see section on reprocessing of endoscopes)	
Probes (oesophageal manometry, rectal, vaginal, cryosurgical and endocavitary)	Mechanically remove gel from transducer Clean the probe with soap and water Immerse or wipe with 70-90% alcohol or hypochlorite (500 ppm available chlorine) Rinse in tap water and dry	Immerse tips in 2% glutaraldehyde for HLD
Laryngoscope and blade	Steam sterilize/chemical sterilant	High-level disinfection with liquid germicides/disinfection with 70-90% alcohol
Laryngeal mirror	High-level disinfection/sterilization with heat or immerse in glutaraldehyde	
Nasal specula	Sterilize by boiling or immerse in glutaraldehyde /1:10 bleach (HLD)	
Nebulizers and nebulizer cups	Clean and heat disinfect, and dry	Low temperature sterilization may be done
Resuscitation accessories: face pieces etc	Heat disinfect or wash with detergent and hot water; dry and disinfect with 70-90% alcohol/chlorine- releasing agents	
Vaginal and other specula	Single use items preferred Otherwise thoroughly clean and autoclave In outdoor clinics, thorough cleaning followed by boiling the entire instrument for 5-10 minutes may be done For chemical disinfection, immerse in 70-90% alcohol Glutaraldehyde 2% for 10 minutes may be used	
Vaginal pessary	Boil for 5 minutes or immerse in glutaraldehyde for 10 minutes	
Ventilators	See section ‘Reprocessing of Respiratory Apparatus”	

Table 5. Cleaning and disinfection and sterilization of Critical items

Article	Standard procedure	Alternative procedure/ Comment
All implantable devices	Sterile, single use	
All intravascular devices	Sterile, single use	
Arterial pressure transducers	Sterilize by heat/EtO gas/hydrogen peroxide	
Biopsy forceps or biopsy equipment, endoscope accessories	Sterilize by heat/EtO gas/hydrogen peroxide	High-level disinfection with compatible germicides
Body-piercing objects	Autoclave	
Catheters (cardiac, urine, arterial)	Sterile, single use, discard after use	
Diagnostic ultrasound transducers-renal, hepatic, vascular	Sterilization/high-level disinfection with a compatible grade disinfectant	
Electrocautery tip	Sterilize with heat by boiling or HLD with glutaraldehyde, OPA	
Endoscopes: cystoscopes, thoracoscopes, hysteroscopes, ureteroscopes, nephroscopes, laproscopes, arthroscopes, GI endoscopes	Refer to section 'Reprocessing of endoscopes'	
Grafts (heart valves/arterial/joints/other implants)	Use sterile items supplied by manufacturers as such	
Haemodialysis, plasmapheresis and heart lung oxygenator surfaces in contact with blood	Heat, low temperature sterilization	
High-speed dental handpieces	Sterilize by autoclaving	
Needles and syringes	Single use: disposable	
Neurological test needles	Use disposable If reusable: heat sterilize/EtO gas	HLD less acceptable
Ophthalmic instruments; phacoemulsification handpieces	Sterilize with heat	See section ' special consideration of CJD' Destroy or reprocess instruments that have been exposed to posterior segments of high-risk patients and

		quarantine according to guidelines
Peak flow (critical)	Disposable: single patient use	
Surgical instruments	Heat sterilize	
Stitch cutters	Sterilize with heat/boil/immerse in glutaraldehyde or use disposable	

The cleaning and decontamination of some specific equipment are as under:

Reprocessing of endoscopes

For reprocessing of endoscopes ensure that

1. HCWs reprocessing endoscopes are protected by using PPE. Personnel responsible for reprocessing should be properly trained.
2. Wherever possible, sterilize by autoclaving scopes (if heat stable) or by low-temperature sterilization methods such as hydrogen peroxide gas plasma or peracetic acid (PAA). However if this is not possible, ensure at least liquid sterilization/high-level disinfection.

In general, endoscope disinfection or sterilization involves the following steps after performing a leak testing:

- *Meticulous cleaning*

  Disconnect and disassemble endoscope components as far as possible and completely immerse the endoscope and components in enzymatic/detergent cleaner. Meticulously clean the internal and external surface of the endoscope (including valves, channels, orifices, connectors and detachable parts) by flushing or brushing to remove all organic residues manually. The external surfaces may be cleaned with a soft cloth/brush or sponge. Use appropriate channel cleaning brushes. The cleaning items should be disposable or thoroughly cleaned and disinfected/sterilized between use. Discard the enzymatic cleaner and detergent after each use.
- *Disinfection*

  Select a disinfectant/sterilant that is compatible with the endoscope. Completely immerse the entire endoscope and its accessories in an FDA approved HLD/sterilants. Let the disinfectant perfuse into all accessible channels and expose for a time and temperature recommended for specific product. Use the germicide according to label instructions. Disinfectants not to be used for endoscope reprocessing include iodophors, chlorine solutions, alcohols, quaternary ammonium compounds and phenols. OPA with a 12 minute HLD claim is replacing glutaraldehyde worldwide.
- Rinse

  Rinse the endoscope and all channels with sterile water/filtered water/tap water to remove disinfectant. Discard the rinse water after each use.
- Dry

  Flush the channels with 70-90% ethyl or isopropyl alcohol and dry using forced air. This drying reduces the possibility of recontamination of endoscope by water-borne organisms
- Store

  Store the endoscope in a way that prevents recontamination and promotes drying (hang vertically with caps, valves and other detachable components removed as per manufacturer's instructions).
- Maintain log indicating patients particulars, endoscopist, technicians who did the reprocessing and the serial number of the endoscope. Check and record the minimal effective concentration of liquid sterilants.HLD at the beginning of the day or more frequently depending on the usage. Discard solution if the concentration is suboptimal. Always discard the sterilants at the end of its reuse life.
- Develop protocol to know whether the endoscopes have been cleaned and disinfected. Ensure

regular maintenance and disinfection of automated washers.

Processing of specific scopes

- *Laparoscopes*: these scopes are easy to clean and disinfect. In general, laparoscopes should be sterilized or at least high-level disinfected.
- *GI endoscopes*: for duodenoscopes used in ERCP, HLD (High level disinfection) with Ortho-phthalaldehyde solution can be used. All GI scopes must be reprocessed after patient use, preferably a second time on the day of use. Duodenoscopes used for ERCP must be reprocessed as close as possible to the time of the procedure because this is a high-risk procedure.
- *Bronchoscopes*: flexible fibreoptic bronchoscopes are commonly used in diagnostic procedures, whereas rigid bronchoscopes are usually used on operating room situations. Rigid bronchoscopes should be sterilized by autoclaving and flexible bronchoscopes should be reprocessed with High level disinfection with Ortho-phthalaldehyde solution.
- *Arthroscopes*: these scopes enter the sterile spaces, and there is a minimal risk of infection as a result of spore-forming organisms. Arthroscopes should be sterilized before each use. If not possible, then they should at least be high-level disinfected.
- *Other fibreoptic scopes and associated equipment*: other fibreoptic scopes used in sterile sites include cystoscopes, thoracoscopes, hysteroscopes, ureteroscopes, etc. these should be sterilized/HLD. Scopes used in mucosal (semi-critical) sites include sinoscopes, laryngoscopes, oesophagoscopes and urethroscopes. These must be at least high-level disinfected.

Periodic bacteriological surveillance is essential for inner surfaces of automated endoscope reprocessors and may be done routinely for duodenoscopes and bronchoscopes.

Reprocessing of Respiratory Apparatus

Ventilators

Mechanical ventilators play an important part in the treatment of patients in ICU and in anesthetic support in surgeries. Ventilators are classified as semi-critical devices and should be sterilized when possible or at least high-level disinfected. The manufacturers of ventilators must provide co9mlete information regarding cleaning and decontamination, which should be followed.

- Cover all equipment when not in use.
- Use appropriate PPE and respiratory protection. Perform hand hygiene after handling these equipment.
- Discard all disposable devices between patients or more frequently if indicated.
- Select an internal filter that has high microbial and water retention property.
- Clean or replace regularly all internal parts. Clean the ventilators to remove all organic soil. Preferably use disposable circuits and filters which should be changed after every patient. Replacing ventilator circuits every 48 hours is no longer recommended. Ventilator circuits should be replaced only when damaged or when visibly contaminated with blood or mucus. The disinfection process must include the entire breathing circuits (mask or tube and connection, CO_2 absorber and valves, reservoir hose and bags and any monitoring devices within the breathing circuit). Dismantle the circuits, wash thoroughly and sterilize by autoclaving/ low temperature method. Alternatively, sterilize with vapourized H_2O_2. Sterile infant ventilators with EtO. However, remove all toxic residues by flushing air and oxygen before reuse. Replace the external filters and tubing if they are visibly soiled and when needed to assure proper ventilation function.
- While assembling the circuit, do not allow the circuit to dangle close to the floor.
- During use, wipe the machine and all its parts (support arm, electric cord, high-pressure hoses, alarm and wheels) with an ILD disinfectant when visibly soiled.

- Keep ventilator accessories, such as spacers for metered dose inhalers at the bedside between treatments, in clean plastic bags.
- Do not allow the tubing condensate to drain into patient's trachea or back into humidifiers. Remove condensate periodically from tubing using aseptic techniques to empty the trap device.

Humidifiers

Heat and moisture exchangers should be cleaned and disinfected by heat disinfection or 70-90% alcohol before refilling with sterile water. Do not add antiseptics to humidifier water. Change the entire humidifier system when indicated. Change humidifiers in between patients. Moisture traps should be incorporated to protect filters.

Nebulizers

Heat disinfect nebulizers daily. Replace but not top up water. Empty the residual medication from nebulizer cup after each treatment and dry before filling water. (If drying is not possible, flush with 70-90% alcohol) rinse the mouthpiece/mask with warm water and dry with clean tissue paper.

Oxygen hoods

Replace the entire oxygen hood delivery system every 7 days. Piped gases do not become contaminated with bacteria provided the lines become dry. Dispose off oxygen hood in between patients.

Anesthetic equipment

Keep the external surface of the machine clean and dry. Clean and thermally disinfect (preferably at the CSSD) tubings, reservoirs, ambu bag, face masks, endotracheal tubes and airways if not single use. Give diposable face masks, tubings and reservoir bags to patients suffering from suspected tuberculosis.

Laryngoscope blade

Clean with detergent, followed by disinfection with 70-90% alcohol for 10 minutes and drying.

Suction equipment

If piped suction is not available, use separate machine for each patient. After use, discard the content in sluice, wash with detergent and water, and dry the bottle. For every suction, a fresh catheter must be used. An antifoaming agent may be added to the bottle contents to protect the filters. The filters should be changed if they become moist and discolored. Disinfectants (chlorine-releasing agents at a concentration for dirty situations) need to be added only if contents are considered to be hazardous. The machine should be periodically returned to the CSSD where pumps can be checked, filters changed, and the tubings, lid, non-return valve and bottles autoclaved.

Decontamination in Respiratory Function Laboratory

In respiratory function laboratories equipment considered semi-critical include reusable mouth pieces, reusable nose clips, one-way breathing valves, pneumotachograph screens, turbine assemblies, mouth shutters and specialized nebulizers used for bronchial challenge tests. These items must be dis- assembled and thoroughly cleaned before reprocessing, using either sterilization or high-level disinfection. Equipment distal to a barrier filter or one-way breathing valves should be cleaned at least once daily to remove particulate matter and moisture. Clean the outside surface of tubings that is in direct contact with or handled by patients. Do not reprocess items labeled as 'single patient use' (peak flow meters, nebulisers used for bronchodilators and oesophageal balloons).

Reprocessing of dental equipments

- Clean housekeeping surfaces by a physical wiping/scrubbing with detergents and water. If surface

is visibly contaminated with blood or OPIM, use ILDs. General cleaning and disinfection of clinical contact surfaces, dental unit and counters is recommended at the end of the day and if contaminated.

- The instruments must be thoroughly cleaned prior to disinfection. Sharp instruments may be cleaned in automated washers to prevent injuries.
- All critical and semi-critical equipment should be sterilized and stored packed. Sterilize high-speed dental hand pieces between patients. Metal and porcelain equipment should be immersed in glutaraldehyde. Removable dentures and acrylic should be disinfected with iodophors or chlorine compounds. Wax rims or bite plates should be disinfected with sprays containing iodophors.
- Surgical/other instruments that penetrate soft tissue/bone (extraction forceps, scalp blades, bone chisel, periodontal scalers and surgical bars) are critical and need to be sterilized after each use or discarded. Instruments not intended to penetrate oral soft tissue or bone amalgam condensers and air/water syringes, but which could contact oral tissues are semi-critical but preferably be sterilized after each use if instruments are heat tolerant. If heat sensitive, they should be high-level disinfected.

Reprocessing of ophthalmic equipments

- Preferably reprocess these instruments in the CSSD because many instruments are extremely delicate.
- Clean the instruments thoroughly after use (manual cleaning may be the only option with delicate instruments like diamond knives and phaco-emulsification hand pieces.) cleaning should be done with detergents and water at 35°C. use a soft brush for cleaning. Cleaning brushed should be cleaned, disinfected and stored dry.
- Mechanical cleaning may be done for scissors, fixation forceps, retractors, lens holders, specula and metal cannulae. In general, a 5 minute ultrasound cycle is sufficient. After cleaning, instruments should be rinsed and dried. Sterilization is preferably done by steam (in a prevaccuum sterilzer). If items are heat sensitive, low-temparature sterilization with EtO and gas plasma may be considered.
- Chemical disinfection may be done if sterilization is not feasible. However, select germicides that are compatible with the instruments and use the instruments immediately. Single use tonometers are preferable to avoid infection.

Reprocessing of surgical instruments

- All used surgical instruments are contaminated and should be segregated at the point of use.
- Do not allow blood/soil to dry on the instruments. Handle the surgical instrument carefully for mechanical cleaning.
- Soak the instruments in water with detergents immediately after use**.** Place instrument in a suitable container so that all surfaces are exposed to the detergent solution.
- Check the compatibility of instrument with sterilization process. Remove sharps and dispose off in appropriate containers
- Place contaminated liquid in leak-proof container for disposal.
- Dis-assemble instruments as per the manufactures instructions (keep parts together for subsequent assembly)
- Clean the instruments thoroughly manually or mechanically
- After cleaning, properly pack the instrument and sterilize. Moist heat (steam) is the preferred method of sterilization (in a vacuum sterilizer). If the items are heat-sensitive, low-temperature sterilization (EtO/hydrogen peroxide gas plasma) may be considered.
- HLD/chemical sterilization should be resorted to only if the above sterilization procedures are incompatible with the devices.
- Store the items as discussed in sterilization practices (see below)

Sterilization practices and monitoring

The cleaning, disinfection and sterilization of medical and surgical equipment should be preferably done at a central processing area by trained personnel. The hospital personnel must comply with the manufacturer's recommendations. The daily operation of the sterilization must be documented. This documentation should be reviewed for each operation, any malfunction should be noted and appropriate action taken.

1. **Cleaning**

   All items must be cleaned using water with detergents or enzymatic cleaners before processing. Pre-cleaning in patient care area may be needed on items that are heavily soiled with faeces, sputum, blood or other material.

2. **Packing**

   Once items are cleaned, dried and inspected, those requiring sterilization must be wrapped or placed in rigid containers and should be arranged in instrument trays/baskets according to guidelines. Surgical items may be kept in rigid containers, peel open pouches, rolls stock or reels and sterilization wrap (woven or not woven). The packaging material must allow penetration of the sterilants, provide protection against contamination during handling, provide an effective barrier to microbial penetration and maintain the sterility of the processed item after sterilization.

3. **Loading**

   All items to be sterilized should be arranged so that all surfaces are directly exposed to the sterilizing agent. Allow for proper sterilants circulation, perforated trays should be placed so that tray is parallel to the shelf, non-perforated containers should be placed on their edge (eg basins). Small items should be loosely placed in wire baskets and peel packs should be placed on edge in perforated or mesh-bottom racks on baskets.

