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Guidelines on Prevention and Control of Hospital Associated Infections

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Contents

Foreword

One of the cardinal principles of hospital care is that it should cause no harm to the patient. However, for many patients the outcome is different; they acquire infections in hospital. There are many reasons for this. Invasive procedures on patients are being undertaken in greater numbers and with a higher degree of aggressiveness. This makes the targeted organs prone to invasion by micro-organisms. The number of patients with immuno-compromised status is increasing. Though HIV/AIDS is a major cause for this, it is not the only one since many other conditions for which patients require hospitalization also weaken their resistance to fight infections. In addition, the environment of the hospital, affected by a variety of micro-organisms over a period, acts as a source of infection. The micro-organisms endemic in hospitals are resistant to most antibiotics since extensive use of these agents destroys the sensitive organisms, thus permitting selection of resistant ones that perpetuate in the hospitals.

It is well known that patients with burns, on ventilators and catheters usually, if not always, contract serious infections while they are in hospital. The incidence of post-operative sepsis is also very high in the countries of this region. Even outbreaks due to resistant organisms have been frequently reported from various hospitals causing considerable morbidity, mortality and economic loss.

Of late, there has been growing realization of this problem. Hospitals are constituting hospital infection control committees. Attempts are being made to institute surveillance mechanisms. However, not much has been accomplished. Realizing that one of the reasons was non-availability of practical guidelines to implement an efficient programme for the prevention and control of these infections, practical and simple guidelines have been developed to assist Member countries in instituting efficient hospital infection control programmes. These guidelines include organization of the infection control programme, management of hospital environment, care of high-risk areas and patients, surveillance and outbreak investigation, isolation procedures, standard precautions as well as care of hospital staff.

I am sure these guidelines will serve as a valuable technical resource for hospital administrators. They could also be used as an advocacy tool to institute appropriate mechanisms to prevent and contain hospital associated infections in Member Countries of our Region.

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Acknowledgements

The draft Guidelines on Prevention and Control of Hospital Associated Infections were finalized during a Consultative Meeting on Prevention and Control of Hospital Associated Infections organized in Bangkok, Thailand, from 26 to 29 June 2001.

The first draft was prepared by Dr Geeta Mehta, Head of the Microbiology Department, Lady Hardinge Medical College, New Delhi, India and finalized in the Consultative Meeting. The valuable contributions of all the experts listed in the Annex are gratefully acknowledged.

Preface

Hospital Associated Infections (HAI) have been the bane of hospitals since time immemorial. Despite rapid advances in medical science in therapeutics, diagnostics and a better understanding of the disease process, the problem of HAI persists throughout the world. The incidence, type and magnitude of HAI varies from hospital to hospital; it is estimated to be around 10% of hospital admissions. Given the prevailing conditions in the hospitals in developing countries, this is likely to increase. Hence, there is an urgent need to set up systematic control measures.

A number of activities have been held in the countries of the Region to raise awareness. However, there is no systematic database on hospital infection. This is probably because of inadequate surveillance activities and lack of standardized methodology to undertake surveillance. To overcome this problem, uniform guidelines are required to provide technical support to Member Countries in supporting suitable measures to prevent and control HAI. Realizing the importance of these guidelines in instituting efficient hospital infections control programmes, WHO organized an informal consultation in Bangkok, Thailand in June 2001 wherein experts from various countries formulated guidelines after extensive discussions.

These guidelines are intended for use in health care facilities at various levels. The guidelines can be used as technical resource materials in developing comprehensive standard operating procedures for various activities to prevent and control HAI. We are confident these guidelines will be found useful by hospital administrators as well as organizers of hospital infection control committees.

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1. INTRODUCTION

Infections which arise in hospitals are termed "hospital associated infections" (HAI). Such infections have also been called "noscomial infections" and sometimes "hospital acquired infections". As more health care is now being provided in ambulant patients, the term "health care associated infections" is also used.

1.1 Definition

Hospital Associated Infections (HAI) or noscomial infections are those infections that were neither present nor incubating at the time the patient was admitted to the health care facility.

The majority of HAI become evident 48 hours or more following admission. However, it may not become clinically evident until after discharge.

There are various reasons why patients in hospital acquire infection.

Patients with infectious diseases are frequently admitted to hospital. Some of these patients are able to spread their organisms to other patients and they provide one source of infection in hospital patients admitted for other causes. Examples of such infections spreading in hospital include – salmonellosis, group A streptococcal infections, tuberculosis, viral hepatitis and other infections. When such patients require admission to hospital, the risk has to be assessed for other patients and appropriate measures taken to contain the infection with isolation procedures of varying degrees of strictness depending on the infection.

The commonest forms of hospital-acquired infection are due to invasive procedures carried out on patients such as surgical operations, intravenous therapy, intubation and catheterization. A variety of measures is needed to control such infections.

Immuno-competence of varying degrees is seen in many of the patients admitted to hospital. These include patients at the extremes of age, those with diabetes, receiving immunosuppressive drugs and those with cancer, in particular those undergoing chemotherapy. These patients are prone to infection with bacteria which have little threat for healthy persons.

1.2 Sources of infection in hospital

Bacteria and viruses are natural inhabitants of the environment, both in the community and in the hospital. The majority of these organisms are not pathogens and may even have a

beneficial role to play in human body. The organisms in the natural environment may provide a reservoir from which they may be passed to other patients and cause infections. However, there are very many reservoirs; the one from which infections arise is usually called the source. Identification of the correct source is essential to arrest the spread from this source.

The sources of spread can be classified along the same lines as the types of infection.

(1) Spread from community-acquired infections to other patients in hospital can be via:

- The respiratory tract as in tuberculosis and respiratory viruses;
- Infected blood as with viral hepatitis and HIV;
- Faeces with salmonella, shigella, vibrio;
- The air or skin scales as with chicken pox, herpes, staphylococci, streptococci, and
- Infected discharges such as pus.

Prevention of such spread requires interventions specific to the individual infectious diseases.

(2) Patients undergoing hospital treatment frequently become infected. These infections arise from many different sources and are usually associated with operative or other invasive procedures carried out in operating theatres, wards, X-ray departments and clinics.

The organisms come from many possible sources, such as:

- The patients' own resident flora – the mouth, gastrointestinal tract, vagina or the skin;
- The resident microbial flora of health care workers and from other patients on the ward;
- Transient bacteria carried on the hands of health care workers from one patient to another;
- Contaminated instruments, dressings, needles, etc. used for invasive procedures, and
- Infusions.

The wide variety of opportunities for acquisition of hospital pathogens requires general standards of hospital practice to protect all patients. At the same time, each risk group or procedure may require specific measures related to removing special sources of infection.