4. **Storage**

   Wrapped surgical trays remain sterile for varying periods depending on the type of material used to wrap the trays. Safe storage times for sterile packs vary with the porosity of the wrapper and storage conditions (open versus closed cabinet). Items that have been sterilized should not be used after the expiration date or if the sterilized packet is wet, torn or punctured. Following the sterilization process, medical and surgical devices must be handled using aseptic techniques to prevent contamination. Sterile supplies should be stored far enough from the floor (8-10 inches), ceiling (5 inches) and outside walls (2 inches) to allow for adequate air circulation, ease of cleaning and compliance with local fire codes. Medical and surgical supplies should not be stored under sinks or in other locations where they can become wet. Sterile items that become wet are considered contaminated because moisture brings with it microorganisms from the air and surfaces. Closed or covered cabinets are ideal, but open shelving may be used for storage. Any package that has fallen or been dropped on the floor must be inspected for damage to the packaging and contents (if the items are breakable).

5. Monitoring

The sterilization must be regularly monitored to evaluate the sterilizing conditions and microbiological status of processed items. Monitoring is done by mechanical, chemical and biological means.

- ***Mechanical indicators*:** these include the daily assessment of cycle time, temperature and pressure. Maintain a record/ printouts of temperature chart and pressure.
- ***Chemical indicators (CIs)*:** these are convenient and inexpensive, and indicate that the items have been exposed to the sterilization process. Chemical indicators should be used in conjunction with biological indicators but should not replace them. CIs are affixed on the outside of each pack to show that the package has been processed through a sterilization cycle, but they do not prove that sterilization has been achieved. Preferably a CI should also be placed on the inside of each pack to verify sterilants penetration. CIs are usually either heat or chemical sensitive inks that change colour when one or more sterilization parameter (steam time, temperature and /or saturate steam, EtO time, temperature, relative humidity and /EtO concentration) are present. If the internal and /or external indicators suggest inadequate processing, the item should not be used.
- ***Biological indicators***: these are ideal monitors of sterilization process because they measure the sterilization process directly by using the most resistant microorganism (bacillus spores) and not be merely testing the physical and chemical conditions necessary for sterilization. Because the Bacillus spores used in BIs are more resistant and present in greater numbers that the common microbial contaminants found on patient care equipment, the demonstration that the BI has been inactivated strongly implies that other potential pathogens in the load have been killed.

  An ideal BI should be well-characterized, non-pathogenic, easily available inexpensive standardized preparation, more resistant to the sterilization process that human pathogens, should give a rapid readout, should be easy to use and should provide positive results only when the sterilization parameter are inadequate to kill microbial contaminants. Traditionally commercially prepared BIs require an incubation time of up to 7 days. The recent development of rapid readout BIs which use fluorometric detection of a spore-bound enzyme at 60 minutes, may offer an alternative to observation of spore growth.

Table 6. Biological indicators for monitoring sterilization

Spore	***Bacillus atrophaeus***	***Geobacillus stearothermophilus***
Monitors	EtO, dry heat	Steam, hydrogen peroxide gas plasma, liquid peracetic acid
Number of spores	10^6 spores	10^6 spores/10^5 spores
Method of use	Place ampoule in centre of one or more packs of chamber, transfer ampoules to lab for culture	Place ampoule in centre of one or more packs of chamber, transfer ampoules to lab for culture
Incubation	35-37°C for 14 days; examine for turbidity, incubate an unexposed spore ampoule	55-56°C for 14 days; examine for turbidity, incubate an unexposed

simultaneously	spore ampoule simultaneously

Apart from routine testing, BIs are also required to be used in the following situations.

- Installation of a new sterilizer
- After relocation of an existing sterilizer
- After a sterilizer malfunction
- After major repair to a sterilizer that are outside the scope of routine or preventive maintenance
- After repairs to the steam generator/delivery system

Interpretation of positive result of Biological Indicators

The CDC recommends that 'objects, other than implantable objects, do not need to be recalled because of a single positive spore test unless the steam sterilizer or the sterilization procedure is defective'. If the mechanical and the chemical indicators suggest that the sterilizer was functioning properly, a single positive spore test probably does not indicate sterilizer malfunction, but the spore test should be repeated immediately. If the spore test remains positive, use of sterilizer should be discontinued until it is serviced. For EtO and hydrogen peroxide gas plasma, a single positive spore test may be considered significant. All loads should be retrieved for reprocessing.

Table 7. Antimicrobial activity of Disinfectants

Anti-microbial activity					
Disinfectant	Spores	Mycobacteria	Other bacteria	Viruses	
				Enveloped	Non- enveloped
Glutaraldehyde 2% (3h-10 min)	Good 3 h	Good* 20 min	Good 10 min	Good 10 min	Good 10 min
Peracetic acid 0.2-0.35% (10 min)	Good	Good	Good	Good	Good
Alcohol 60-70% (ethanol or isopropanol) (1-10 min)	None	Moderate	Good	Good	Moderate
Peroxygen compounds 3-6% (20 min)	None	Poor	Good	Good	Moderate
Chlorine releasing agents >1000 ppm Cl2 (15-60 min)	Good	Good	Good	Good	Good
Clear soluble phenolics 1-2% **	None	Good	Good	Poor	None
Quaternary ammonia components 0.1-0.5%***	None	Variable	Moderate	Moderate	Poor

*Less active against M. avium intracellulare.

**Potentially toxic. Should not be used in neonatal wards.

***Dilute solutions may allow the growth of Gram-negative bacilli.

Chapter 11: BIOMEDICAL WASTE MANAGEMENT

INTRODUCTION

Biomedical wastes are defined as waste that is generated during the laboratory diagnosis, treatment or immunization of human beings or animals, or in research activities pertaining thereto, or in the production of biological. Biomedical waste carries a higher potential for infections and injuries. Therefore, it is essential to have safe and reliable methods of segregation and disposal of hospital waste.

Waste generated in hospitals

It is estimated that quantity of solid waste generated in hospitals varies from 1/2 to 2 kg/bed in Govt. hospitals, private hospitals and nursing homes.
However, biomedical waste accounts for a minor proportion of total waste generated in hospitals. In developing countries, the waste generated in hospitals falls into the following categories-

- General waste (80%) -Vast majority of waste falls in the general waste category, which may be disposed with usual domestic and urban waste management system. They do not cause any harm to humans.
- Biomedical waste (20%)-
    - Pathological and infectious waste (15%)- This is the component of hospital waste that produces maximum hazards. Pathogens in the infectious waste may enter through ingestion, inhalation or direct skin to skin contact.
    - Chemical and pharmaceutical waste (3%)- Most of the chemicals (e.g. disinfectants) and pharmaceuticals are toxic , genotoxic (affect genetic system), corrosive, flammable, explosive or shock sensitive.
    - Sharp waste (1%)- Needle stick and other sharp injuries are of great concern as they are capable of transmitting blood borne pathogens such as HIV, hepatitis B and C virus etc.
    - Less than 1% accounts for special waste such as cytotoxic drug, radioactive waste, broken thermometers and used batteries.

Situation in India

According to the Ministry of Environment and Forests (MoEF) gross generation of biomedical waste in India is about 4,05,702 kg/day, of which only 2,91,983 kg/day is properly disposed, which means that almost 28% of the wastes is left untreated and not disposed, finding its way in dumps or water bodies and re-enters our system. Karnataka tops the chart among all the states in generation of biomedical waste.

TREATMENT AND DISPOSAL METHODS

There are several methods of disposal of biomedical waste. Though incineration is widely used, the recently developed alternative methods are becoming increasingly popular.

Incineration

It has been the method of choice of disposal of biomedical waste.

- Incineration is a high temperature dry oxidation process that reduces organic and combustible waste into nonorganic incombustible matter, resulting in a very significant reduction of waste volume and weight.
- Incineration is usually done for those wastes that cannot be reused, recycled or disposed off in a land fill site, for example human and animal anatomical waste, microbiological waste, solid non-plastic infectious waste.
- Incineration should not be done for-
    - Pressurized gas containers
    - Reactive chemical waste
    - Halogenated plastics such as PVC
    - Waste with high heavy metals such as mercury, silver salts, radiographic waste, broken thermometers

Autoclave

Autoclaving is a thermal process where steam is brought into direct contact with waste in a controlled manner and for sufficient duration to sterilize the wastes. For ease and safety in operation, the system should be horizontal type and exclusively designed for the treatment of bio-medical waste. For optimum results, prevacuum based system is preferred against the gravity type system. It shall have tamper-proof control panel with efficient display and recording devices for critical parameters such as time, temperature, pressure, date and batch number, etc.

Chemical disinfection

Chemicals are added to waste to kill or inactivate the pathogens within it. It results in disinfection rather than sterilization.

- It is more suitable for liquid waste such as blood, urine, stool and hospital sewage.
- However, solid waste microbiological cultures and sharps, etc. may be disinfected chemically with certain limitations.

Effluent Treatment Plant

The liquid effluent generated during the process of washing containers, vehicles, floors, etc is first subjected to chemical treatment and then disposed in effluent treatment plant.

Microwaving

In microwaving, microbial inactivation occurs as a result of the thermal effect of electromagnetic radiation spectrum lying between the frequencies 300 and 300,000 MHz.

- Microwave heating is an inter-molecular heating process.
- The heating occurs inside the waste material in the presence of steam.
- The efficacy of microwave disinfection should be monitored regularly.

Shredder

Shredding is a process by which waste are deshaped or cut into smaller pieces so as to make the wastes unrecognizable. It helps in prevention of reuse of bio-medical waste and also acts as identifier that the waste has been disinfected and is safe to dispose off.

Sanitary land fill

It is a small deep burial pit of 2 meters depth. It should be half filled with waste, then covered with lime within 50 cm of the surface, before filling the rest of the pit with soil. It is specially designed for disposal of hospital waste.

- For health and safety, a landfill site should be constructed away from residency, forests, and coastal waters.
- If the facilities are not available to treat the waste before disposal, landfills are regarded as an acceptable route of disposal. However, medical waste should not be disposed in open dump.
- The wastes falling under category 5 i.e. discarded medicines, cytotoxic drugs and category 10 i.e. chemical wastes (solids) can be disposed in a secured landfill.

Plasma Pyrolysis

Plasma is the state of matter obtained by breaking down atoms into ions and electrons by the process of ionization. Plasma pyrolysis provides solutions for complete pyrolysis of typical hospital waste such as cellulose polymer dressings, polyvinyl chloride blood bags, polyurethane and silicon rubber gloves & catheters and other disposables made of polyethylene, polymethyl methacrylate, rubber, glass etc. The system provides high temperatures combined with high UV radiation flux which destroys pathogens completely.

BIO-MEDICAL WASTE RULES

Bio-Medical Waste management Rules, 1998

The first rule of Bio-Medical Waste was introduced in 1998 by Ministry of Environment & Forests. According to this rule, the bio-medical wastes generated in hospitals were categorized into 10 categories. The items included under each category had a specific color coded bag/container for waste segregation and a specific method for waste disposal.

Bio-Medical Waste managementRules 2011 (Draft)

The Ministry of Environment and Forests (MoEF) had proposed a revised draft of Bio-Medical Waste Rules 2011. It is much simpler, containing 8 categories of wastes, each has to be segregated by a single color bag, thus clears the confusion over the color coding of the containers used for disposal of biomedical waste under 1998 Rule. However, this rule was never enforced.

Bio-Medical Waste management Rules 2016

The Ministry of Environment and Forests' has recently enforced the new Biomedical Waste Management Rules 2016. This is the rule which should be followed in all health care facilities. It is proposed that this new rule will change the way the country used to manage biomedical waste" and "make a big difference to the Clean India Mission". It has many unique features which differentiates it from that of 1998 rule. It has simplified the categorisation into four categories- yellow bag, red bag, transparent/white puncture proof box and blue card board box.

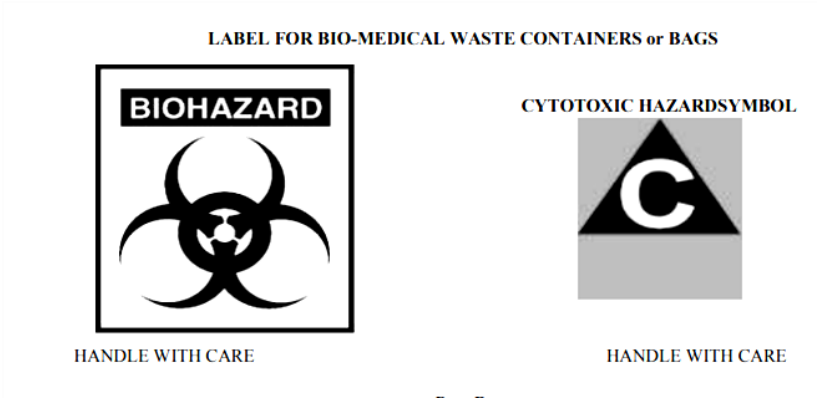
Table-1: Biomedical wastes categories and their segregation, collection, treatment, processing and Disposal options (Difference between Bio-Medical Waste Rules, 2016 and 1998)

WASTE	Biomedical Waste Rule 1998	Biomedical Waste Rule 2016
Human Anatomical Waste	YELLOW plastic bags (Category-1 and 2) Incineration/deep burial	YELLOW non chlorinated plastic bags Incineration or Plasma Pyrolysis*
Animal Anatomical Waste		
Microbiology, Biotechnology and other clinical laboratory waste	YELLOW/RED (Category-3) Local autoclaving/microwaving/ incineration	YELLOW non chlorinated plastic bags Pre-treat to sterilize with non-chlorinated chemicals thereafter for Incineration
Soiled Waste	YELLOW (Category-6) Autoclaving/microwaving/ incineration	YELLOW non chlorinated plastic bags Incineration or plasma pyrolysis In absence of above facilities, Autoclaving or micro-waving/hydroclaving followed by shredding or mutilation or combination of sterilization and shredding. Treated waste to be sent for energy recovery
Expired or Discarded Medicines	BLACK (Category-5) Incineration/destruction and drug disposal in secure landfill	YELLOW non chlorinated plastic bags or containers Incineration at >1200^{O}C or Encapsulation or Plasma Pyrolysis at >1200^{O}C.
Chemical Waste (Solid)	BLACK(Category-10) Chemical treatment and discharge secured landfill for solids	YELLOW non chlorinated plastic bags Incineration or Plasma Pyrolysis or Encapsulation in hazardous waste treatment, storage and disposal facility.
Chemical Liquid Waste	Chemical treatment and discharge into drains (Category-10)	Separate collection system leading to effluent treatment system Pre-treated before mixing with other waste water.
Discarded linen, mattresses, beddings contaminated With blood or body fluid	YELLOW (Category-6) Autoclaving/microwaving/ incineration	YELLOW non chlorinated plastic bags Non-chlorinated chemical disinfection followed by incineration or Plasma Pyrolysis or for energy recovery. In absence above facilities, shredding or mutilation or combination or sterilization and shredding. Treated waste to be sent for energy recovery or incineration or Plasma Pyrolysis.

Contaminated Waste (Recyclable)	RED (Category-3 and 7) Chemical/ autoclaving/ microwaving and shredding	RED non chlorinated plastic bags. Autoclaving or micro-waving /hydroclaving followed by shredding or mutilation or combination of sterilization and shredding. Treated waste to be sent to registered or authorized recyclers or for energy recovery or plastics to diesel or fuel oil or for road making, whichever is possible. Plastic waste should not be sent to landfill sites.
Waste sharps (Metal sharps except implants)	BLUE/WHITE (Category-4) Chemical/ autoclaving/ microwaving and shredding	WHITE (TRANSLUSCENT) Puncture proof, leak proof, tamper proof box /containers) Autoclaving or Dry Heat Sterilization followed by shredding or mutilation or encapsulation in metal container or cement concrete; ii)combination of shredding cum autoclaving; and sent for final disposal to iron foundries (having consent to operate from the State Pollution Control Boards or Pollution Control Committees) or iii)Sanitary landfill or iv) Designated concrete waste sharp pit.
Glassware Metallic Body Implants	BLUE/WHITE (Category-4) Chemical/autoclaving/ microwaving and shredding	BLUE card board box Disinfection (by soaking the washed glass waste after cleaning with detergent and Sodium Hypochlorite treatment) or through autoclaving or microwaving or hydroclaving and then sent for recycling.

Note- For detail, refer to the Biomedical Waste Rule 1998 and 2016.
*Disposal by deep burial is permitted only in rural or remote areas where there is no access to common bio-medical waste treatment facility.

Figure-1:
A) Biohazard symbol and cytotoxic hazard symbols



B) Label for transporting biomedical waste

Part B

LABEL FOR TRANSPORTING BIO-MEDICAL WASTE BAGS OR CONTAINERS

Day .....Month .....
Year .....
Date of generation .....