The general procedures include items such as:

- Supply of adequately sterilized instruments and dressings;
- Operating theatre design, discipline and procedures;
- General application of aseptic techniques;
- Good environment cleaning, safe food, effective laundry procedures and waste disposal, and

Specific measures include items such as:

- Standardized procedures for intubation, catheterization, venous access and investigative procedures and
- Peri-operative surgical chemoprophylaxis.

(3) The groups at high risk of acquisition of infection due to diminished defences require additional protection including hospital areas where there are enhanced invasive procedures. The specific requirements of ICU, special baby units, oncology departments and long-stay surgical wards need to be documented and implemented. For neutropenic patients, special isolation procedures providing a protective environment rather than containment facility are necessary.

With such a complex series of events, it is necessary to apply a scientific approach to the assessment of risks in order to establish priorities for infection control. All hospital staff require information on control of hospital infection and the particular role each group has to play in the process. The practicalities of the situation have to be discussed with staff at all levels to ensure that they are capable of carrying out the recommended procedures. Instructions are more readily complied with if the procedures have been explained and are acceptable to the surgeons, nurses, technicians and domestic staff who have to implement them.

1.3 Magnitude of problem

Hospital-associated infections are considered as major causes of mortality, emotional stress and enhanced morbidity in hospitalized patients. These also account for significant economic loss and additional burden on health care institutions. In a study conducted by WHO, the highest frequencies of HAI were reported from hospitals in the Eastern Mediterranean Region (11.8%) followed by South-East Asia, where it was 10%. It has also been estimated that at any time over 1.4 million people worldwide suffer from infectious complications acquired in hospital. The infections acquired in the hospitals may be due to resistant organisms that further accentuate the problem. It has also been estimated that these infections cost more than US$ 40 million every year in Thailand alone.

2. INFECTION CONTROL PROGRAMME

Each hospital needs to develop a programme for the implementation of good infection control practices and to ensure the well being of both patients and staff by preventing and controlling HAI.

2.1 Objectives of the infection control programme

- Monitoring of hospital-associated infections;
- Training of staff in prevention and control of HAI;
- Investigation of outbreaks;
- Controlling the outbreak by rectification of technical lapses, if any;
- Monitoring of staff health to prevent staff to patient and patient to staff spread of infection;
- Advice on isolation procedures and infection control measures;
- Infection control audit including inspection of waste disposal, laundry and kitchen, and
- Monitoring and advice on the safe use of antibiotics.

2.2 Responsibility of hospital administrator/ head of health care facility

The hospital administrator/head of hospital should:

- Provide the funds and resources for infection control programme;
- Ensure a safe and clean environment;
- Ensure the availability of safe food and drinking water;
- Ensure the availability of sterile supplies and material, and
- Establish an infection control committee and team.

2.3 Infection control organizations in a hospital

Infection control organizations are essential features of an infection control programme. These organizations are:

(1) Infection Control Committee (ICC)

Representatives of medical, nursing, engineering, administrative, pharmacy, CSSD and microbiology departments are the members. The committee formulates the policies for the

prevention and control of infection. One member of the committee is elected chairperson and has direct access to the head of the hospital administration. The infection control officer is the member secretary. The committee meets regularly and not less than three times a year.

(2) Infection Control Team (ICT)

Members are the Infection undertake out the day to day measures for the control of infection.

(3) Infection Control Officer (ICO)

The Infection Control Officer is usually a medical microbiologist or any other physician with an interest in hospital associated infections.

Functions

(1) Secretary of Infection Control Committee and responsible for recording minutes and arranging meetings;

(2) Consultant member of ICC and leader of ICT;

(3) Identification and reporting of pathogens and their antibiotic sensitivity;

(4) Regular analysis and dissemination of antibiotic resistance data, emerging pathogens and unusual laboratory findings;

(5) Initiating surveillance of hospital infections and detection of outbreaks;

(6) Investigation of outbreaks, and

(7) Training and education in infection control procedures and practice.

(4) Infection Control Nurse (ICN)

A senior nursing sister should be appointed full-time for this position. Adequate full-time or part-time nursing staff should be provided to support the programme.

Functions

(1) To liaise between microbiology department and clinical departments for detection and control of HAI;

(2) To collaborate with the ICO on surveillance of infection and detection of outbreaks;

(3) To collect specimens and preliminary processing; the ICNs should be trained in basic microbiologic techniques;

(4) Training and education under the supervision of ICO, and

(5) To increase awareness among patients and visitors about infection control.

(5) Infection Control Manual(ICM)

It is recommended that each hospital develops its own infection control manual based upon existing documents but modified, for local circumstances and risks.

2.4 Role of the microbiology laboratory

The microbiology laboratory has a pivotal role in the control of hospital associated infections. The microbiologist is usually the Infection Control Officer. The role of the department in the HAI control programme includes:

- Identification of pathogens - the laboratory should be capable of identifying the common bacteria to the species level;
- Provision of advice on antimicrobial therapy;
- Provision of advice on specimen collection and transport;
- Provision of information on antimicrobial susceptibility of common pathogens, and
- Periodic reporting of hospital infection data and antimicrobial resistance pattern - The periodic reporting of such dates is an important service provided by the microbiology department. The frequency of this should be as determined by the ICC.
- Identification of sources and mode of transmission of infection - Culture of carriers, environment for identifying the source of the organism causing infection (outbreak organism). The selection of sites for culture depends upon the known epidemiology and survival characteristics of the organism;
- Epidemiological typing of the isolates from cases, carriers and environment;
- Microbiological testing of hospital personnel or environment - Testing for potential carriers of epidemiologically significant organisms. As a part of the infection control programme, the microbiology laboratory at times may need to culture potential environmental and personnel sources of noscomial infections. Usually this is limited to outbreak situation when the source and method of transmission needs to be identified. Routine microbiological sampling and testing is not recommended;
- Provide support for sterilization and disinfection in the facility including biological monitoring of sterilization.
- Provide facilities for microbiological testing of hospital materials when considered necessary - These may include: sampling of infant feeds; monitoring of blood products and dialysis fluids; quality control sampling of disinfected equipment; additional sterility testing of commercially sterilized equipment is not recommended;
- Provide training for personnel involved in infection control -This forms an important part of the Infection Control Programme. Each hospital should develop an employee training programme. Different categories of staff should be targeted through this programme training relevant to their functions. The Infection Control Nurse plays a major part in training and education. The aim of the training programme is to thoroughly orient all hospital personnel to the nature of HAI and to ways of prevention and treatment. As the various hospital employees have different functions and their level of education is different, the training programme needs to be altered to suit the functional requirements of each category of staff and should be adapted accordingly. Training should be preceded by a needs assessment survey. The training programme should include the following:

- Basic concepts of infection;
- Hazards associated with their particular category of work.;
- Acceptance of their personal responsibility and role in the control of hospital infection;
- Methods to prevent the transmission of infection in the hospital, and
- Safe work practice.