Waste category Number .....
Waste quantity……

Sender's Name and Address	Receiver's Name and Address:
Phone Number	Phone Number .....
Fax Number.....	Fax Number .....
Contact Person	Contact Person .....

In case of emergency please contact :
Name and Address :
Phone No.
Note :Label shall be non-washable and prominently visible.

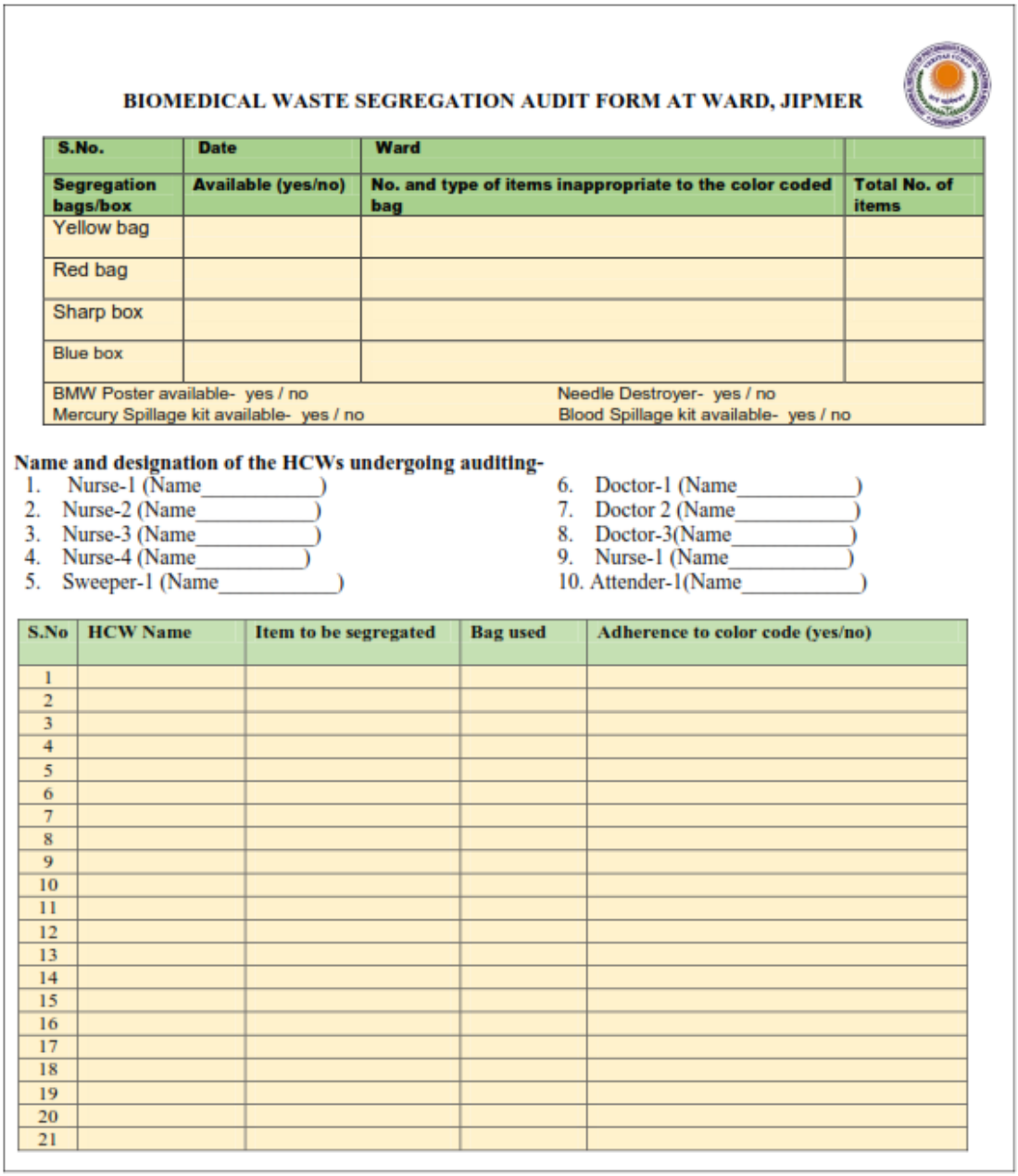
Basic principles of biomedical waste handling

1. Health care setting should have authorization to handle biomedical waste.
2. Biomedical waste should not mix with general waste.
3. Segregation should be done at the generation site in accordance with color coded system mentioned in biomedical waste Rule 2016.
4. Labelling of bags is MUST with details of ward number, weight and date.
5. Transportation of waste should be done safely without spillage & leakage in closed vehicle.
6. Biomedical waste should be treated and disposed within 48 hours as per rule.
7. Health care workers handling biomedical waste should be vaccinated for Hepatitis B & TT.
8. Major accidents should be reported immediately.
9. Annual report of biomedical waste should be submitted.

Food Waste Management: Food and other non-infectious general waste should be segregated separately and sent for disposal. There is no written rule for the color coded bag for the disposal of general waste. Various hospital follows different color coded bags for segregation, for e.g. in JIPMER black bags are used. The various methods available for disposal of food waste are:

- Disposal in Dump yard
- Composting and recycling (preferred method)

Figure-3: Sample of Biomedical waste segregation Audit form at ward, Source: JIPMER, Puducherry



BIOMEDICAL WASTE SEGREGATION AUDIT FORM AT WARD, JIPMER

S.No.	Date	Ward	
Segregation bags/box	**Available (yes/no)**	**No. and type of items inappropriate to the color coded bag**	**Total No. of items**
Yellow bag			
Red bag			
Sharp box			
Blue box			
BMW Poster available- yes / no Mercury Spillage kit available- yes / no		Needle Destroyer- yes / no Blood Spillage kit available- yes / no	

Name and designation of the HCWs undergoing auditing-

1. Nurse-1 (Name_____)
2. Nurse-2 (Name_____)
3. Nurse-3 (Name_____)
4. Nurse-4 (Name_____)
5. Sweeper-1 (Name_____)
6. Doctor-1 (Name_____)
7. Doctor 2 (Name_____)
8. Doctor-3(Name_____)
9. Nurse-1 (Name_____)
10. Attender-1(Name_____)

S.No	HCW Name	Item to be segregated	Bag used	Adherence to color code (yes/no)
1				
2				
3				
4				
5				
6				
7				
8				
9				
10				
11				
12				
13				
14				
15				
16				
17				
18				
19				
20				
21				

Figure-4: Sample of Biomedical waste segregation Audit form at collection centre, Source: JIPMER, Puducherry

BIOMEDICAL WASTE SEGREGATION AUDIT FORM
AT COLLECTION CENTRE, JIPMER

S.No	Date	Ward	Segregation bags/box	Label	No. and type of items inappropriate to the bag	Total No. of items	3/4th full	Tied

Label- A-absent, P-Partially filled, F- Fully filled
Y- Yellow bag, Red bag, W-White transparent puncture proof box, B-Blue card box

Table 2. Validation test for treatment of biomedical waste by autoclave/microwave/chemical treatment/Dry heat sterilization

S. No	Type of equipment used for treatment of bio-medical waste	Type of Validation Test	Frequency
(i)	Autoclave	(i) biological indicator strips or vials (Geobacillus stearothermophilus spores with at least $1X10^6$ spores),	once in three months
		(ii) chemical indicator strip or tape	each batch of waste treated
(ii)	Microwave	Bacillus atrophaeus spores using vials or spore strips with at least 1 x 10^4spores per detachable strip	-
(iii)	Chemical treatment	Bacillus Subtilis (ATCC 19659)-4 Log10 reduction or greater	-
(iv)	Dry heat sterilisation	consistently kill the biological indicator Geobacillus Stearothermophillus or Bacillus Atropheaus spoers using vials with at least 6 log10 spores per ml.	Once in three months
		A chemical indicator strip or tape	Once in a week

Chapter 12: ANTIMICROBIAL USE AND ANTIMICROBIAL RESISTANCE

It is well-documented that there exists relationship between prior antibiotic usage and the emergence of bacterial resistance. Misuse and overuse of antibiotic leads to selection pressure favoring the emergence, and amplification of resistant pathogens and subsequent transmission among patients in healthcare facilities. Resistant bacteria are associated with higher treatment costs, longer duration of hospital stay and have significant impact on morbidity and mortality. Antibiotic Stewardship Program to facilitate the establishment of effective antibiotic stewardship programs at national, state, healthcare facility and community levels.

A major contributing factor towards rising resistance is increasing antibiotic use. Various studies have reported that antibiotics are used widely in India. In a study from central India, 80% of inpatients were prescribed antibiotics with a high number being combinations. An outpatient study reported 66%being prescribed antibiotics with quinolones frequently prescribed. In primary and secondary health care facilities, 69% were prescribed antibiotics. Two third of these were cotrimoxazole and penicillins whereas in the private sector 40% were quinolones and cephalosporins.

In India, infection control programme were introduced into many hospitals relatively
early. Initiatives on antimicrobial stewardship, guidelines and training have however lagged behind. Publications from India in these areas are also few. Antibiotic stewardship programs aim to modify antibiotic prescription to promote the use of narrow spectrum antibiotics which are less likely to select resistant bacteria. Surveillance data can be used to identify changes in usage of antibiotics that may be linked to development of resistance and to measure the impact of antibiotic stewardship programs.

12.1. Measures to control spread of antibiotic resistance-

i. **Appropriate antimicrobial use**

Each health care facility should have an antimicrobial use programme. The goal is to ensure effective economical prescribing to minimize the selection of resistant microorganisms.

- Formulation of guidelines with a multidisciplinary approach using the local antibiogram.
- Provide ongoing education on rational use of antibiotics to clinicians and ensure implementation of antibiotic policies.
- Restricted antibiotic use-

- Use must be justifiable based on clinical diagnosis.

- Before initiating antibiotic treatment, appropriate specimens for bacteriological examination must be submitted to laboratory and selection of an antibiotic must be based on the sensitivity pattern, patient tolerance, and cost

- An agent with as narrow a spectrum as possible should be used with appropriate dosage and duration of antimicrobial therapy.

- The correct dose must be used.

- Control antibiotic use - Selected antibiotics may be restricted in use.

-Cyclic rotation of antibiotics in a class

-Discontinuation of antimicrobial therapy based on predefined criteria

- Carry out periodic prescription audits.

- Restriction of hospital formulary through pharmacy.

ii. Standard and contact Precautions including rigorous adherence to hand hygiene, appropriate use of PPE.

iii. Isolation and cohorting of patients infected or colonized with Multi-drug resistant organisms (MDROs).

iv. Education and training of HCP.

v. Increased environmental cleaning and patient-dedicated equipment.

vi. Proper sterilization and disinfection.

vii. Surveillance for Multidrug resistant organisms especially in high risk areas.

Activities to be stressed

- To include assessing the ground level realities in antibiotic use and hospital infections.
- Developing strategic interventions through a collaborative approach to improve infection control and rational antibiotic use.

12.2 Chemoprophylaxis

Antibiotic prophylaxis is used only when it has been documented to have benefits which outweigh risks. Some accepted indications include:

- selected surgical prophylaxis
- endocarditic prophylaxis

Where chemoprophylaxis is appropriate, antibiotics must be initiated intravenously within one hour prior to the intervention. In most cases, prophylaxis with a single preoperative dose is sufficient. The regimen selected depends on the prevailing pathogen(s), the pattern of resistance in the surgical service, the type of surgery, the serum half-life of the antibiotic, and the cost of the drugs. Administration of prophylactic antibiotics for a longer period prior to the operation is counterproductive, as there will be a risk of infection by a resistant pathogen. Antibiotic prophylaxis is not a substitute for appropriate aseptic surgical practice.

12.3 Role of the microbiology laboratory

The microbiology laboratory has a major role in antimicrobial resistance. This includes:

a) Perform antibiotic susceptibility testing of appropriate microbial isolates consistent with standards.
b) Determine which antimicrobials are tested and reported for each organism.
c) Provide additional antimicrobial testing for selected resistant isolates, as requested.
d) Participate in activities of the Antimicrobial Use Committee.
e) Monitor and report trends in prevalence of bacterial resistance to antimicrobial agents.
f) Provide microbiological support for investigation of cluster of resistant organisms.
g) Notify infection control promptly of any unusual antimicrobial resistance patterns in organisms isolated from clinical specimens.

Role of Specimen Collection and Transportation.

Poor specimen collection and transport isthe single commonest cause for wrong diagnosis and overconsumption of antibiotics.

Following measures must be taken:

1. Microbiologists must train nurses and phlebotomists to collect specimens properly and transport them fast. This requires support of hospital administration. Microbiologists must do an audit every month to give a feedback to head of institute and matron on the inappropriate samples.
2. Microbiology lab must reject sample which are collected or received late as such reports are not only unless but give a wrong diagnosis wrong diagnosis and lead to over/misuse of antibiotics.
3. Here are some examples:
   - Respiratory samples contaminated with oral secretions are inappropriate and must be rejected. Lab must report only Pathogens but NOT Contaminants and colonizers. Quality and quantity of sputum have an impact on diagnosis of pneumonia and tuberculosis.
   - Urine samples contaminated with vaginal secretions or urethral flora be rejected. Only MSU samples be accepted.
   - Blood culture: Pseudobacteremias are quite common when skin cleaning is not adequate. Lab must identify these. Single blood culture has a poor PPV.
   - Clinical Microbiology is a science of Interpretive Judgment. Reports must be accurate, significant and clinically relevant.

     Do not report everything that grows on a plate in the lab. Have a technical policy and a manual. Regular interaction by the microbiologists with the clinicians is important..

     Microbiology report should release data analysis of ONLY clinically significant pathogens (not colonizers and contaminant) isolates from each patient and each site. Clinicians should not treat everything that a lab report.

     Respiratory infections are often caused by viruses (at all ages, more so in children) or Atypical (Mycoplasma, Chlamydia or Legionella) and our labs are ill-equipped to identify them. This leads to overtreatment with antimicrobials. Clinicians need reports at the earliest. The following measures are suggested:

     - Microscopy is a fast and reliable method. It also help to identify poor quality of specimens. It also acts as an audit on culture isolates.
     - Use telephones to communicate results.
     - Use methods like Direct IF for rapid diagnosis.
     - PCRs are expensive, not appropriate on contaminated samples and can be late if done in batches (once or twice a week to reduce the cost). The impact of PCR on routine clinical diagnosis and antibiotic therapy in patients is still NOT fully documented.
     - Use of biomarkers and point of care tests.

     References: [Ann Trop Paed 1997;17:127.] [Med Princ Prac 2005;14:235.] [Lancet Infect Dis 2011;11:408.] [Trans Royal Soc Trop Med Hyg. Nov,2013.] [N Engl J Med 2015;372:1048.]

Role of Biomarkers in Infectious Diseases

1. CRP and PCT have been used frequently as diagnostic and prognostic tools in clinical practice for new fevers. These when done on admission and repeated 6-12 h later have a high sensitivity and specificity to rule out bacterial etiology. PCT shows better correlation with severity of infection and can be used as guide for antibiotic therapy. Values of PCT less than 0.1 µg/L shows that bacterial cause is most unlikely and antibiotics can be withdrawn, while levels of > 0.5 show that bacterial etiology is very likely and antibiotics should be continued. Serial PCT levels are an excellent guide for antimicrobial steward-ship program. This reduces mortality length of hospital stay, cost an emergence of AMR and MDR bacteria. CRP > 70mg/L and PCT > 1.5 ng/ml have NPV 87% and 80% respectively.
2. Elevated serum lactate levels are a good risk stratification for mortality (being high (25%) if levels are >4.0mmols/L).Serial levels correlate with septic shock and multi organ failure.
3. Eosinopenia and absolute PMN count, immature vs mature PMN (shift to the left) are easy markers of sepsis.
4. Point of care test for diagnosis of specific diseases is useful. Immunochromatographic tests for enteric fever and dengue are useful.
5. Markers for fungal infections: galactomanin for Aspergillus and penicillium has a sensitivity of 60-65% and specificity of 65-95% is a useful marker. β – (1-3) D glucan assay has a sensitivity of 63-90% and > 95% specificity for early diagnosis of fungal infections (Candida, Aspergillus, Pneumocystis, Fusarium but not Cryptococcus or Zygomycetes). Serial studies of these markers reduce antifungal therapy and consumption.