Training should provide the information needed to modify staff behaviour. Innovative techniques such as role-play, problem solving, quiz competitions and poster making etc should be employed.

The ICC should agree to the level and frequency of training.

3. THE HOSPITAL ENVIRONMENT AND HOSPITAL ASSOCIATED INFECTIONS

3.1 Environment

The environment in the hospital plays an important role in the occurrence of hospital associated infections. The hospital environment consists of many components. Many have a direct bearing upon HAI including design of ward and operating theatre facilities, air quality, water supply, food and handling of medical waste and laundry.

(1) Premises/buildings

An infection control team member should be involved in the planning of any new facility or renovation. The role of infection control in this process is to minimize hospital associated infections. These include items such as:

- Ensuring appropriate hand washing facilities;
- A safe water supply;
- Adequate isolation facilities for the hospital;
- Adequate ventilation for isolation rooms and high risk areas like operation theatres, transplant units and intensive care units;
- Recommending traffic flow to minimize exposure of high risk patients and facilitate patient transport;
- Preventing exposure of patients to fungal spores during renovations, and
- Outlining precautions to be taken to control rodents, pests and other vectors responsible for transmission of infection.

(2) Air

Airborne droplet nuclei generated during coughing or sneezing are a potential source of transmission of infection either by direct inhalation or indirectly through contaminated medical devices. Droplets generated from infected respiratory tracts can remain airborne for long periods of time and transmit infections like tuberculosis, respiratory viral illnesses and antibiotic-resistant hospital bacteria.

Some housekeeping activities (such as sweeping, using dry mops or cloths or shaking linen) can aerosolize dust particles that may contain micro-organisms. Therefore, wet mopping is preferred. The number of organisms present in room air will depend on the

number of people occupying the room, the amount of activity, and the rate of air exchange. Skin squamae and lint are important sources of contamination.

Ventilation:

Some HAI are caused by airborne pathogens and appropriate ventilation is necessary. Some laboratory monitoring may be needed in high-risk areas such as operation theatres for cardiac surgery, neurosurgery and transplant surgery after major building works in the unit.

Circulation of fresh filtered air dilutes and removes airborne bacterial contamination, in addition to removing odour. All hospital areas and in particular the high-risk areas, should be well ventilated as far as possible. Ventilation systems should be designed and maintained to minimize microbial contamination. The air conditioning filters should be cleaned periodically and fans that can spread airborne pathogens should be avoided in high-risk areas.

Good housekeeping should ensure that unnecessary items like empty boxes do not clutter and impede ventilation in high-risk areas. Positive air pressure is recommended for high-risk areas that must be kept clean. Negative air pressure vented to the air is recommended for contaminated areas and is required also for isolation of patients with infections spread by the airborne route. Filtration systems (air handling units) designed to provide clean air should have HEPA filters in high-risk areas. Unidirectional laminar airflow systems should be available in appropriate areas in the hospital construction. Ultraclean air is valuable in some types of cardiac surgery / neurosurgery / implant surgery theatres and transplant units.

Critical parameters for air quality include:

(1) Maintenance / validation of efficacy of filters

(2) Pressure gradient across the filter bed and in the operation theatre

(3) Air changes per hour (minimum 15 air changes per hour)

(4) Temperature and humidity should be maintained between 20-22°C and 30-60%, respectively to inhibit bacterial multiplication.

(3) Water

Water is used in hospitals for many different uses. The purpose for which the water is to be used determines the criteria for water quality. The criteria for drinking water are usually not adequate for the medical uses of water.

Drinking water should be safe for oral intake. For more details, refer to WHO guidelines for drinking of water quality.[1]

The water supply system should ensure the provision of safe water. The overhead storage tanks should be cleaned regularly and the quality of water should be sampled periodically to check for faecal contamination. Some micro-organisms in the hospital have caused infection of wounds, respiratory tract and other areas where equipment such as

endoscopes were rinsed with tap water after disinfection. Infection control teams should have written valid policies for water quality to minimize risk of infections due to water in hospitals.

Safe drinking water

- Where safe water is not available, water should be boiled for five minutes to render it safe. Alternatively, water purification units can also be used.
- The storage of water should be as hygienic as possible. Hands should not enter the storage container. Water should be dispensed from the storage container by an outlet fitted with a closure device or tap.
- Storage containers and water coolers should be cleaned regularly.

(4) Kitchens and food handling

Ensuring safe food is an important service in health care facilities - inappropriate food handling practices permit contamination, survival and growth of infecting bacteria.

The common errors contributing to outbreaks of food poisoning include:

- Using contaminated, uncooked food;
- Advance preparation of food, i.e. more than a half day, should be avoided
- Undercooked food;
- Cross-contamination of cooked food by raw food during preparation or storage;
- Contamination by food handlers;
- Storing food at room temperature or inadequate refrigeration;
- Inadequate reheating, and
- Unhygienic preparation of enteral or baby feeds.

Food contamination should be prevented by using reliable supplies of food; providing adequate storage facilities; separation of raw and cooked food to prevent cross-contamination; preparation of food taking all hygienic precautions; use of appropriate cooking methods to prevent microbial growth in food, and adequate refrigeration of uncooked and prepared food; kitchen staff should change work clothes at least once a day and keep hair covered.

Food handlers must carefully wash their hands before preparing food and maintain scrupulous personal hygiene.

They should avoid handling food when suffering from an infectious disease (enteric, respiratory or skin infection) and report all infections.

(5) The Kitchen

Foodborne diseases are important, particularly in immuno-compromised patients. As the community incidence of enteric infections may be high in some countries, it becomes all

[1] Surveillance of Drinking-Water Quality (Monograph Series No.63), WHO, Geneva, 1976

the more important that special attention is given to food preparation and handling in order to avoid contamination.

- The kitchen must have adequate supply of clean and potable water. All work surfaces and food storage areas must be kept clean and sanitary.
- Food should be served as soon as possible after preparation.
- Food storage refrigerators and freezers should be properly maintained and the temperature checked daily by provided thermometers.
- Left-over food should be discarded.
- In regions where enteric infections are common, food handlers should undergo pre-employment faecal examination for the presence of *Shigella, Salmonella* and parasites such as *Entamoeba, Giardia*, etc
- Dishwashing machines should be preferably used for crockery and utensils.

(6) Cleaning of the hospital environment

- Routine cleaning is important to ensure a clean and dust-free hospital environment.
- There are usually many micro-organisms present in "visible dirt", and routine cleaning helps to eliminate this dirt. Soap or detergents do not have antimicrobial activity, and the cleaning process depends essentially on mechanical action.
- Methods must be appropriate for the likelihood of contamination, and necessary level of asepsis. This may be achieved by classifying areas into the following zones:
  - Administrative and office areas with no patient contact require normal domestic cleaning.
  - Most patient care areas are cleaned by wet mopping. Dry sweeping is not recommended. The use of a detergent solution improves the quality of cleaning. Any areas with visible contamination with blood or body fluids must be disinfected.
  - High risk areas like the isolation rooms and other areas with infected patients need cleaning with a detergent/disinfectant solution.
  - All horizontal surfaces and all toilet areas should be cleaned daily.
  - Hot water (80°C) is a useful and effective environmental cleaner.
- Bacteriological testing of the environment is not recommended unless indicated on epidemiological grounds when seeking a potential source of an outbreak.

(7) Waste

Hospital waste is a potential reservoir of pathogenic micro-organisms and requires appropriate handling. The commonest documented transmission of infection from waste to health care workers is through contaminated metallic wastes.

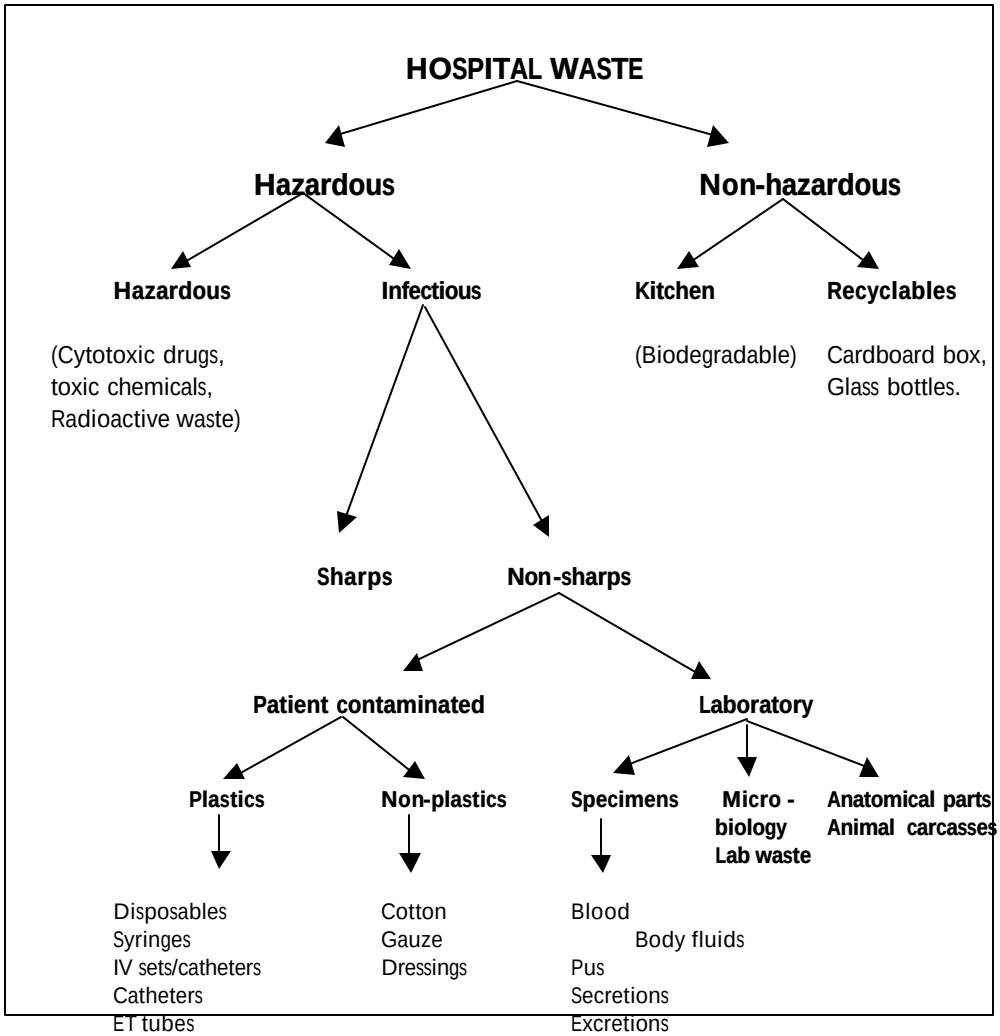
Principles of waste management

The "Cradle to grave" concept of waste management

- Hospital waste requires management at every step from generation, segregation, collection, transportation, storage, treatment to final disposal.

- Segregation of wastes into the prescribed categories must be done at the source i.e. at the point of generation.
- Colour coded bags as per international norms* need to be placed in appropriate containers with the appropriate label/logo e.g. biohazard symbol for infectious waste.
- Puncture proof containers made of plastic or metal with a biohazard symbol, in blood collection areas, injection trolleys and nursing stations, and operation theatres should be made available for collecting metallic wastes.
- A collection system for the transport of segregated wastes i.e. carts need to be provided.
- A storage area for wastes prior to treatment needs to be demarcated.

Practical Classification of Hospital Waste



[2]Safety in Health Care Laboratories, WHO, 1997 (WHO/LAB/97.1)

Treatment of hazardous and infectious wastes

Sharps

Alternatives available include:

- Needle burners at the work station;
- Puncture proof containers which can be autoclaved, shredded and land-filled or microwaved, shredded and land-filled or treated by plasma pyrolysis;
- Deep burial in a secure area, and
- Cutting of needles which is a mechanical method of disfigurement to avoid recycling but is not a disinfection modality.

Wastes requiring incineration

- Anatomical parts and animal carcasses, and
- Cytotoxic drugs (outdated), toxic laboratory chemicals other than mercury.
- Patient contaminated non-plastics and non-chlorinated plastics.

Waste that cannot be incinerated

Chlorinated plastics, volatile toxic wastes such as mercury.

Patient-contaminated plastics, non-plastics and infectious laboratory wastes may be treated by steam sterilization in autoclavable bags or microwave treatment. Shredding should follow both these methods. In case of non-availability of the above, chemical treatment with 1% hypochlorite or a similar disinfectant is recommended. However, excessive use of chemical disinfectants may be a health and environmental hazard.

Radioactive wastes

These are dealt with according to local laws.

(8) Laundry

Two categories of used linen are recognized. Where there is visible contamination by blood, faeces or other biological fluids, it is termed "contaminated". Other linen is termed "soiled". These two categories should be segregated and treated separately.

- All linen should be handled with minimum agitation to avoid aerosolization of pathogenic micro-organisms.
- Contaminated linen may be a source of infection to patients and staff and should be placed in impervious bags for transportation.
- Disinfection can be achieved by using hot water and / or bleach, using heavy-duty gloves, eye protection and masks to protect against splashes.
- Heavy-duty washers / dryers are recommended for hospital laundry.
- Laundered linen should be autoclaved before being supplied to the operating rooms / theatres and high risk areas e.g. burns units and transplant units.

No linen should leave the hospital premises unless it has been decontaminated.