References. [Crit Rev Clin Lab Sci 2013;50(1):23-36.] [J Paed Infect Dis 2012;1(4):343-6.] [Thorax 2015;70:41-47.]

12.4. Control of spread of specific organisms

- **Methicillin Resistant *Staphylococcus aureus* (MRSA)**

MRSA strains are resistant to the penicillin's-resistant penicillins (methicillin) and cephalosporins and are often resistant to multiple classes of drugs and occasionally are sensitive only to Vancomycin and teicoplanin. MRSA are highly-transmissible strains and have a high potential to spread across hospitals. Since there are few therapeutic options available for treatment of this resistant organism, the best strategy to control the spread are the preventive measures.

Transient carriage of the organism on hands of HCWs accounts for major route of transmission from infected/colonized inpatients to other patients. Transmission from environmental surfaces and airborne routes is known to occur. The measures to control MRSA in hospitals are screening for MRSA carriage or infection in certain high risk patients or units at admission, standard and contact precautions, isolation and cohorting of patients, treatment of infected/colonized patients, environmental cleaning, education and training of staff.

- **Vancomycin – Resistant Enterococcus (VRE)**

Enterococcal infections are difficult to treat because of their intrinsic resistance to many antimicrobial agents and easily acquire resistance to almost all antimicrobials including Vancomycin. Transmission of VRE can occur by direct contact or indirectly via transient carriage on hands of HCW, contaminated surfaces or patient-care equipment. To prevent and control the nosocomial transmission of VRE, judicious use of antibiotics especially Vancomycin, education of HCW, implementation of hospital infection control practices, equipment and environmental cleaning, using patient-dedicated or

single-use non-critical patient-care equipment, isolation and cohorting of infected/colonized patients, use of PPE, and surveillance for VRE infection/colonization should be implemented.

Infection prevention strategies against XDR (Extensively Drug Resistant) Gram negative bacteria

Introduction

Hospitals are seriously affected by the challenge of MDR, XDR and even possible PDR Gram negative bacteria. Tens of thousands of hospitals in India, with dissimilar infrastructure necessary for the practice of infection control and the sheer size of the Gram negative bacterial challenge in the country are the major deterrentsto compile uniform infection control recommendation for all hospitals.[1] A "best of the ability approach"- to contain the spread of XDR GNB, may be the practical and implementable methodology in the Indian scenario. Hospitals with good infrastructure must follow all precautions to the best possible extent, while hospitals with resource constraints should follow precautions to the best of their ability and affordability.

MDRO (Multi Drug resistant Organisms) Definition

1) Multi-drug resistant *Pseudomonas aeruginosa* and *Acinetobacter baumanii*: Multi-drug resistant *P. aeruginosa* and *A. baumanii* means a bacterial isolate which is resistant to one or more agents in three or more different classes of antimicrobials that the isolate is expected to be susceptible to; e.g., b-lactam-inhibitor combinations, cephalosporins, aminoglycosides, fluoroquinolones and carbapenems. [CDC,2006 http://www.cdc.gov/ncidod/dhqp/pdf/ar/mdroguideline2006]

2) Carbapenem Resistant Enterobacteriaceae (CRE): Centre for Disease control and prevention (CDC) surveillance definition for CRE is Enterobacteriaceae resistant to imipenem, meropenem, doripenem or ertapenem OR documentation that the isolate possesses a carbapenemase.

3) ESBL producing Enterobacteriaceae are examples of MDR Gram negatives. In India, where the prevalence of ESBL producers is very high, specific infection control measures against these bacteria are not feasible.

4) CRE and CRACB (Carbapenem resistant Acinetobacter) are examples of XDR. (Extensively drug resistant Gram negatives) where only very few antibiotics retain sensitivity (for e.g. Colistin, tigecycline)

5) If the Gram-negativebacteria are resistant to all antibiotics, then the terminology of PDR (Pan drug resistance) is used. If all tested antibiotics are resistant, and a few antibiotics, not routinely available in the practice are not tested, then the terminology of "possible PDR" is used (for e.g. All antibiotics including colistin is reported resistant, but fosfomycin is not tested)

6) Chryseobacterium, *B.Cepacia* and *Stenotrophomonas maltophila*. These organisms are intrinsically multidrug resistant.

Prevention of Infections – MDR GNB control strategy includes not just measures to reduce transmission but measures to reduce generation of these bacteria as well. This can be achieved by prevention of occurrence of Health care Associated Infection (HAIs) and proper management of these infections.
Prevention is better than cure!

Preventive strategies include -

- Appropriate management of vascular and urinary catheters
- Prevention of lower respiratory tract infection in intubated patients
- Use of bundles in the care of patients on devices
- Accurate diagnosis of infectious etiologies with appropriate cultures

- Judicious antimicrobial selection and utilization-Antimicrobial Stewardship There is evidence that widespread use of broad-spectrum antimicrobials leads to selective pressure, which then, facilitates the proliferation of the multidrug resistant organisms.
- Avoidance of inappropriate or excessive antimicrobial therapy in all healthcare settings
- Ensuring that antimicrobials are given at the correct dosage (concentrating on the PK/PD) and for the shortest duration required for its efficacy.
- Reducing the use of broad-spectrum antimicrobials, particularly carbapenems and colistin.
- Eradication of MDRs requires a strong knowledgeable team of health care professionals who are willing to work with persistence and perseverance.
- The control of MDROs requires periodic assessment and addition of new and more stringent strategies or interventions over a period of time.
- The studies reporting successful MDRO control employed multiple interventions concurrently or sequentially.

Control interventions

Administrative support-

- The hospital administration plays a crucial role in the prevention of MDROs
- Administrative support is required for human resources.(For e.g. staffing in the ICU)
- Effective communications –computer alert to identify patients previously colonized with MDROs
- Placements of hand washing sinks and alcohol-containing hand rub dispensers in the facility.

Educational Interventions to health care workers: Focusing on antibiotic prescribing pattern, hand hygiene and transmission based precautions.

MDRO surveillance

Surveillance is a critically important component of any MDRO control program,

- It allows detection of newly emerging pathogens
- Monitoring epidemiologic trends
- Measuring the effectiveness of interventions.

Surveillance for MDROs isolated from routine clinical cultures

- Antibiograms
- MDRO Incidence Based on Clinical Culture Results
- MDRO Infection Rates
- Molecular typing of MDRO isolates
- Surveillance for MDROs by Detecting Asymptomatic Colonization

http://www.cdc.gov/hicpac/mdro/mdro_4.html#10

Active Surveillance cultures are frequently included as a part of bundle approach in both endemic and outbreak settings. Guidelines recommend active surveillance culture in outbreak setting and most guidelines do not recommend this intervention in endemic setting. One notable exception is CRE, where active surveillance may have a role in all settings.

Infection Control measures for the Control of MDROS

- Standard Precautions are extremely important in limiting the spread of all transmissible MDROs in a health care setting. Hand hygiene protocols should be implemented at all times.

- Patient colonized or infected with MDRO should be placed in a single room with an attached toilet. If there is limited availability of single rooms, a risk assessment should be done and patients with highest risk should be

isolated. Cohorting should be considered in such circumstances. There should be adequate space around each bed space to minimize transmission. [CDC,2006 http://www.cdc.gov/ncidod/dhqp/pdf/ar/mdroguideline2006]

- Though some experts have argued for a move from targeted (vertical) to universal (horizontal) interventions for MRSA and VRE, all MDR GNB guidelines recommend targeted (vertical) approach. Screening and isolation are examples of targeted approach and environmental cleaning an example of horizontal approach.Contact precautions (use of personal protective equipment such as gloves and gowns and clear signage), can be implemented by cohorting in a multi-occupancy bay or isolating in a single-room setting.[Clin Infect Dis 2014; 58:697–703.]

- A recent review of recommendations by various European guidelines underscores that all the guidelines recommend single room isolation of patients known to be infected or colonized with MDR-GNB in all settings (both endemic and outbreak), though cohorting is an option in outbreak settings. In resource limited Indian settings, with lack of availability of single rooms, cohorting could be an option in all settings. The decision to isolate in a single room or cohorting in multi-occupancy bay should be decided based on the availability of single rooms and supplies such as gloves and gowns.

- The highest priority for isolation should be given to those patients who have conditions which may facilitate transmission of an MDRO, i.e. those with uncontained excretions or secretions such as:
  -Draining wounds
  -Incontinence of urine
  -Copious respiratory secretions
  -Persistent diarrhea

Personal protective equipment:

PPE refers to barriers used alone or in combination to protect healthcare workers from contact with organisms to prevent the spread.

These include:

Single-use disposable gloves-Disposable plastic apron and gloves should be donned before entering the room of a patient infected or colonized with an MDRO.

- PPE should be changed between each patient
- It should be removed and discarded prior to leaving the patient's room into appropriate colour coded bin placed in the patients care area.
- This is done to in order to prevent contamination of non-contaminated areas.

Aprons and long-sleeved gowns- there is some evidence to suggest that use of long-sleeved gowns may reduce contamination of clothing of healthcare workers with MDRO, especially during direct patient contact. [Clin Microbiol Infect 2014; 20(Suppl. 1): 1–55.]. If the level of anticipated environmental or contact with the patient is high exposure is high long-sleeved gowns in preference to aprons should be considered.

Facial protection for eyes, nose and mouth-

- During splash generating or aerosol generating procedures (wound irrigation, oral suctioning, intubation, when caring for patients with open tracheostomies) face masks and eye protection should be worn in accordance with Standard Precautions.
- Masks are not otherwise recommended for healthcare workers carrying out routine care.

Basics of Contact Precautions

- Don gloves before or immediately upon entry to room. Change gloves after contact with infectious material.
- Change gloves when moving from a contaminated body site to a clean body site.
- Remove gloves and decontaminate hands before leaving a patient's room.
- After glove removal and hand hygiene, ensure that hands do not touch potentially contaminated surfaces or items in the patient's room.
- Remove gloves and decontaminate hands before performing care for another patient.
- Don gowns before or immediately upon entry to the room/cubicle.

- Remove gloves before removing gown.
- After gown removal, ensure that hands and clothing do not contact potentially contaminated environmental surfaces or equipment.
- Ensure that hands/clothing do not become contaminated during removal.
- PPE should be removed prior to leaving the isolation room and discarded into appropriate healthcare waste stream.
- PPE removal and disposal should be always followed by hand hygiene.
- Hand hygiene should always be the final step following removal and disposal of PPE.
  Reference: APIC guide 2010.

Isolation precautions in hospitals:

Duration of Contact Precautions for patients treated for infection due to MDRO, but colonized with the organism at one or more body sites, remains an unresolved issue. Shedding of MDRO can be intermittent and active surveillance cultures may not always detect their presence. [CDC,2006 http://www.cdc.gov/ncidod/dhqp/pdf/ar/mdroguideline2006]

- It is advisable to continue Contact Precautions for all patients who have been previously infected or colonized with the MDR GNB during the entire admission. But it could be reasonable to remove Contact Precautions when three or more surveillance cultures for the target MDRO are repeatedly negative over the course of one or two weeks in a patient who has not received antimicrobial therapy for several weeks, particularly in the absence of copious respiratory secretions and draining wound. In resource limited Indian settings, such strict criteria may not be feasible. Infection control team should make a risk assessment and should isolate or cohort at least those patients with high risk of transmission (draining wounds, incontinence of urine, copious respiratory secretions, persistent diarrhea etc.)

- On re-admission rescreening is advised to facilitate an infection control risk assessment.

- Patients with Carbapenem-Resistant *Enterobacteriacae, Acinetobacter* and *Pseudomonas*-should be isolated on readmission and the decision to remove the patient from isolation should be taken following results of rescreening infection prevention and control team risk assessment.

Patient Movement and Transfer

The movement of patients with MDRO within a health care facility should be kept to a minimum. However this should not compromise their essential care. [MMWR Recomm Rep. 2002 Oct 25; 51 (RR-16): 1-45.]

Limit movement or transport of the patient from the room to essential purposes only particularly when they have uncontained drainage of body fluids or secretions.

- Adequately contain their wound or non intact skin
- Notify transport staff and the receiving department staff when a patient on contact isolation is being transported.
- Ensure that the transport designation staff also complies with contact isolation precautions hand hygiene and environment and equipment cleaning. [APIC guide 2010].

Staff cohorting

Staff cohorting is recommended in outbreak settings, though this could be feasible only in the case of nurses and not doctors who may have to visit multiple patients in different wards. [Clin Microbiol Infect 2015; 21: 1057–1066.]

Assigning individual nurse to each MDRO colonized or infected patient may not be feasible in wards, but should be tried in Intensive care units. In wards, patient cohorting will be a more practical option.

Screening Health care workers
Guidelines recommend against screening of health care workers except in outbreak settings. [Clin Microbiol Infect 2015; 21: 1057–1066.]

Cleaning of the Environmental and patient care equipment

Cleaning is the first step in infection control. *Staph aureus* is known to survive for 12 weeks on dry cotton lint and MRSA for 16 weeks. All equipment, doctors stethoscope, machines, curtains and beds, drip stands, lockers and furniture must be thoroughly cleansed regularly with soap & water or alcohol wipes. Environmental cleaning should have a separate manual for implementation and the supervisory staff must ensure implementation with a regular AUDIT.

- Daily cleaning of the isolation room with detergent and water should be sufficient
- On transfer or discharge of the patient terminal clean being completed on, in accordance with local hospital decontamination policy. In addition to thorough cleaning, adequate disinfection of bedside equipment and environmental surfaces (e.g., bedrails, bedside tables, carts, commodes, doorknobs, faucet handles) is indicated as organisms can survive on inanimate surfaces in the environment for prolonged periods of time.
- Curtains should be changed at the time of terminal cleaning.
- Cleaning and disinfection of frequently touched surfaces and equipment should be carried out on a more frequent schedule.
- It is essential that the proper amount, dilution and contact times for disinfectants are used consistently in conjunction with the hospital policy.
- Use of dedicated single-patient use non-critical medical equipment (blood pressure cuffs, thermometers stethoscopes, blood glucose monitoring equipment).
- Assignment of dedicated cleaning staff to areas where patients with MDRO are being cared for.
- Checklist for high touch and terminal cleaning can be followed to ensure compliance.
- Enhanced cleaning is recommended for all pathogens in an outbreak setting, though its utility is not proven in an endemic setting.
    - Vacate units for intensive cleaning
    - Review use of disinfectant agents, methods and meticulousness of cleaning, dilutions and contact time of the hospital cleaning procedures.
    - Implement environmental cleaning procedures with audit and feedback
    - Specify in protocols which items are to be disinfected, which disinfectant to use, and how often items need to be disinfected
    - Dedicate the use of non-critical patient-care equipment to a single patient or cohort of patients
    - Specific protocols for the disinfection of endoscopes and respiratory equipment should be implemented locally
    - Consider closure of the ward or the unit to new admissions in order also to facilitate cleaning until there is evidence of control of transmission.
- Environmental screening should not be performed routinely in endemic settings but maybe useful during outbreaks.

Decolonization

Currently there are no recommended regimens available for the routine decolonization of patients harbouring MDRO other than MRSA. Selective digestive decontamination as a prophylactic measure in the intensive care unit reduces the acquisition of MDRO, including MDR-GNB, but there is increased risk of development of resistance. Guidelines do not recommend SDD for reduction of MDR GNB. The (Public Health England) PHE CPE guidelines recommend against the use of antibiotics to attempt to decolonize patients with MDR-GNB in all settings for all organisms. Chlorhexidine bathing is a common constituent of GNB outbreak bundles. But, studies of chlorhexidine daily bathing have been consistently unsuccessful to demonstrate a reduction in MDR-GNB, possibly due to under powering of these studies.

Though some guidelines recommend chlorhexidine bathing during outbreaks, there are guidelines those do not recommend this in any setting. This is different from the scenario of MRSA where chlorhexidine is a component in the decolonization strategy (MRSA decolonization: Nasal decolonization with mupirocin twice daily for 5–10 days and topical body decolonization regimens with a skin antiseptic solution (e.g., chlorhexidine) for 5–14 days).