3.2 Sterilization and disinfection

(1) Sterilization

Sterilization is the destruction of all micro-organisms including bacterial spores. Operationally, this is defined as a decrease in the microbial load by 10^{-6}. Sterilization can be achieved by either physical or chemical means.

Methods of sterilization

Heat sterilization

- Moist heat sterilization: exposure to saturated steam at 121°C for 30 minutes or 134°C for 4 minutes in an autoclave.
- Dry heat sterilization: exposure to 160°C for 120 minutes, or 170°C for 60 minutes or 180°C for 30 minutes.

Chemical sterilization

- Ethylene oxide and formaldehyde are being replaced in many countries because of safety concerns.

Low temperature sterilization

- Plasma systems using peracetic acid or hydrogen peroxide.

- Plastics such as polyethylene and polypropylene are suitable only for sterilization with chemical or low temperature methods.
- Sterilization is necessary for medical devices penetrating sterile body sites, as well as all parenteral fluids and medications.
- Cleaning to remove visible soiling in reusable equipment should precede sterilization.
- All materials must be packed before sterilization. Only packed sterilized materials should be described as sterile.

Materials for packaging include:

- *Paper*: This prevents contamination if intact and can also be used to wrap used devices after the procedure.
- Non-woven disposable textiles
- *Containers*: These can be used only if they contain material intended for a single treatment procedure for a single patient. They must be provided with a filter and a valve, and must be monitored regularly. The end-user must check the physical integrity of the package before use.

- Quality control parameters for the sterilization process record information on the sterilization processing cycle and serve as a checklist for the CSSD:
  - Load number
  - Load content
  - Temperature and time exposure record chart
  - Regular physical/chemical testing

- Regular biological testing

- Regular maintenance must be performed and documented. The following records must be maintained for all sterilization equipment:
  - Date of service
  - Model and serial number
  - Location
  - Descriptions of replaced parts
  - Biological testing records
  - Bowie-Dick test
  - Name and signature of controller

(2) Disinfection

Disinfection is a process by which vegetative i.e. growing forms of pathogenic organisms are killed.

An *antiseptic* is a non-toxic disinfectant that can be used on skin and living tissues.

Decontamination is a process by which vegetative micro-organisms are killed. Before cleaning, such processing may be required to make soiled instruments or material safe for handling and further processing.

Common Disinfectants

Disinfectants	Recommended Use	Precautions
Sodium hypochlorite 1% in-use dilution 5% solution to be diluted 1:5 in tap water.	Disinfection of material contaminated with blood and body fluids	• Should be used in well-ventilated areas. • Protective clothing required while handling and using undiluted • Not to be mixed with strong acids to avoid release of chlorine gas • Corrosive to metals
Bleaching powder 7g/litre with 70% available chlorine	Toilets, bathrooms, may be used in place of liquid bleach if liquid bleach is not available.	• Same as above
Alcohol (70%) Isopropyl, ethyl alcohol, methylated spirit.	Smooth metal surfaces, table tops and other surfaces on which bleach cannot be used.	• Flammable, toxic, to be used in well- ventilated area, avoid inhalation. • To be kept away from heat sources. electrical equipment, flames, hot surfaces. • Should be allowed to dry completely, particularly when using diathermy as it can cause diathermy burns.
Glutaraldehyde (2%)	For disinfection of endoscopes, respiratory therapy equipment and for	• Eye and nasal irritant, may cause asthma and skin allergies, hence

Disinfectants	Recommended Use	Precautions
	therapy equipment and for materials that are destroyed by heat. Can work as a sterilant if contact time is 6-8 hrs and if used under strictly controlled condition.	skin allergies, hence should be used in well ventilated area, keep covered with well fitting lids. • Eye protection, plastic apron and gloves should be worn while handling
Detergent with enzyme	Cleaning endoscopes, surgical instruments before disinfection	
Chlorhexidine combined with alcohol or detergents	Antiseptic, for skin and mucous membranes, preoperative skin preparation , disinfection of hands	• Inactivated by soap, organic matter • Relatively non toxic • Should not be allowed contact with brain meninges, eye or middle ear
Quaternary Ammonium Compounds (e.g. Dettol) May be combined with chlorhexidine	Antiseptic, for cleaning dirty wounds (Low level disinfection only)	• Relatively non toxic • Dilutions in use are likely to get contaminated and grow gram negative bacteria • Should be used in correct dilution • Solution in use should be changed every 8 hours • Stock bottle should not be topped up

Decontamination procedure for equipment

Pre-cleaning of any item / medical device is an essential step prior to disinfection

Article	Standard Procedure	Comments
Ambubag	Should be cleaned with detergent and water; dried and sterilized.	
Applinators (Tonometer prisms)	Immersion in 0.05% hypochlorite (500 parts per million available chlorine) for 10 minutes.	A fresh solution should be prepared at the start of each clinic.
Arterial catheters	Sterile single use only, must be discarded after used.	

Article	Standard Procedure	Comments
Baby equipment Feeding bottles & teats	1) Disposable - single use. 2) Re-usable – should be returned to CSSD or washed in hot detergent and water, rinsed and immersed in Milton fluid, freshly made up from tablets according to manufacturer's instructions.	Should be soaked for a minimum of 1 hour.
Crockery and cutlery	Should be washed after each use with detergent and water	
Baby weighing scales	A fresh liner should be used for each baby. Clean tray as necessary with detergent and water.	If contaminated should be wiped with hypochlorite 1000ppm after washing.
Baby bath	Should be cleaned after each use with detergent and water	
Beds and couches Frame	Should be cleaned with detergent and water between patients and as required.	If contaminated with body fluids, see spillage policy. If used in isolation room - after cleaning, should be wiped with a disinfectant
Mattresses and pillows	Should be cleaned with detergent and water between patients and as required.	If contaminated with body fluids, the blood spills policy should be implemented. Should not be used if cover is damaged. Contaminated pillows must be discarded. Torn mattress covers must be replaced before mattress in re-used.
Bedpans and urinals	Should be cleaned and disinfected with 0.5% sodium hypochlorite or hot water. It must be ensured that the item is dry before re-use.	
Breast pumps	Should be washed with detergent and water, immersed in sodium hypochlorite, freshly made up from tablets according to manufacturer's instructions.	

Article	Standard Procedure	Comments
Brushes Nail Toilet	1) Disposable - single use. 2) Re-usable – to be returned to CSSD after each use. Should be rinsed well in flush water and stored dry.	Should not be left on sink after use.
Carpets	Vacuum daily.	Should be shampooed or steam cleaned in isolation rooms as part of terminal cleans.
Commodes	Seat and arms should be cleaned with detergent and water, and dried.	If soiled or used in isolation, should be wiped with sodium hypochlorite 2%, and dried, after cleaning.
Cradles	Should be cleaned with detergent and water, and dried.	
Crockery and cutlery	Should be heat disinfected in dishwasher. If washed in sink - hot water and detergent.	
Curtains	Should be changed as part of a rolling programme by domestic services.	Should be changed as part of terminal clean.
Denture pots	1) To be cleaned by patients themselves with detergent and water 2) Disposable with lid - single use.	
Drainage bottles Drip stands	3) Disposable - single use 4) Re-usables -rinse and return to CSSD Should be cleaned with detergent and water and dried.	 After use in isolation, should be wiped with sodium hypochlorite 2%, and dried after cleaning.
Ear pieces for auroscope	Should be cleaned with detergent and water and dried.	To be returned to CSSD after use in isolation.
Earphones	Should be cleaned with detergent and water and dried.	Foam should be replaced after use in isolation.

Article	Standard Procedure	Comments
Leads and monitors	Should be dismantled to smallest components and cleaned with detergent and water and dried.	
Eye protection	Should be cleaned with detergent and water and dried.	For blood splashes blood spillage policy should be followed.
Floors	Should be vaccumed daily. A damp mop with detergent and water should be used.	For blood splashes blood spillage policy should be followed.
Flower vases	Should be clean with detergent and water and dried. Should be stored inverted.	
Furniture	Should be damp dusted with detergent and water.	
Humidifiers	Should be cleaned and sterilized at low temperature.	
Incubators	Should be cleaned with detergent and water and switch on to dried.	Terminal sterilization with ethylene oxide gas may be required after some infections.
Intravenous monitoring pumps (and feed pumps)	Should be cleaned with detergent and water and dried.	After use in isolation wipe with sodium hypochlorite 2%, and dry, after cleaning.
Instruments	Single use only. To be returned to CSSD.	
Linen	Should be soaked in hot water; returned to laundry	
Mops	Disposable - use for one day. Re-usable to be laundered in washing machine.	Mops must not be stored wet or cleaned in disinfectant solutions.
Peak flow	Disposable - single patient use.	
Nebulizers	Cleaning and low temperature sterilization.	
Pressure relieving devices	Should be clean with detergent and water and dried.	
Proctoscopes	Disposable - single use Re-usables to be rinsed and returned to CSSD.	

Article	Standard Procedure	Comments
Raised toilet seats	Should be cleaned after each use with detergent.	
Razors	Safety - single use – disposable Electric - patients own. Razors should not be shared. Detachable head and clean with 70% isopropyl alcohol swab.	
Shaving brush	Should not be used unless supplied by the patients for their own use.	
Skin disinfection	Showers are preferred to bath or bed baths.	
Soap dispensers	Should be cleaned weekly with detergent and water and dried.	
Sphygmomanometer cuffs	After use in isolation, should be laundered in washing machine.	
Spillages	Should be cleaned with detergent.	
Sputum pots	Disposable with close fitting lid. Should be discarded into clinical waste for incineration.	
Stethoscopes	Should be cleaned with detergent and water and dried. Should be wiped with 70% alcohol.	
Suction bottles	Disposal liners. Must be sealed when 75% full and placed in yellow plastic bag. Re-usable; should be cleaned with sodium hypochlorite and dried. Must be changed daily and in between each patient. To be stored dry when not in use.	
Telephones	To be wiped with 70% alcohol.	
Thermometers	To be covered with disposable sleeve before use and stored dry in	

Article	Standard Procedure	Comments
	individual holder. In between patients, should be cleaned and wiped with 70% isopropyl alcohol (swab). If disposable sleeve not used, in between patients, should be washed in general purpose detergent and tepid water then wiped with 70% alcohol (swab). To be stored in individual holder inverted.	
Toilet seats	To be cleaned at least twice daily with detergent.	
Toys	Toys should be cleaned with detergent and water and dried.	For isolated patients, toys that cannot be decontaminated to be avoided. Heavily contaminated toys may have to be destroyed.
Trolleys (Dressing)	To be cleaned daily with detergent and water. After each use should be wiped with 70% isopropyl alcohol.	
Urine measuring jugs	To be heat disinfected after each use in bed pan washer.	
Venilators Vomit bowls	To be sent to respiratory therapy unit. Contents must be emptied into sluice then rinsed and washed and disinfected with hot water and detergent	
Walls	Should be cleaned with detergent and water as part of planned preventative maintenance programme.	
Wash bowls	Patients must have own dedicated bowl. After each patient's use, should be cleaned with detergent.	
Wheel chairs	Patient's own – should be cleaned with detergent and water as necessary. Hospital – clean between patients with detergent and water	

4. PREVENTION OF HOSPITAL ASSOCIATED INFECTIONS

4.1 Standard/universal precautions

With the onset of the AIDS pandemic, the concept of universal precautions has been adopted i.e. precautions that should be practised with all patients and laboratory specimens regardless of diagnosis. It is presumed that every patient/specimen could be potentially infected with blood borne pathogens such as HIV, hepatitis B and C. Universal (Standard) precautions are applied to all patients regardless of diagnosis, instead of universal testing. The main objective is to prevent exposure of staff and patients to blood and body fluids.

Body fluids considered to be potentially infected with blood-borne pathogens are: semen, vaginal secretions, amniotic fluid, pericardial fluid, pleural fluid, cerebrospinal fluid, synovial fluid or any body fluid that is visibly contaminated with blood. Spills of blood or body fluids should be treated with hypochlorite.

Universal precautions do not apply to the following unless they contain visible blood: faeces, nasal secretions, sputum, tears, urine, vomitus, breast milk and saliva. Since the above may have the potential to transmit other pathogens, precautions should also be applied to all body secretions and excretions. Spills of blood or body fluids should be treated with hypochlorite.

Standard precautions also apply to unfixed tissue and all pathological and laboratory specimens.

(1) Procedures for standard precautions

Hand decontamination

The role of hands in the transmission of hospital infections has been well demonstrated, and can be minimized with appropriate hand hygiene. Compliance with handwashing, however, is frequently suboptimal. This is due to a variety of reasons, including lack of appropriate accessible equipment, high patient to staff ratios, allergies to handwashing products and insufficient knowledge of staff about risks and procedures.

Handwashing is the single most important means of preventing the spread of infection. Hands should be washed between patient contacts and after contact with blood, body fluids, secretions, excretions and equipment or articles contaminated by these.

For hand washing, the following facilities are required:

- Running water: large washbasins with hands free controls, which require little maintenance and with anti-splash devices.
- Products: dry soap or liquid antiseptic depending on the procedure.
- Suitable material for drying of hands: disposable towels, reusable sterile single use towels or roller towels which are suitably maintained.

For hand disinfection

- The specific hand disinfectants – antiseptics recommended are: 2-4% chlorhexidine, 5-7.5% povidone iodine, 1% triclosan or alcoholic rubs.
- Alcoholic handrubs are not a substitute for hand washing, except for rapid hand decontamination between patient contacts.