Screening patients

Active surveillance screening for CRE may be useful in identifying carriers and hence augmenting contact isolation or cohorting of these patients. Active surveillance cultures and contact tracing for CRE have helped settings to significantly reduce the CRE rate, as shown by centres in Israel. Perirectal, rectal or stool samples could be used for CRE screening. Unfortunately the benefit of this practice is unclear in Indian settings, with high prevalence of CRE in hospitals and increasing prevalence in the community. Special settings such as Oncology centres can consider this intervention as an additional measure for tighter infection control measures for CRE. This may also help in selecting the empirical antibiotic when these high-risk patients develop sepsis.

Education of Patients, Staff, Visitors and Carers.

- A patient who is found to be newly infected or colonized with an MDRO should be informed about the status by the clinical team.
- An information leaflet can be given to the patient regarding prevention of transmission.
- Visitors to the patient and the health care workers should be alerted, to check with the nurse for instruction prior to visiting the patients' room.
- An appropriate signboard stating contact precautions with specific instructions can be placed outside the patient care area.
- All patients should be encouraged to perform hand hygiene after using the toilet.

Reference: CDC,2006 http://www.cdc.gov/ncidod/dhqp/pdf/ar/mdroguideline2006

Nosocomial Tuberculosis

Tuberculosis Infection Control Programs are often not implemented in the developing world including India though India has more TB patients than any other country in the world. The risk of transmission to other patients and healthcare workers is well recognized. The prompt diagnosis and basic DOTS services are the key elements. Transmission particularly in the era of MDR and XDR MTB has serious consequences. Dealing to outbreaks and infection of healthcare givers. Therefore, interventions are essential particularly in tertiary care settings.

Segregating patients with infection pulmonary TB (open cases) from other patients is an effective strategy. Improving mechanical exhaust ventilation (window fans), improving natural ventilation through open windows and sunlight, cough procedures and using simple surgical masks are low cost effective measures.

Periodic regular testing of healthcare personnel for patent disease and early evaluation of symptomatic staff is feasible.

Education of staff and patients is essential.

N95 Masks should not be routinely used except in TB laboratories.

Ref: Emerging infectious Diseases 12: Sept.2006.

In healthcare facilities:

Antibiotic usage rates in healthcare facilities are high for some classes of drugs, and there is considerable unexplained variation between hospitals in the use of certain antibiotics, particularly broad-spectrum antibiotics. Problems resulting from inappropriate use of antibiotics apply to both current and future healthcare facility patients due to changes in healthcare facility microbial ecology resulting from the resistance.

Additional costs of infections caused by resistant organisms include:

- The need for more expensive and broader spectrum antibiotics to treat the infections.
- The need to isolate patients colonized with resistant organisms in order to minimize cross-infection.

In the community:

Community antibiotic use is high and there is irrational use of antibiotics including the over the counter sales due to lack of monitoring mechanism in spite of the existing laws. Thus multi-resistant bacteria, such as community strains of MRSA(CA-MRSA) and extended-spectrum beta-lactamase-producing Gram-negative bacteria are causing increasing human morbidity and there is concern that past excessive antibioticuse in the community or in animal production systems (or both) is responsible.

MERS-CoV & other respiratory infections.

Background

It is not yet understood exactly how people become infected with MERS-CoV. However, it is an established fact that spread of infection with MERS-CoV in hospital settings have been reported from Saudi Arabia, Jordan, United Kingdom and France. Recently, there have been an increased number of reports of health care-associated infections.

Standard precautions are the most basic. Contact, droplet and airborne precautions are used in addition to standard precautions. Regardless of the type of precaution that is used, each has a list of required PPE (for example, gloves or masks) as well as related infection control activities such as the use of dedicated medical instruments.

Chapter 13. ANTIMICROBIAL STEWARDSHIP PROGRAMME

The objective of this chapter is to provide the importance of antimicrobial stewardship programme and the challenges while implementing the programme in the hospital and teir solutions. It provides the necessary recommendations to the healthcare workers in hospitals to improve the quality of antibiotic prescribing and thereby improve patient clinical outcomes.

WHY TO IMPLEMENT ANTIMICROBIAL STEWARDSHIP IN HOSPITALS?

Antimicrobial resistance (AMR) is a rising threat across the globe. There is a dramatic increase in the antimicrobial resistance in the recent days and many of those are multidrug resistance (MDR). The multidrug resistance organisms (MDROs) are prevalent in each and every country though the extent and the severity of the problem vary.

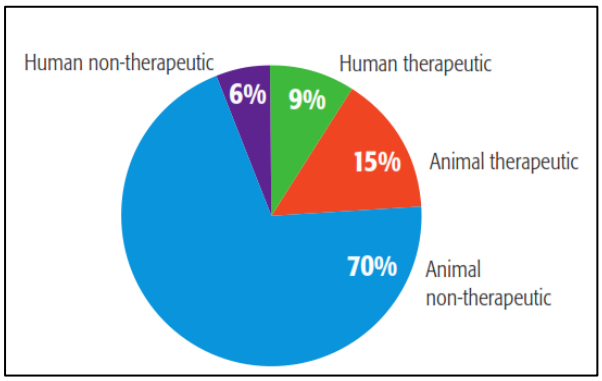
Misuse and over-use of antibiotics

Since the discovery of penicillin, there has been widespread use of antibiotics in hospital and community settings. Though, last seven decades witnessed that the antibiotics were highly effective and have saved millions of lives, at the same time, this has also led to their misuse through various ways such as use without a prescription and overuse for self-limiting infections, non-bacterial infections and treatment of colonization/contamination.

Antibiotics are used in various sectors. Interesting fact is world's largest antibiotic use occurs for animal no-therapeutic purpose (70%), followed by animal therapeutic purpose (15%). Human use accounts for only 15% of total antibiotic consumption out of which only 9% are used for human therapeutic purpose. This data explains that just bringing in stewardship programme in health care facility won't bring down antibiotic use dramatically. A robust plan should also be in place for control of antibiotic use in animals.

Poor antibiotic research and development

Unfortunately there are not many research going on for the development of newer antibiotics especially when it comes to antibiotics active against Gram-negative bacteria. Research and development of any antibiotic is a huge investment for the pharmaceutical industry. More so, soon after the discovery of the antibiotic, the bacteria develop resistance mechanisms to tackle the antibiotic. As a result, the investment goes waste. Lack of profitability has forced pharmaceutical industry to graze in fresh meadows, leaving the field of anti-infective research quite barren. That is why it is also hypothesized that there could be a return to the pre-antibiotic era, where many people could suffer or die from untreatable bacterial infections.



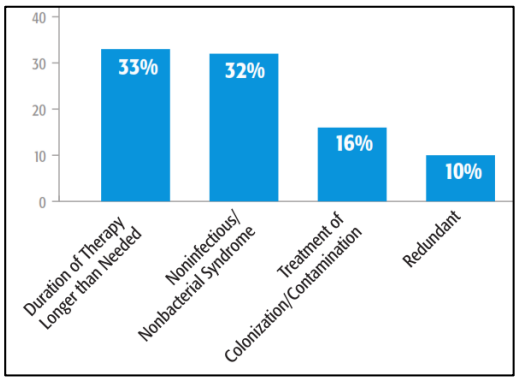


Fig-1:Current use of antibiotics in the worldFig 2: Unnecessary Antimicrobial Therapy

Antimicrobial Prescribing Facts: the 30% rule

Hoffman et al in 2007 have described that Antimicrobial prescribing facts follow 30% rule. Although there is no clear cut data available for India, but it is believed that the situation is same or even worse in in Indian scenario.

- Nearly 30% of all hospitalized inpatients at any given time receive antibiotics
- Over 30% of antibiotics are prescribed inappropriately in the community
- Up to 30% of all surgical prophylaxis is inappropriate
- About 30% of hospital pharmacy costs are due to antimicrobial use

- 10-30% of pharmacy costs can be saved by antimicrobial stewardship programs

ANTIMICROBIAL STEWARDSHIP

Antimicrobial stewardship [AMS] is one of the key strategies to overcome antimicrobial resistance. It involves the careful, judicious and responsible management of antimicrobial use.

Definition

There are many ways Antimicrobial stewardship can be defined.

"Antimicrobial stewardship" is an inter-professional effort, across the continuum of care involves timely and optimal selection, dose and duration of an antimicrobial for the best clinical outcome for the treatment of prevention of infection with minimal toxicity to the patient and minimal impact on resistance and other ecological adverse events such as *C. difficile*" [Nathwani et al., 2012].

CDC has defined "Antimicrobial stewardship" as-

- The right antibiotic
- for the right patient,
- at the right time,
- with the right dose, and
- the right route, causing
- the least harm to the patient and future patients

(www/cdc.gov/getsmart/healthcare/inpatient-stewardship)

Goals of Antimicrobial Stewardship

The four main goals of antimicrobial stewardship are listed below with examples of evidence that stewardship programs can help achieve these goals.

1. **Goal 1: Reduce antimicrobial resistance-**
   - Restricting antibioticsresults in reduction of antibiotic pressure which in turn prevents the development of antimicrobial resistance.
   - Restricting antibiotics can reduce colonization or infection withGram-positive or Gram-negative resistant bacteria
2. **Goal 2: Improve patient outcomes**
   - Improve infection cure rates
   - Reduce surgical infection rates
   - Reduce mortality and morbidity
3. **Goal 3: Improve patient safety**
   - Reduce antimicrobial consumption, without increasing mortalityor infection-related readmissions e.g. 22%-36% reduction inantimicrobial use [Dellit et al., 2007].
   - Reduce *C.difficile* colonization or infection by controlling the useof "high-risk" antibiotics [Valiquette et al,. 2007].
4. **Goal 4:**Reduce healthcare costs towards antimicrobial expenditure without adversely impacting quality of care

IMPLEMENTATION OF ANTIMICROBIAL STEWARDSHIP PROGRAM

The six key steps of Antimicrobial Stewardship Program (AMSP) is depicted in table-1.

Table-1-Key steps for implementing an Antimicrobial Stewardship Program (AMSP)

1. Administrative Support (Leadership)
2. Assess the situation
   - Supporting infrastructure
   - Supporting manpower
3. Set up AMS Team
4. Frame Antimicrobial Policy- Hand book with system wise indications
5. Implement AMS strategies
   - Front end strategies- Formulary restrictions
   - Back end strategies- Antimicrobial review methods
6. Educate and train

Step-1: Administrative Support (Leadership)

The most important prerequisite for implementing AMSP is a strong administrative support.None of the efforts of ID physicians, microbiologists, or infection control specialist to establish AMSP are likely to be successful without active involvement by hospital leadership. The role of administrators are-

- Publicly committed to the program- Hospital administrators should play a front role and show leadership quality while implementing AMSP. Many a times, it is observed that AMSP is initiated by ID physicians or microbiologists, or infection control specialists and they try to convince the administrators to provide a passive support. All those attempts often fail because unless admin is actively push the program, it is unlikely that the clinicians and other stakeholders of the program will be adhere to the policy guideline.
- Program funding -Without adequate support from hospital leadership, program funding will be inadequate or inconsistent since the programs do not generate revenue although they may result in significant cost savings.
- Freedom and power to AMS team- Hospital administrators should provide the liberty, freedom and power to the members of antimicrobial stewardship team to execute the policy.

Step-2: Assess the situation

The hospital administrators should analyze the situation and what problems they want to address. There are many international guidelines available but these need to be adapted them to the local situation. Define where you are and where you want to go, with quantitative figures. The followings should be assessed first before implementing AMSP.

Assess the diagnostic support available-

Availability of rapid microbiology diagnostic tools and biomarkers is recognized as a key intervention in implementation of antimicrobial stewardship in hospitals. The diagnostic facility should be improved first before start implementing AMSP in the hospitals. However, the availability of these facilities in resource-limited hospitals is likely to be a challenge to their introduction. But the administrators should realize that additional budget needed for these investigations will be much lesser compared to the cost saving which can be achieved by rationalizing the use of antibiotics.

- **Complete automation of microbiology**- This is an essential requirement before implementing AMSP. Availability of a fast & accurate identification and susceptibility testing (within 24 hours), will achieve better clinical outcomes and timely streamlining/de-escalating of empiric broad-spectrum antibiotics in seriously ill patients. The various diagnostic facility available are-
  - Culture automation– BACTEC or Bact/Alert
  - Identification automation – MALDI-TOF
  - Antibiotic susceptibility testing automation – by Phoenix or Vitek (it gives results in MIC which is more reliable and accurate than disk diffusion method)
- **Rapid identification systems** such as near-patient rapid tests can be revolutionized. For example, bed side rapid tests for influenza and Strep A can be useful to identify patients with bacterial versus viral infections.
- **Rapid molecular diagnostic screening tests** play an important role in pathogen detection in critically ill patients

which will improve antibiotic stewardship and clinical outcomes. For example, the Film Array (biomerieux) Meningitis Panel is an FDA-cleared multiplex PCR system targeting 14 different meningitis pathogens and gives results in 1 hour.

- **Biomarkers for sepsis e.g. procalcitonin**- Procalcitonin (PCT) has been used as a rapid-reacting biomarker of bacterial infection, a very important interventional tool for antibiotic stewardship. Many studies have shown the benefits of PCT among patients with respiratory tract infection and sepsis by significantly reducing antibiotic exposure and length of ICU stay.

Assess the pharmacodynamics support available-

- Monitoring of serum antibiotic level by HPLC (high performance liquid chromatography)
- Monitoring antibiotic quality by HPLC (high performance liquid chromatography)

Assess the manpower support available-

- ID physician (dedicated)
- Fully functional HICC and designated infection control officer
- Stewardship nurses
- Clinical Pharmacists
- 24/7 reporting facility for culture and sensitivity by Dept. of Microbiology

Assess the information technology support available-

- Hospital information system (HIS)- Fully functional HIS including Laboratory information system will augment the stewardship program by many folds.
- Computerized Order-Entry and Decision Support Systems

Step-3: Set up AMS Team

Antimicrobial Stewardship team (AMS team) is a multidisciplinary committee who will be involved in executing the interventions (both front and back end strategy as described later) and evaluating the adherence to AMSP. The members of AMS team are-

- ID physician
- Stewardship nurses
- HICC- Infection Control Officer and nurses
- Clinical microbiologist
- Clinical pharmacists with expertise in infection
- Quality improvement /patient safety managers
- Pharmacy department

Leadership (Antibiotic steward)

An antibiotic steward is a physician who is trained in infectious diseases and infection control or a microbiologist with training in infection control and antibiotic stewardship. In hospitals without an ID physician or microbiologist, any clinician with special interest in infection control and antibiotic stewardship can function as an antibiotic steward.

- Antibiotic steward should be responsible for reviewing the antimicrobial prescriptions and giving a second opinion especially on the higher-end antibiotic usage.
- Availability of more than one antibiotic steward in any one hospital will provide flexibility in providing round the clock support.

Step-4: Frame Antimicrobial Policy

Every hospital should frame their own hospital antibiotic policy in the form of a 'Handbook of Antimicrobial Use'. The core chapters of the Handbook has been depicted in table-2.

Treatment regimens of common infections of major systems-

This is the main component of the hand book. The major departments involved in each system should frame the antibiotic treatment regimens for the infectious diseases under that system.

i. *Reference to be followed*- Every antibiotic treatment regimen should be supported by a reference which has to be quoted in the chapters against each indication of antimicrobial use. Some of the examples are given below.
    a. Harrison, IDSA (Infectious disease Society of America)- For Medicine
    b. Sabiston's textbook of Surgery
    c. Any other guideline / standard book for other dept
    d. Local Antibiogram should also be taken into consideration. However, guideline should not be made only based on local antibiogram pattern.

ii. Common consensus- After preparing the treatment regimen, the major departments involved for each system should initiate discussion among themselves to arrive at a common consensus.
    a. Intra Unit discussion
    b. Intra Departmental discussion
    c. Inter Departmental discussion

iii. The AMS team members should coordinate via mail, personal and subgroup meetings with various departments to arrive at the common consensus.

iv. Every stakeholder's opinion and consensus should be taken so that once the Hand Book is implemented, maximum adherence can be obtained.

Table-3: Chapter distribution of Handbook of Antimicrobial Use of a hospital

Chapters	Name of the chapter		Should contains
1.	Title Page		Name of policy, date, version, review date, and contact details for normal hours and out-of-hours enquiries
2.	Goal of AMSP		
3.	List of available antimicrobials		Unrestricted, restricted (approval of a specialist is required) or permitted for specific conditions
4.	General Guidelines		
5.	Microbiology culture sensitivity		
6.	AMR Surveillance data of last year		Resistant pattern of common pathogens- Overall, ICU/ward/OPD wise, specimen wise
7.	**Treatment regimens of common infections** Should contain five columns- Disease, agents, antibiotic regimen in adult and children, comments/suggestions (see the template below in figure-3)		
	Infections of major systems		**Major department Involved are-**
	I	GI and Intra -abdominal Infections	Common/Surgery/Medicine/Medical and surgical gastroenterology
	Ii	CVS Infections	Medicine/Cardio/CTVS
	Iii	Skin and soft tissue Infections	Common/Medicine/Surgery/ Dermatology
	Iv	Bone and joint Infections	Common/Ortho
	V	Respiratory Infections	Common/Medicine/TB Chest
	Vi	Genitourinary Infections	Common/Medicine/Urology / Nephrology/OBG/Dermatology(for STI)
	Vii	CNS Infections	Medicine/Neuromedicine/Neurosurgery
	Viii	Ocular Infections	Ophthalmology
	Ix	Dental Infections	Dental Dept.
	X	Empiric antibiotic therapy for ICU	All ICUs
	Xi	Patients with Fever and Neutropenia	Oncology, Medicine
	Xii	For management in NICU	Neonatology, Pediatric Surgery
	Xiii	Children column in each system	Pediatrics
	Xiv	Surgical site infections	Surgery and all Surgical dept.
8.	Frequently asked questions (FAQs)		

Figure-3: Template for treatment regimens of common infections

GI and intra-abdominal infections				
Disease	**Etiological agents**	**Antibiotics in adults**	**Antibiotics in children**	**Remarks/Alternative antibiotics**
Acute gastroenteritis	Viral Enterotoxigenic and Enteropathogenic *E.coli*, nontyphoidal salmonella	No antibiotics usually required. Prompt rehydration essential. If diarrhea persists beyond 2 days or in immunosuppressed patients :Ciprofloxacin 500mgbd X 5 days	Nil	When blood or mucus appear in stool, or if there is evidence of cholera or invasive diarrhea; antibiotics are indicated in children
Cholera	*V.cholerae*	Cap Doxycycline 300 mg, single dose (6mg/ kg, maximum 300 mg Or Tab Ciprofloxacin 1gm single dose	Ciprofloxacin single dose 30mg/ kg maximum 1 g Above 8 years, doxycycline 5 mg/kg to be preferred	Prompt rehydration essential, antibiotic therapy is only adjunct to rehydration
Bacillary dysentery	*Shigella*	Tab Cefixime 400mg od X 5 days (8mg/kg/day) Or Tab Ciprofloxacin 500 mg bd X 5 days	Tab Cefixime (10 mg/kg/day) x 7 days. Continue feeding and add zinc Supplementation	If no response then switch to cefoperazone sulbactam i.v (150mg/kg/day)
Amoebic dysentery	*Entamaoeba histolytica*	Metronidazole 400mg tds for 10 days	Metronidazole 30-35 mg/kg/ day in three divided doses for 10 days	

* Source: Handbook of Antimicrobial use at JIPMER, Puducherry

Step-5: Implement AMS strategies

Front end strategies-

1) Formulary restrictions

This involves determining the list of restricted antimicrobial agents and criteria for their use combined with an approval system which is subject to regular audit and feedback to the prescribers. Though sounds more attractive and appears to be the most ideal way to achieve antimicrobial stewardship, but practically implementing formulary restrictions is not that easy. It creates lot of confusion as it directly impacts the clinician's freedom to choose antimicrobials. More so availability of the concerned authority to give approval all the time further complicates the problem especially in emergency situations. Hence, instead of surveillance on the usage of all antibiotics, monitoring higher-end antibiotics is a more practical and implementable strategy.

- Antimicrobials can be classified into restricted, semi-restricted and un-restricted groups (table-4).
- All antimicrobial prescriptions must be countersigned in duplicates by the consultants or faculty in-charge of the unit, not by post graduate students or residents.
- Pharmacy will keep one prescription for its record purpose and will hand over the second prescription to the AMS team.
- The AMS team will review the antibiotic prescription and give a second opinion by countersigning on it. Further continuation of the antimicrobial use will depend upon the approval from AMS team. The duration to obtain the approval from AMS team can vary depending upon the class of antimicrobials.
    - **Restricted antimicrobials**-This group include third line antibiotics active against gram-negative bacteria such as colisitin, carbapenems and tigecyclines where more vigilant monitoring is needed. For these antimicrobials, prior approval by AMS team should be made mandatory to obtain pharmacy supply of >1 day.
    - **Semi-restricted antimicrobials-** This group include third and fourth generation cephalosporins, BL-BLI agents (piperacillin tazobactam, cefoperazone –sulbactam) and second line antibiotics active against gram-positive bacteria such as teicoplanin, vancomycin, daptomycin, linezolid. For these antimicrobials, prior approval by AMS team should be made mandatory to obtain pharmacy supply of >3 days.
    - **Unrestricted antimicrobials**-This group include first & second generation cephalosporins, cotrimoxazole, azithromycin, clarithromycin and fluoroquinolones where a less vigilant monitoring is needed. Pharmacy supply need not requires AMS team approval. However, retrospective review of antimicrobial use will be done by AMS team from time to time.

Table-4: Proposed formulary restriction

Restricted antimicrobials	Semi-Restricted antimicrobials	Unrestricted antimicrobials
Colistin Carbapenem Tigecycline	Teicoplanin Vancomycin Daptomycin Linezolid Third and fourth generation cephalosporins BL-BLI agents	First & second generation cephalosporins Cotrimoxazole Azithromycin Clarithromycin Fluoroquinolones
Pharmacy supply of >1 days requires prior approval by AMS team (for second opinion). Pharmacy supply needs a prescription in duplicate prior to dispensing. Pharmacy will send the prescription for compulsory second opinion from AMS team within 24 hours.	Pharmacy supply of >3 days requires prior approval by AMS team (for second opinion). Pharmacy supply needs a prescription in duplicate prior to dispensing. Pharmacy will send the prescription for compulsory second opinion from AMS team within 72 hours.	Pharmacy supply does not require AMS team approval. However, retrospective review of antimicrobial use will be done by AMS team from time to time.

2) Antibiotic cycling

Antibiotic cycling or antibiotic rotation refers to the development of strategies utilizing the scheduled rotation of antimicrobials in order to minimize the emergence of bacterial resistance. Theoretically, during the periods when an antimicrobial is out of rotation (i.e. off the cycle) and its use is minimal, there won't be antibiotic pressure; as a result resistance to that drug will decline. These programs typically target gram-negative resistance and are generally limited to the ICU setting.

Poor compliance-

Antibiotic cycling is in principle the most restrictive of all approaches to antimicrobial stewardship as it involves dictating the clinicians exactly which antimicrobials are to be used in a given time period. Therefore researches done on antibiotic rotation reveals that compliance with the cycling protocol is extremely low. There could be many reasons behind it such as-

- Physicians may ignore the protocol and prescribe off-cycle antimicrobials to their patients
- Allergies or toxicity may preclude administration of the on-cycle drug
- The final regimen may be tailored to culture results.

Back end strategies

Back end strategies include antimicrobial review methods and providing timely feedback.

Antimicrobial review methods

Though difficult to perform, but it is the most effective strategy to implement AMSP. This is done at two stages. First, during the clinical rounds, an exhaustive and thorough intra unit review of various aspects of antimicrobial use can be carried out. This should be further reviewed (for a second opinion) during stewardship rounds which should be carried out by AMS team members. Thevarious aspects of antimicrobial use which can be reviewed are-

- Indication for antibiotic and compliance with policy
- Appropriateness of the antibiotic choice, dose, route and duration
- Duplicative therapy [potential overlapping spectra]
- Review of directed therapy based on microscopy or PCR, biomarkers or other rapid tests
- Timely de-escalation or escalation based on culture and susceptibility report
- Potential for conversion from IV to oral route
- Requirement for therapeutic drug monitoring

- Any antibiotic related adverse events
- Any potential drug interactions
- Drug allergy if any
- Requirement for renal adjustment
- Need for extended infusion.

Back-end strategies, although more labour-intensive, are:

- More widely practiced
- More easily accepted by clinicians
- Provide a higher opportunity for educating and training the health care professionals.
- They probably provide a more sustained impact of improving the overall quality of antimicrobial prescribing *[Chung et al., 2013]*.

Step-6: Educate and train

Similar to any other health care program, AMSP also needs continuous education, training, motivation and assessment of the health care providers. Developing antimicrobial stewardship is a behavioral change within the person. Hence, adequate motivational education MUST to bring in such change.

- **Who should receive education in Hospitals –** Every stakeholder should be educated on rational use of antimicrobials.
    - Medical practitioners (physicians and surgeons), phamacists and nurses should be educated about AMSP.
    - AMSP should be brought in as a part of undergraduate, internship and post graduate curriculum.
    - Educating patients and the general public is also important and it may indirectly support hospital education efforts. The following aspects should be addressed.
        - General hygiene
        - Hazards of Antibiotic use without prescription
        - Discouraging over the counter sale
    - **Content of education-**Content should be adapted to each profession.
        - Basic knowledge of infection management,
        - Basic microbiology
        - Importance of prudent prescribing in tackling AMR
        - Best practices for prescribing to support safe and effective prescribing administration and monitoring of antimicrobial therapy.
    - **Who should deliver the training-** It is usually delivered by the AMSP team members. However, the administrators should take part active role and address the audience time to time to increase the seriousness of the training.
    - **Evaluation process**- Without assessment, no educational training can be effective. Various assessment tools can be used for the competency assessment of the trainee time to time.
        - Attendance forms
        - Completion certificates
        - Questionnaires
        - Case scenario based tests

EVALUATION OF ANTIMICROBIAL STEWARDSHIP PROGRAM

Measurement of prescribing performance is essential to evaluate the impact of stewardship interventions on clinical practice and demonstrate benefits for patients. It is said “If you cannot measure it, you cannot improve it”. There are various ways the impact of AMSP is evaluated (table 5).

Table-5: Methods for evaluation of AMSP

1. Policy adherence outcome indicator

- Antimicrobial Stewardship Audit

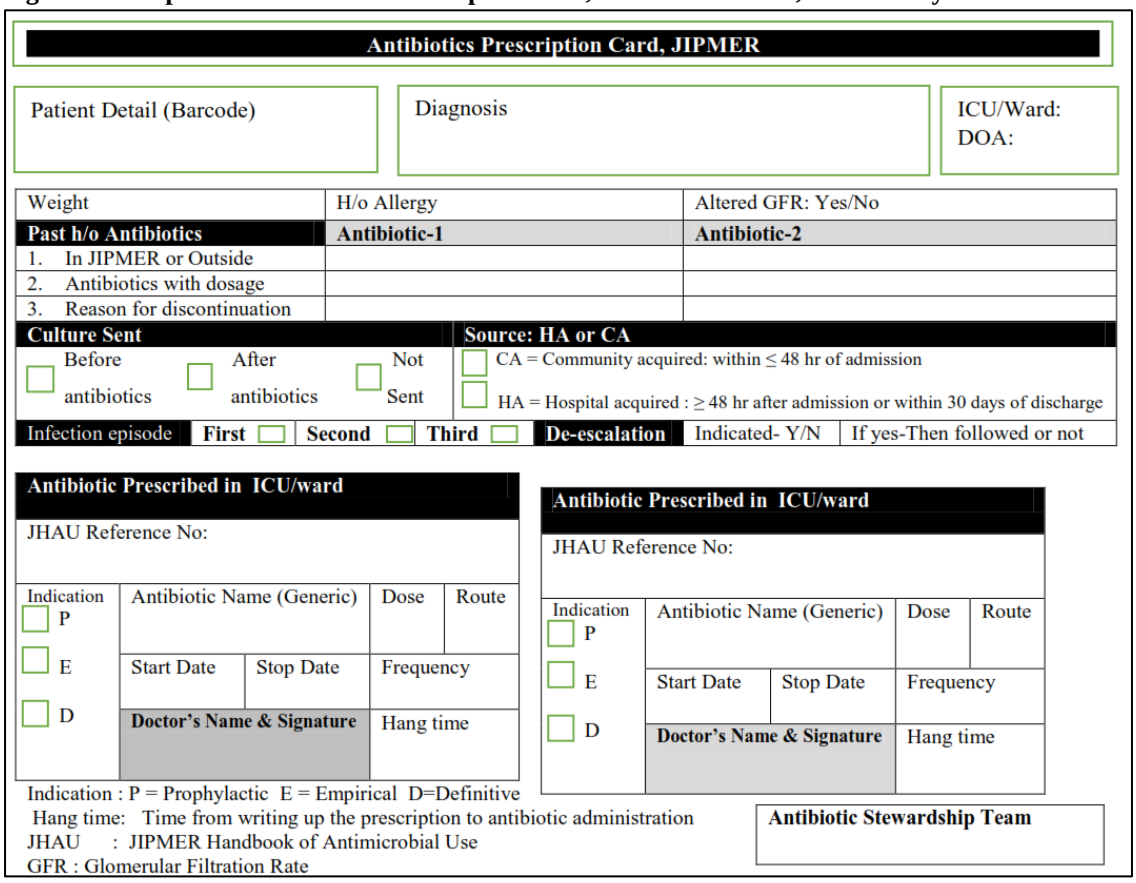
2. Antibiotic Usage outcome indicator
   - Antibiotic Usage Surveillance (DDDs and DOTs)
3. Antimicrobial resistance outcome indicator
   - AMR Surveillance – Manual and WHONET
4. Clinical outcome indicators-
   - Morbidity and Mortality
5. Financial outcome indicators

Policy Adherence outcome indicators

Antimicrobial Stewardship Audits

Antimicrobial stewardship audits (ward rounds)should be done to monitor the adherence to antibiotic policy of the hospital. The members of AMS team members should carry out this audit. *Antibiotics Prescription Card*should be implemented in the hospital (figure-4). For each patient on antibiotics, this card should be filled and countersigned by the ICU or ward liaison. During the AMS audit rounds, the AMS team will evaluate the correctness filling the card.

Figure-4: Sample of a Antibiotics Prescription card, Source: JIPMER, Puducherry



Antibiotics Prescription Card, JIPMER

Patient Detail (Barcode)	Diagnosis	ICU/Ward: DOA:

Weight	H/o Allergy	Altered GFR: Yes/No
Past h/o Antibiotics	**Antibiotic-1**	**Antibiotic-2**
1. In JIPMER or Outside		
2. Antibiotics with dosage		
3. Reason for discontinuation		

Culture Sent			**Source: HA or CA**
☐ Before antibiotics	☐ After antibiotics	☐ Not Sent	☐ CA = Community acquired: within ≤ 48 hr of admission ☐ HA = Hospital acquired : ≥ 48 hr after admission or within 30 days of discharge

Infection episode	**First** ☐	**Second** ☐	**Third** ☐	**De-escalation**	Indicated- Y/N	If yes-Then followed or not

Antibiotic Prescribed in ICU/ward			
JHAU Reference No:			
Indication ☐ P ☐ E ☐ D	Antibiotic Name (Generic)	Dose	Route
	Start Date / Stop Date	Frequency	
	Doctor's Name & Signature	Hang time	

Antibiotic Prescribed in ICU/ward			
JHAU Reference No:			
Indication ☐ P ☐ E ☐ D	Antibiotic Name (Generic)	Dose	Route
	Start Date / Stop Date	Frequency	
	Doctor's Name & Signature	Hang time	

Indication : P = Prophylactic E = Empirical D=Definitive
Hang time: Time from writing up the prescription to antibiotic administration
JHAU : JIPMER Handbook of Antimicrobial Use
GFR : Glomerular Filtration Rate

Antibiotic Stewardship Team

The policy adherence outcome indicators include-

(a) *Antimicrobial prescription card filling adherence rate* = No. of cards filled / Total no. of antimicrobial prescriptions given in the same period X 100

(b) *De-escalation adherence rate* = No. of times de-escalation done after the culture sensitivity report/ No. of possible de-escalations indicated in the same period X 100

(c) *Handbook adherence rate* = No. of times antimicrobials prescribed according to hand book of antimicrobial use at JIPMER / Total no. of antimicrobial prescriptions given in the same period X 100

(d) *Percentage of culture sent before administration of antimicrobials* = No. of times blood culture sent before administration of antimicrobials / Total no. of blood culture sent in the same period X 100

(e) Timely cessation of antibiotics given for surgical prophylaxis

Antimicrobial usage outcome indicators-

This will be calculated based on DDD (Defined Daily Dose) and Days of Therapy (DOT).