For surgical scrub (surgical care)

- Training is needed in the current procedure for preparation of the hands prior to surgical procedures.
- Scrubbing of the hands for 3-5 minutes is sufficient. The recommended antiseptics are 4% chlorhexidine or 7.5% povidone iodine.

Equipment and products are not equally accessible in all countries or health care facilities. Flexibility in products and procedures, and sensitivity to local needs, will improve compliance. In all cases, the best procedure possible should be instituted.

Clothing

Staff can normally wear clean street clothes. In special areas such as burn or intensive care units, uniform trousers and a short-sleeved gown are required for men and women.

The working outfit must be made of a material easy to wash and decontaminate. If possible, a clean outfit should be worn each day. An outfit must be changed after exposure to blood or if it becomes wet through excessive sweating or other fluid exposure.

Shoes

In aseptic units and in operating rooms, staff must wear dedicated shoes, which must be easy to clean. In other areas, change of footwear is unnecessary for prevention of infection.

Caps

In aseptic units, operating rooms, or performing selected invasive procedures, staff must wear caps or hoods which completely cover the hair.

Masks

Masks of cotton wool, gauze, or paper masks are ineffective. Paper masks with synthetic material for filtration are an effective barrier against micro-organisms. Masks are used in various situations and their requirements differ depending on the purposes for which they are needed.

Patient protection: Staff wear masks to work in the operating room, to care for immuno-compromised patients, to puncture body cavities. A surgical *deflector mask* which directs aerosols away from the surgical site is sufficient.

Staff protection: Staff must wear masks when caring for patients with airborne infections, or when performing bronchoscopies or similar examination. A high efficiency *filter mask* is recommended. Filter masks remove organisms which might be inhaled.

Patients with airborne infections must use surgical deflector masks when outside their isolation room.

Gloves

Gloves are used for:

- *Patient protection:* Staff should wear sterile gloves for surgery, care for immuno-compromised patients and invasive procedures which enter body cavities. Non-sterile gloves should be worn for all patient contacts where hands are likely to become contaminated, or for any mucous membrane contact. When performing multiple procedures, the gloves should be decontaminated between patients. If visibly soiled with blood, a fresh pair should be used.
- *Staff protection:* Staff should wear non-sterile examination gloves to care for patients with communicable disease transmitted by contact.
- Hands must be washed when gloves are removed or changed.
- Disposable gloves should not be reused.

The wearing of gloves, masks and other protective clothing is only necessary for the tasks at hand and these items should be removed after the procedure.

(2) Safe injection practices:

To prevent transmission of infections between patients:

- Unnecessary injections must be eliminated. Many medicines can be given orally and this is preferred to parenteral administration.
- Sterile needle and syringe should always be used. These should be disposable, if possible.
- Contamination of medications must be prevented by using single use vials.
- Safe disposal practices in respect of metallic waste should be followed.

4.2 Additional precautions for prevention of transmission of infection

In addition to standard precautions which are required for all patients in all situations, special precautions need to be taken for patients suffering from certain infections. These are based on the mode of transmission of these infections. The ICC should decide the policy for the individual hospital and procedures which are feasible in its situation.

(1) Routes of transmission

Transmission of HAI can occur by one or more of the following modes:

Airborne

Through small particles suspended in the air or large droplets expelled into the air by coughing, sneezing, talking (aerosols), or by shedding of skin scales.

Contact

Through direct contact of hands or skin contact or indirectly through environmental surfaces and other items which come in contact with the patient.

Inoculation or parenteral

Contaminated solutions, blood and body fluids can enter either through abrasions or other skin lesions, through mucous membranes but not through intact skin.

Faeco-oral

Micro-organisms found in the intestines can be transmitted either directly through contaminated food and water following unhygienic practices or indirectly.

Multiple routes

A disease may be transmitted by more than one mode e.g. respiratory viral infections can be transmitted through airborne (droplet) as well as by physical contact.

Transmission-based precautions are special precautions taken in addition to standard precautions for known infections based on the mode of transmission of the infection. Education is most important. Awareness programmes for staff, visitors and patients must be established. Posters outlining the precautions should be placed at appropriate locations. As the name implies, additional precautions should be applied *in addition to* standard/universal precautions.

The following precautions are recommended:

(1) Respiratory precautions

For infections transmitted by the airborne route through small droplets less than 5 micron in size which can be dispersed over long distances e.g. tuberculosis.

- The patient should be placed in a single room that ideally has good ventilation and sunlight, negative air pressure and 6-12 air changes per hour. If single room is not possible, patients should be in a cohort with other patients with same infection. Doors should be kept closed.
- For additional respiratory protection, well-fitting filter masks should be worn. Susceptible persons should not enter the room of patients having measles or chickenpox whereas persons immune to measles or chicken pox do not need to wear mask.

- Transportation of patient should be done only when essential. Patient should wear a mask during transportation.

(2) Contact precautions

These precautions should be used in addition to standard precautions for patients who are infected or colonized with important organisms that can be transmitted directly by hand or skin contact or indirectly through fomites or environmental surfaces in contact with the patient, such as gastrointestinal, respiratory, conjunctival, skin and wound infections or colonization with multiresistant bacteria.

- The patient should preferably be placed in a single room. If that is not possible, he/she should be placed with a cohort of patients having infection with the identical micro-organism.
- Clean, non-sterile gloves should be worn on entering the room or patients environment. Gloves must be removed after leaving the patient's environment and hands washed immediately.
- A clean non-sterile gown should be worn on entering the patient's room and removed on leaving the room.
- Sharing of patient care equipment between patients should be avoided. If sharing is necessary, the equipment should be adequately cleaned and disinfected before using on another patient.
- Transportation of patient must be limited. If transport is necessary, precautions must be taken to avoid contact with other patients and contamination of the environment.

(3) Blood/inoculation precautions

In addition to standard precautions, diseases transmitted through inoculation or parenteral route such as hepatitis B, HIV/AIDS, malaria can be prevented by:

- Rational Injection Practice: Unnecessary injections, suturing and blood transfusions must be reduced.
- Safe procedures for the handling and prevention of accidents with sharp metallic waste should be ensured.
- Recapping of needle should be avoided; if recapping is required, then well-established single-handed procedures should be used.
- Metallic waste should always be disposed into a puncture resistant container.
- Exposed sharp metallic waste should never be passed directly from one person to another.
- During exposure-prone procedures such as phlebotomy, the risk of injury may be reduced by having maximum visibility and proper positioning of the patient.
- Fingers must be protected from injury by using forceps for holding suturing needles.
- Overflow of sharp metallic waste disposal containers can be prevented by sending the containers for disposal before they are completely filled.

4.3 Surgical site infections

Definition

Infection in the surgical site that occurs within 30 days of the surgical procedure or within one year if there is an implant or foreign body such as prosthetic heart valve or joint prosthesis.