(a) ***No of Defined Daily Dose (DDD)-***

Defined Daily Dose (DDD) is the average maintenance dose per day for a drug used for its main indication in adults. Therapeutic dose should not be used for calculating antibiotic usage because it varies between the persons depending upon the weight, disease, associated factors such as renal adjustment etc. Hence, DDD is the best indicator to calculate the antimicrobial consumption. Every antimicrobial has a WHO assigned DDD (WHOCC - ATC/DDD Index) which should be used for calculating the DDDs (table -6). More detail, visit http://www.whocc.no/atc_ddd_index/

No of DDDs = Therapeutic dose (No. of Tablets used X gm per tablet) / WHO defined DDD of the antimicrobial.

DDDs per 100 patient days= No of DDDs used in an ICU in a period/ Total patient days of the ICU in the same period (sum of occupied beds daily) X 100

Table-6: Antibiotics, their therapeutic dose and Defined daily dose (DDD)

	ATC Index	Antibiotics	Antibiotic Name	Therapeutic dose	DDD
J01C		Beta-lactam antibacterials (Pn)			
	J01CE01		Crystalline (Benzyl)Penicillin	2 lakhs units QDS	3.6g
	J01CR05		Piperacillin plus Tazobactum	4.5 gm QDS	14g
J01D		Other Beta-lactam antibacterials			
	J01DH02		Meropenam	1gm TDS	2 g
	J01DC	2nd generation cephalosporin			
	J01DC02		Cefuroxime		0.5g(O)3g (P)
	J01DD	3rd generation cephalosporin			
	J01DD04		Ceftriaxone	1 gm BD	2g
	J01DD12		Cefoperazone Sulbactum	2 gm BD	4g
	J01DD08		Cefixime	1 gm BD	0.4 g
	J01DD02		Ceftazidime	1 gm TDS	4 g
	J01DD01		Cefotaxime	1 gm BD	4g
J01FA		Macrolides and Lincosamides			
	J01F		Azithromycin	250mg OD	0.3g
S01AA26		Aminoglycoside			
	J01G		Amikacin	750mg OD	1g
	J01GB03		Gentamicin		0.24g
J01MA		Fluoroquinolones			
	J01MA02		Ciprofloxacin	200 mg BD	1g (O) 0.5g (P)
	J01MA12		Levofloxacin	750 mg OD	0.5 g
	J01MA14		Moxifloxacin	400mg OD	0.4g
	J01MA01		Ofloxacin	400 mg BD	0.4g
		Others			
	J01XB01		Colistin	2 million units TDS	3MU
	J01XA01		Vancomycin	2 gm BD	2g

	G01AF01		Metronidazole	0.5g TDS	0.5g

(b) ***Days of Therapy (DOT per 100 patient days)-***

Days of Therapy (DOT) per 100 patient days -

Total Days of Therapy of an antimicrobial in an ICU in a period / Total patient days of the ICU in the same period (sum of occupied beds daily) X 100

Antimicrobial resistance outcome indicator

AMR Surveillance is the key to generate local antibiogram pattern of the hospital which can be used to monitor the trend of AMR. Dept. of Microbiology should carry out the surveillance to generate data on AMR and communicate the clinicians time to time. AMR can be generated at various level.

a. Location wise AMR pattern (ward/ICU/OPD wise)
b. Specimen wise AMR pattern
c. Overall AMR pattern of the hospital

There are two methods by which AMR Surveillance is carried out.

a. Manual data entry and analysis by using Microsoft excel.
b. WHONET

Clinical outcome indicators

These include the parameters to measure the infection related morbidity and mortality .

a. Morbidity indicator-

i. Length of stay in ICU
ii. Surgical site infection (SSI) rate
iii. Rate of occurrence of complication due to sepsis e.g. organ failure
iv. Rate of occurrence of readmission within 30 days
v. Ward to ICU transfer rate
vi. Antibiotic-related toxicity (e.g. aminoglycoside) rate
vii. Rate of CDI (*C.difficile* infection)

b. ***Mortality indicator-***

i. Death due to sepsis by sepsis score
ii. Standardized Mortality Rates (SMRs)

Financial outcome indicators

a. Antibiotic cost per patient day- Antibiotics used per day in an ICU X cost of the antibiotics
b. Antibiotic cost per year- Antibiotics used in an ICU for the whole year X cost of the antibiotics
c. Antibiotic cost per admission- Antibiotics used in the ICU in a given period X cost of the antibiotics / no. of admissions in the same ICU during the period X 100

Chapter 14: Prevention of Infections among the Staff & Post- Exposure Prophylaxis

Exposure to infected blood or blood contaminated body fluids can result in transmission of blood-borne viruses (BBV) from:

a. Patient to Health care worker
b. Health care worker to patient
c. Patient to patient

All patients should be treated as potentially infectious and standard precautions should be applied to minimize the risk of transmission of infection from person to person.

Health care workers are at a higher risk of occupational exposure to blood borne pathogens such as Human Immunodeficiency virus (HIV), Hepatitis B virus (HBV), and Hepatitis C virus (HCV). Health care workers working in the infectious wards, operation theaters, blood banks, casualty, handling bio medical waste, labour room, intensive care units, laboratories are at a higher risk of contracting the healthcare associated infections.

Post-exposure management is an essential component of infection control programme and a policy must be in place to prevent and manage infections in hospital staff.

Before beginning employment, all staff should be assessed and offered testing and/or vaccination for specific infectious diseases before being allowed to work in high-risk areas.
Heath care worker can be protected from hospital acquired infection by following standard work precautions(hand hygiene and PPE, etc.) as well as preventive health checkup (once every year) and post exposure prophylaxis after accidental occupational exposure to patient's blood and body fluids..

A) Routine screening and assessment at induction and yearly thereafter.

B) Immunization against vaccine preventable diseases like HBV, chiken pox and as advised in case of outbreaks (H1N1, typhoid, etc.)

C) Post exposure prophylaxis in special circumstances.

Components of post exposure management

1. Development of specific post exposure policies, compliance to which must be ensured.
2. Education and training of staff about standard work precautions, risk associated with exposure, vaccination and prophylaxis/treatment options available.
3. Prompt reporting and record keeping of all occupational exposures.
4. Evaluation of type of exposure and risk of seroconversion involved.
5. Counseling and treatment of exposures, post exposure vaccination/drugs/ immunoglobulin's.
6. Follow up.

13.1 Pre-employment screening and immunization:

Personnel Medical assessment (presence of any disease and immune status):a questionnaire (with recording of information gained) should check for details of medical history, particularly for rubella, measles (rubeola), mumps, chickenpox (varicella), hepatitis B, immune disorders and skin conditions, and for prior exposure to tuberculosis (including working in high-risk settings and high-risk demographic background).

Laboratory and other testing this should include a routine tuberculin skin test. Routine screening of patients for carrier state is not recommended, although this form of screening may be instituted in the case of an outbreak.

Table 1: Health care worker are categorized as per their work activities:

Cat.	Risk	Example
A	**High risk-Direct contact with blood or body substances.** This category includes all persons who have physical contact with, or potential exposure risk to blood or body substances	Medical practitioners, nurses, allied health practitioners, health care students, dentists, laboratory staff, maintenance engineers who service equipment, sterilizing service staff, cleaners, and staff responsible for bio medical waste management.
B	**Low risk-Indirect contact with blood and body substances** Rarely have direct contact with blood or body substances. These employees may be exposed to infections spread by the airborne or droplet routes, but are unlikely to be at occupational risk for blood borne diseases.	Catering staff and ward assistant, hospital ancillary staff.
C	**Minimal risk-Minimal patient contact** Occupational groups that have no greater exposure to infectious diseases than do the general public. The exact nature of job responsibilities should be taken into account when deciding immunization requirements and all staff should be encouraged to be fully vaccinated.	Office clerical staff, gardening staff and kitchen staff

Table 2: Immunization requirements for healthcare workers can be determined using a risk stratification system that assesses the exposure to blood and body substances.

Vaccine	Risk category	Vaccination notes	Remarks
Hepatitis A	A	Still not recommended in India.	Recommended for healthcare workers who work with remote Indigenous communities, persons with intellectual disabilities childcare staff, maintenance staff in contact with sewage.
Hepatitis B	ABC	To be considered immune a blood test result (anti-HBs) must be provided.	Healthcare workers must be aware of their status if performing exposure prone procedures (EPP) by undertaking testing to

		Anti-HBs >10 at any stage post vaccination indicates lifelong immunity to hepatitis B.	ensure protective anti HBs Ag antibody titer. All staff as HBV is now part of UIP
Influenza	A,B		Annual seasonal influenza vaccine may be offered to all staff.
Tetanus Toxoid	A, B	Vaccination history during last six month	If not taken in last six month, can be given.
Rabies	A		Pre-exposure prophylaxis to be considered for HCW handling the rabies cases
Chicken Pox **(Varicella)**	A,B	Healthcare workers can be considered immune if they have a documented medical history of chicken pox or shingles. Healthcare workers with an unsure history should have serological screening.	To be considered for healthcare workers with patient contact particularly, ID wards.

Immunization

Head of the institution of the hospitals should take all reasonable steps to ensure that staff members are protected against vaccine-preventable diseases. Where healthcare workers may be at significant occupational risk of acquiring or transmitting a vaccine-preventable disease, a comprehensive occupational vaccination program should be implemented. Such a program should include:

- A vaccination policy.
- Maintenance of current and all staff vaccination records.
- Provision of information about the relevant vaccine-preventable diseases.
- The management of vaccine refusal (which should, for example, include reducing the risk of a healthcare worker transmitting disease to a vulnerable patient).

Healthcare management should advise healthcare workers of the potential consequences if they refuse reasonable requests for immunization. Such advice and refusal to comply should be documented.

Duties may be modified if a healthcare worker has a confirmed infection that may directly affect the risk of transmission of infection during exposure-prone procedures. This is determined at the local facility level.

Vaccine refusal, contraindication to vaccination and vaccine non-response may be managed by ensuring appropriate work placements, work adjustments and work restrictions. This should be documented.

Staff records

Employers and healthcare management need to retain details of screening results and immunizations provided, including vaccine preventable disease history, date and results of serology, record of immunizations consented/ refused, date given and batch number, type and brand name of vaccine. Records need to be secure and accessible to authorized personnel when needed, updated when relevant events occur, and maintained in accordance with confidentiality and privacy laws.

Steps of post exposure management

1. Exposure site should be washed with soap and water.
2. Prompt reporting of exposure
3. Type and severity of exposure should be assessed and recorded (skin/ percutaneous/ mucous membrane exposure; depth of injury, volume of blood/body fluid/ body secretions)
4. Exposure source, whether known case of infection with HIV, HBV or HCV.
5. Vaccination status of exposed person.
6. Investigations for the infection status of the exposed person and the source.
7. Treatment/ vaccination of the exposed person if required.

Fig 1a. Needle stick Injury Reporting Proforma (Source: JIPMER, Puducherry)

NEEDLE STICK INJURY REPORTING PROFORMA								
Exposure ID:			**Date & Time of Exposure:**					
Contact details:								
Health Care Worker Name				JIPMER ID NO:		Age	Sex	
Mobile No:		Land line no-		Email id:				
Job Description of HCW: Job place : Department /Unit								
Job category	Student	Doctor	Nurse	Lab technician	Attender	G4S	DLR	Others
Place where the incident occurred:								
Was the source patient identifiable? Yes/No/Unknown/Not applicable								
If identifiable, whether the source is a known HIV/HBV/HCV patient								
Type of contact: Needle-stick and sharp or Mucocutaneous exposure								

If the exposure involved needle stick and sharp object
1. Were you the original user of the sharp item? Yes/No/Unknown/Not applicable
2. Was there blood on the device? Yes/No/Unknown
3. The source (person/equipment) is :
a. Known case of HIV/HBV/HCV..... Previous lab report no.....
b. Negative for HIV/HBV/HCV
c. Unknown
4. For what purpose was the sharp item originally used?
a. Unknown/Not applicable
b. Injection, intra-muscular/subcutaneous/intradermal (*syringe*)
c. To draw arterial/venous blood sample
d. To place IV/arterial/central line
e. To obtain a body fluid or tissue sample (urine/CSF/amniotic fluid/other fluid, biopsy)
f. Suturing
g. Other: Specify……
5. Did the injury occur?
a. Before use of item (*item broke/slipped, assembling device, etc.*)
b. During use of item (*item slipped, patient jarred item, etc.)*
c. While recapping the used needle
d. Device left on floor, table, bed or other inappropriate place
e. From item left on or near disposal container
f. While putting item into disposal container
g. After disposal, stuck by item protruding from opening of disposal container
h. Other: Specify: ……..
6. What type of device caused the injury? Needle (hollow-bore/plain) or instrument or Glass
7. Specify the instrument that caused the injury:
8. What was the site of the injury?
9. Was the injury?
a. Superficial (*little of no bleeding*)
b. Moderate (*skin puncture, some bleeding*)
c. Severe (*deep stick/cut, or profuse bleeding*)
10. If injury was to the hand, then - Gloves used (single pair or double pair) or no gloves used

Describe the incidence in own words

Fig 1b. Needle stick Injury Reporting Proforma (Source: JIPMER, Puducherry) continued…

If the exposure (splashes) involved blood and body fluid:
1. Type of body fluid was involved in the exposure?
2. Was the body fluid visibly contaminated with blood? Yes/No/Unknown
3. What was the exposed part? (Check all that apply)
Intact skin Non-intact skin Nose (*mucosa*) Mouth (*mucosa*) (*Conjunctiva*) Others
4. What were all barrier garment(s) worn at the time of exposure?(Check all that apply)
Gloves Surgical maskPlastic apron Goggles Surgical gown
Eyeglasses (*Not a protective item*) Lab coat, Others
5. Was the exposure the result of? (Check one box only)
a. Direct patient contact
b. Specimen container leaked/spilled /broke
c. Touched contaminated drapes/sheets/gowns, etc.
6. If equipment failure (device malfunction) , Specify: Equipment type and manufacturer
7. For how long was the blood or body fluid in contact with your skin or mucous membranes?
< 5 minutes 5-14 minutes 15 min- 1 hour > 1 hour
8. How much blood/body fluid came in contact with your skin or mucous membranes? (Check one)
a. Small amount - Few drops
b. Large amount - Several drops or splashes
9. For injured healthcare worker: Do you have an opinion that any other engineering control, administrative or work practice could have prevented the injury? Yes/No/Unknown. If yes then specify-

POST EXPOSURE FOLLOW UP
SOURCE INFORMATION
1. Source known and tested
2. Source known but not tested, reason:
3. Source not known
Was the source patient positive for the pathogens below? **If tested before, then Lab report No.** Hepatitis B Hepatitis C HIV Others:
If the source patient was believed to be high risk group for blood borne pathogens : Blood product recipient / injection drug use / sex worker / Hemophilia / dialysis / Others.....
If the source patient was HIV positive, ART has been started? If yes what regimen was followed?
INFORMATION OF THE HEALTHCARE WORKER:
First aid (Specify):
First dose of ART taken:
Vaccination status of HCW 1. Complete vaccination with Anti HBs titre tested.....Report no. & date 2. Complete vaccination with no titer testing 3. Incomplete vaccination **4.** No vaccination
Whether pregnancy test done: Yes/ No/Not applicable *If yes, trimester? First/second/third*
RESULTS OF BASELINE TESTS:

Test	**SOURCE**	**HEALTHCARE WORKER**
HIV Antibody		
HBsAg		
HCV antibody		
Anti-HBs Antibody	Not applicable	Protective or Not protective (Titer_____)

Follow up Advice Given-

1. Tests for HIV Antibody are scheduled on
2. Referred to ART clinic
3. HBV Vaccine taken on Next dose scheduled on
4. Hepatitis Immunoglobulin taken on Next dose scheduled on

INFECTION CONTROL NURSE

POST-EXPOSURE MANAGEMENT

Post-exposure prophylaxis (PEP) is the medical response given to prevent the transmission of blood-borne pathogens following an exposure. PEP includes first aid, counseling including the assessment of risk of exposure to the infection, testing, and depending on the outcome of the exposure assessment, the prescription of antiretroviral drugs, with appropriate support and follow-up

HBV is highly infectious and the risk of HBV transmission following percutaneous injury is approximately 6-30% (depending on the infective status of the source) while, the risk of transmission of Hepatitis C virus (HCV) by similar means is approximately 3%; and for HIV/AIDS, 0.3%.

- For people who have an exposure to a known source, post exposure prophylaxis (PEP) for HIV should be initiated as soon as possible within two hours after the incident. Factors associated with an increased likelihood of occupational acquisition of HIV infection following injury include:
    - Deep (intramuscular) injury
    - Visible blood on the injuring device
    - Injuring device used to enter a blood vessel
    - Source patient with high viral load
    - Hollow-bore needle

- Initiation of HBV PEP is dependent on the type of exposure, the source's HBsAg status and the exposed persons HBV immunization history and level of anti HBs Ag antibody.
- At present, there is no prophylaxis proven to be effective for Hepatitis C. The aim of follow up is to detect acute hepatitis C as soon as possible so that appropriate treatment can be instituted.

HIV occupational exposure Post Exposure Prophylaxis (PEP)

- Recommendations are based on WHO guideline for post-exposure prophylaxis (published in December 2014).
- In contrast to earlier guidelines (DHHS 2005, NACO 2007), recent guidelines including WHO 2014, DHHS 2013 and BHIVA prefer three drugs for PEP, irrespective of the degree of exposure (Irrespective of percutaneous or mucous membrane exposure and irrespective of mild, moderate or severe exposure).This change was aimed at simplification of the recommendation to improve uptake and completion rates for post-exposure prophylaxis. This shift towards recommending a three-drug regimen for everyone was based on the availability of less toxic and better tolerated medications, the difficulty in evaluating the risk of drug resistance and need to simplify prescribing.

- There may be situations where only two-drug regimens are available for post-exposure prophylaxis or where the risk of additional toxicity outweighs the benefit. In these scenarios two drug regimen is acceptable.

Eligibility for post-exposure prophylaxis

- PEP should be offered, and initiated as early as possible, to all individuals with exposure that has the potential for HIV transmission, and ideally within 72 hours.
- Exposures that may warrant occupational post-exposure prophylaxis include:
    - parenteral or mucous membrane exposure (splashes to the eye, nose or oral cavity)
    - the following bodily fluids may pose a risk of HIV infection: blood, blood-stained saliva, breast-milk, genital secretions and
    - cerebrospinal, amniotic, rectal, peritoneal, synovial, pericardial or pleural fluids.

Exposures that does not require post-exposure prophylaxis include:

- when the exposed individual is already HIV positive
- when the source is established to be HIV negative
- exposure to bodily fluids that does not pose a significant risk: tears, non-blood-stained saliva, urine and sweat.

PEP regimen

- A regimen for post-exposure prophylaxis for HIV with two ARV drugs is effective, but three drugs are preferred.
- Raltegravir or a PI can be used as the third drug (WHO guideline recommends PI as the preferred third drug and raltegravir as the alternative but DHHS recommend raltegravir as the preferred drug and PI as the alternative option.)
- Please refer to the given tables for drug choices and doses (WHO recommendation)

Post-exposure prophylaxis ARV regimens	Adults and adolescents	Children ≤10 years old
Preferred backbone regimen	TDF + 3TC (or FTC)	AZT + 3TC
Alternative backbone regimens	-	ABC + 3TC or TDF + 3TC (or FTC)
Preferred third drug	LPV/r or ATV/r	LPV/r
Alternative third drug options	RAL, DRV/r or EFV	ATV/r, RAL, DRV, EFV and NVP
Duration	28 days	28 days

[a] Adult and Adolescent ARVdrug dosages for use in PEP	
Generic name	Dose
Tenofovir (TDF)	300 mg once daily
Lamivudine (3TC)	150 mg twice daily or 300 mg once daily
Emtricitabine (FTC)	200 mg once daily
Lopinavir/ritonavir (LPV/r)	400 mg/100 mg twice daily or 800 mg/200 mg once dailya
Atazanavir/ritonavir (ATV/r)	300 mg +100 mg once daily
Raltegravir (RAL)	400 mg twice daily
Darunavir + ritonavir (DRV/r)	800 mg +100 mg once daily or 600 mg +100 mg twice daily
Efavirenz (EFV)	600 mg once daily

Follow up

- HIV Antibody testing should be done for at least 6 months post-exposure (e.g., at baseline, 6 weeks, 3 months, and 6 months) to ensure no transmission has occurred.

PRE-EXPOSURE PROPHYLAXIS FOR HEPATITIS B VIRUS

HCW have a higher risk of exposure to HBV infection than the general population, hence routine vaccination against HBV of personnel who are likely to come in contact with blood, body fluids or sharps, is mandatory (NABH) . The HBV vaccine in generally administered in a three-dose vaccine series at 0-, 1- and 6-month schedules. The vaccine should be administered intra-muscularly in deltoid muscle because gluteal injection leads to poor immunogenicity. The efficacy of the vaccine is >90 % after the third dose in terms of formation of a protective antibody titer.

After 1-2 months of completion of 3 dose vaccination series, HCW may be tested for anti-HBs titers. A seroprotective (adequate) level of anti-HBs after completion of a vaccination series is defined as anti-HBs ≥10 mlU/mL; a response < 10 mlU/mL is inadequate and is not a reliable indicator of protection. Those whose anti-HBs titers are below protective titer of 10mIU/ml should complete a repeat 3 dose vaccine series or be evaluated for HBs Ag positivity. Around 50 % of individuals who did not respond to the first series of the HBV vaccine respond to the second series of the vaccine. If the HCW does not respond to the second series, He/She should be labeled as a non-responder.

POST-EXPOSURE PROPHYLAXIS FOR HEPATITIS B VIRUS

If the source is **KNOWN** or **SHOWN** to be positive for Hepatitis B surface antigen (HBsAg), the level of antibodies is important.

- If the injured HCW is immunized (anti-HBs antibodies > 10 IU/mL) - whether from vaccination or past infection – they are protected, and there is no need for Hepatitis B immunoglobulin after a potential or confirmed exposure to Hepatitis B.

- If the HCW is unimmunized or a non-responder (did not seroconvert to the vaccine) or has antibody levels to HBsAg less than 10 IU/mL), and sustains a needle-stick injury from a patient with evidence of chronic HBV (HBs Ag positive), they should be given HBIG (hepatitis B hyper-immune globulin) 0.06ml/kg as soon as possible, preferably within 24 hours and should simultaneously start/reinitiate the course of HBV immunization with three-dose of hepatitis B vaccineq at a different site for unimmunized/previously unfinished second hepatitis B series. The second and third doses should be separated by at least 2 months interval. If the HCW has had two series of the HBV vaccine and was still a non-responder, they should receive a second dose of HBIG, 1 month after the first dose.
    - Following completion of 3 dose vaccination series, the level of immunity (antibodies to surface antigen i.e. anti-HBs titers) should be checked 1-2 months later. Those whose anti-HBs titers are <10mIU/ml should complete a second 3- dose vaccine series or be evaluated for HBs Ag positivity. If HBs Ag is positive after exposure, the person should be counseled regarding the modes of prevention of HBV transmission to others and to seek treatment for HBV.

Table 4. Post exposure prophylaxis for percutaneous or per mucosal exposure to hepatitis B virus

Vaccination/Serostatus	Source HBs-Antigen positive	Source HBs-Antigen negative	Source unknown
Unvaccinated	Hepatitis B immunoglobulin(HBIG) single dose and initiate vaccination	Initiate Vaccination	Initiate Vaccination
Responder to vaccine/Protected	No treatment	No treatment	No treatment
Non responder			
After one series (3- dose) of vaccination	HBIG single dose and initiate revaccination	No treatment	If source known to be high-risk: treat as if source were HBsAg-positive (HBIG single dose and initiate revaccination)
After 2 series (6 doses) of vaccination	HBIG two doses (separated by 1 month)	No treatment	If source known to be high-risk: (treat as if source were HBsAg-positive) HBIG single dose and initiate revaccination
Antibody response unknown	Test exposed person for anti-HBs: If ≥10 mIU/mL: no treatment If <10 mIU/mL: HBIG single dose and vaccine booster	No treatment	Test exposed person for anti-HBs If ≥10 mIU/mL: no treatment If <10 mIU/mL: initiate revaccination

Source: Adapted from Immunization of Health-Care Personnel: Recommendations of the Advisory Committee on Immunization Practices (ACIP) MMWR 2011 /60(RR07); 1-45(PEP NACO guidelines, 2007).

Exposure to hepatitis C virus:

Over 60% of the infected with Hepatitis C virus may develop chronic liver disease. Depending on whether active viral replication is occurring for Hepatitis C, the risk of transmission after a sharps injury from an HCV infected person varies from 3-10%. The routes of infection are similar to hepatitis B infection. No post exposure therapy is available for hepatitis C, but seroconversion (if any) must be documented. The exposed HCW should be retested for HCV antibodies at 3 and 6 months with monitoring of clinical signs and symptoms. Preferably the exposed HCW should be under the care of a hepatologist/physician so tha HCV infection if happens is detected at the earliest (Liver enzymes monitored and in case these increase that may indicate infection) and treatment for HCV can be instituted.No recommendations exist regarding

restriction of professional activities of HCW with an HCV infection. Standard precautions and other infection control practices should be followed. As for hepatitis B viral infection, the source person must be tested for HCV infection. For any occupational exposure to blood borne pathogens, counseling and appropriate clinical and serological follow-up must be provided.

At this time, there is no prophylaxis proven to be effective for Hepatitis C. The aim of follow up is to detect acute hepatitis C as soon as possible so that appropriate treatment can be instituted.

Standard guidelines for pre-test counseling or pre-test discussions for HIV, HBV and HCV must be followed when testing the source and the healthcare worker.

***Neisseria meningitides* infection:**

N. meningitides can be transmitted through respiratory secretions. Occupational infections are rare, but the severity of the disease warrants appropriate chemoprophylaxis for close contact between patients and health care workers. Close contact is defined as direct mouth-to-mouth contact as in resuscitation attempts. Recommended prophylaxis includes one of the following: a single dose of ciprofloxacin (500 mg), or a single dose of ceftriaxone (250 mg) IM. Rifampicin is not recommended for chemoprophylaxis in view of high prevalence of tuberculosis in India.

***Mycobacterium tuberculosis*:**

Transmission to hospital staff occurs through airborne droplet nuclei, usually from patients with pulmonary tuberculosis. The association of tuberculosis with HIV infection and multidrug-resistant tuberculosis are a current major concern. In the case of health care exposure, individuals with Mantoux conversion (≥10 mm indurations) following exposure should be considered for isoniazed prophylaxis, depending on local recommendations.

Other infections (varicella, hepatitis A and E, influenza, pertussis, diphtheria and rabies):

Transmission of these microorganisms may be uncommon, but policies to manage staff exposure should be developed. Vaccination of hospital staff against varicella and hepatitis A is recommended. Influenza vaccination should be given yearly. Rabies vaccination may be appropriate in ID facilities managing rabies patients.

REFERENCES

1. Malhotra S, Sharma S, Hans C Department of Microbiology, PGIMER and Dr RML Hospital New Delhi.International Journal of Medicine and Medical Sciences (ISSN: 2315-9844)Vol.1(7)pp.91-94,July,2014Availableonlinehttp://internationalinventjournals.org/journals/IJMMSCopyright ©2014 International Invention Journals
2. Goossens H, Ferech M, Vander Stichele R, Elseviers M; ESAC ProjectGroup. Outpatient antibiotic use in Europe and association withresistance: a cross-national database study. *Lancet* 2005; *365* : 579-87.
3. Sharma M, Eriksson B, Marrone G, Dhaneria S, Lundborg CS. Antibioticprescribing in two private sector hospitals; one teaching and one nonteaching:a cross-sectional study in Ujjain, India. *BMC Infect Dis*. 2012 Jul12; 12:155.
4. Pathak, A, Mahadik K, Dhaneria SP, Sharma A, Eriksson B, Lundborg CS.Antibiotic prescribing in outpatients: Hospital and seasonal variations inUjjain, India. *Scand J Infect Dis.* 2011 Jul;43(6-7):479-88.
5. S KI, Chandy SJ, Jeyaseelan L, Kumar R, Suresh S. Antimicrobialprescription patterns for common acute infections in some rural andurban health facilities of India. *Indian J Med Res.* 2008 Aug; 128(2):165-71.

6. Australian guidelines for the Prevention and Control of Infection in Healthcare© Australian Government 2010.
7. Standard precautions in health care Epidemic and pandemic alert and response © World Health Organization 2007
8. Prevention of hospital-acquired infections A practical guide 2nd edition World Health Organization Department of Communicable Disease, Surveillance and Response WHO/CDS/CSR/EPH/2002.12
9. National Standards for the Prevention and Control of Healthcare Associated Infections 20 May 2009 Health Information and Quality Authority.
10. INTERIM GUIDANCE :Interim Infection Prevention and Control Guidance for Care of Patients with Suspected or Confirmed Failovers Hemorrhagic Fever in Health-Care Settings, with Focus on Ebola. WHO 2014 WHO/HIS/SDS/2014.4Rev.1.
11. Manual on Infection prevention and control policies and guidelines (WHO/AFRO/CRHCS/East, Central and Southern African College Of Nursing, Prepared by Una V. Reid ,HRD Consultant, November, 2001.
12. Prevention of hospital-acquired infections, A practical guide, 2nd edition, World Health, WHO/CDS/CSR/EPH/2002.12

Chapter 15. Translating Infection Control Guidelines into Practice

It is essential to ensure compliance of AMR and HIC policies nationwide through appropriate monitoring. Implementation and adherence of these policies nationwide requires sustained efforts at institutional levels, both in public and private sector. Theoretically it is within reach. However, progress is slow in spite of sustained efforts. There is a need for multifaceted approach: economic and govt. support and commitment, human behavior, an efficient microbiology laboratory support (collection of right samples, their transportation and processing) and early prompt and correct reports of only pathogens (excluding colonizers/contaminants). Use of microscopy and biomarkers can have significant impact on early diagnosis and choice of antibiotics at an early stage & this save valuable time in management. Involvement of clinical pharmacologists and pharmacists is valuable.

Plan of action:

1. Institutional culture hospital-wide
2. Institutional endorsement
3. Design and develop appropriate HIC & AMR policies
4. Link HIC adherence to patient outcomes to educate the staff.
5. General accountability ownership and pride & facilitate teamwork.

The stumbling blocks are:

1. Professional authority and autonomy of clinicians especially seniors.
2. Interpersonal resistance and lack of understanding.
3. Invisible threat to established practices.

Reference: Quality Health Res. 2014; 24: 551-560

Contributors

Dr. A. C. Dhariwal, Director, National Centre for Disease Control, Delhi.

Dr. S. Venkatesh, Ex-Director, National Centre for Disease Control, Delhi.

Dr. Sunil Gupta, Additional Director and Head, Microbiology, National Centre for Disease Control, Delhi.

Dr. Shashi Khare, Ex-Additional Director, Microbiology, National Centre for Disease Control, Delhi.

Dr. Sarika Jain, Assistant Director, Microbiology, National Centre for Disease Control, Delhi

Dr. Usha Baveja, Senior Consultant, Microbiology, Medanta-The Medicity, Gurgaon

Dr. Ratna Rao, Senior Consultant, Microbiology, Apollo Hospital, Hyderabad

Dr. Apurba Sastry, Assistant Director, Microbiology, JIPMER, Puducherry

Dr. George K Varghese, Infectious Diseases Consultant, Narayana Hrudayalaya, Bangalore

Dr. Vidya Devarajan, Infectious Diseases Consultant, Apollo Hospital, Chennai

Dr. Anup Warrier, Infectious Diseases Consultant, Aster Medcity, Kochi

Dr. N. Kumaraswamy, HIV consultant, YRG care, Chennai

Dr. Abdul Ghafur, Consultant in Infectious Diseases and Clinical Microbiology, Apollo Hospital, Chennai

Dr. Manisha Biswal, Associate Professor, Microbiology, PGIMER, Chandigarh

Dr. Vasant Nagvekar, Infectious Diseases Consultant, Leelawati Hospital, Mumbai

Dr. Nitin Shinde, Infectious Diseases Consultant, Wockardt hospital, Nagpur

Dr. Malini R Capoor, Professor, Microbiology, VMMC & Safdarjang Hospital, New Delhi