Classification of operations

Clean: An operative wound where an organ space is not entered or a wound that undergoes primary closure.

Clean contaminated: An operative wound in which an organ space is entered under controlled conditions without unusual contamination.

Contaminated: Open, fresh, accidental wounds or operative wounds with spillage and microbial contamination from the gastrointestinal tract.

Dirty/infected: Old traumatic wounds with existing clinical infection or following operations on perforated viscera.

The key factors to be recorded clinically are:

- The severity and the extent of the infection in the patient.
- The type of operation and
- The time period between the operation and the development of the infection.

Factors which influence the frequency of surgical site infections include:

- Surgical technique
- Extent of endogenous contamination of the wound at surgery (clean, clean-contaminated)
- Duration of operation
- Underlying patient status
- Operating room environment
- The number of organisms shed from the skin of the operating room team and from the skin of the patient

Risk factors for surgical site infections	Prevention
Patient	
Age	Avoid operating on very old or very young as they are at higher risk for developing infections
Nutritional status	Build a good nutritional status
Diabetes	Control and maintain blood sugar levels
Smoking	Cessation of smoking at least one month prior to surgery
Obesity	Reduce weight prior to surgery
Co-existent infections in a remote body site	Treat adequately before operation

Risk factors for surgical site infections	Prevention
Colonization with micro-organisms	Screen and treat carriers; avoid pre-operative shaving
Altered immune response	Boost immunity if possible
Length of preoperative stay	Avoid long stay in hospital
Operational procedures	***Guidelines***
Duration of surgical scrub	2 minutes as effective as 10 minutes
Skin antisepsis	Use povidone-iodine / chlorhexidine gluconate
Pre-operative shaving	Avoid if possible or shave immediately prior to operation
Preoperative skin preparation	Allow drying of antiseptic
Duration of operation	Keep procedures as short as possible
General factors	***Guidelines***
Antimicrobial prophylaxis	Give suitable antimicrobial cover
Operating room ventilation	Adhere to specifications below
Inadequate sterilization of instruments	Monitor CSSD processes
Foreign material in the operative site	Maintain high level of asepsis
Surgical drains	Avoid unless really necessary
Surgical technique Poor haemostasis Failure to obliterate dead space Tissue trauma	Maintain good surgical technique and ensure minimal tissue trauma.

A systematic programme for prevention of surgical site infections includes the practice of optimal surgical techniques, a clean operating room environment with restricted staff entry and appropriate staff attire, sterile equipment, adequate pre-operative preparation of the patient, appropriate use of peri-operative antimicrobial prophylaxis, and a surgical wound surveillance programme. Surgical site infection rates are decreased by continuous, standardized surveillance with reporting back of rates to individual surgeons.

Ventilation requirements for operation rooms

- Mechanical ventilation with air conditioning providing filtered air.
- At least 15 air changes per hour at 22°C are recommended.
- Filters and air flow should be checked regularly.
- In some hospitals, window air conditioners are in use. These air conditioners require proper maintenance and do not guarantee air quality.

Theatre clothing

- Persons working in the operating rooms must wear clean surgical attire in place of their ordinary clothing.

- Surgical attire should be designed for maximum skin coverage; shedding of skin scales is a potential source of contamination.
- Operating theatre shoes should be washable and impervious.
- Head and facial hair should be covered.
- Personnel should wear disposable deflector masks.
- The surgical team should wear sterile gowns and gloves. A plastic apron should be worn under the sterile gown.
- Double gloving is used for protection of the team in operations on HIV, HBV or HCV positive patients. Double gloving is also used for implant surgery.

Surgical handscrub

- 4% chlorhexidine or 10% povidone-iodine should be used for skin disinfection.
- Scrubbing for two minutes is as effective as scrubbing for 10 minutes.

Preparation of the surgical site

- The patient's skin at the site of incision as well as a wide margin should be prepared with 10% povidone iodine, or 4% chlorhexidine. These should be allowed to dry before making the incision.
- The skin should be covered by impervious drapes or with sufficient thickness of pervious material to prevent fluid penetration during the surgery.

Personnel

- Unnecessary conversation and movement should be restricted.
- The number of personnel in the operation theatre should be restricted to the minimum necessary for the procedure.

Surgical procedure

- Wounds should not be drained unless absolutely necessary. A closed system of drainage should be used in cases where a drain is essential.
- The technique of surgery should ensure minimum tissue trauma for the patient.

(1) Perioperative chemoprophylaxis in surgery

Perioperative chemoprophylaxis is an essential adjunct to many surgical procedures. For some operations, there is inevitable contamination of the surgical wound following opening of a hollow viscus such as the gastrointestinal tract or the incisions through mucous membranes with a rich normal microbial flora such as the mouth, oesophagus and vagina. In other operations, the use of implants as in cardiac valve prostheses or artificial joints increases the risk of persistence of normal skin flora at the prosthetic site. In such procedures, perioperative chemoprophylaxis reduces the incidence of hospital-associated infections.

Peri-operative antimicrobial chemoprophylaxis is to be given with induction of anaesthesia and continued for not more than 24 hours. The choice, dosage and duration of antimicrobial chemoprophylaxis are important.

Choice of antimicrobial for chemoprophylaxis

The organisms involved in surgical operations are usually derived from the normal flora and are sensitive to many antibiotics. Patients admitted to hospital and operated as emergencies such as acute abdominal emergency or trauma are not colonized with multi-drug resistant hospital flora. Patients admitted within 24 hours of an elective operation are not colonized with hospital flora. Patients having repeated surgery and after antibiotic therapy are often colonized with antibiotic resistant bacteria in the gastro-intestinal tract (*Klebsiella sp, Pseudomonas sp*, etc.) or the skin (methicillin-resistant coagulase-negative staphylococci, *Acinetobacter sp.)* or mouth (*Candida sp.).*

The choice of antibiotics for these patients depend on the endogenous flora likely to cause the infection.

	Likely organisms	Suitable agents
Emergency abdominal surgery	*E. coli*, anaerobes	Co-amoxyclav or Cefuroxime + Metronidazole or Ampicillin- sulbactam
Orthopaedic trauma	*Staph. aureus*	Cloxacillin, Cefazolin or Cefuroxime
Cardiac/Orthopaedic surgery	*Staph. aureus*	Cloxacillin, Cefazolin or Cefuroxime
Elective bowel surgery	*E. coli*, anaerobes	Amoxy+Clavulanic A or Cefuroxime or Cefazolin + Metronidazole, Gentamicin/ Clindamycin
Multiple operations/Long stay in the hospital	*Klebsiella sp.* *Pseudomonas aeruginosa* Staphylococci Enterococci	Piperacillin/Tazobactam/ Gentamicin or Ceftazidime/ Cloxacillin

When to start; when to stop

Start of chemoprophylaxis: Given with induction of anaesthesia and second dose may be given in prolonged surgeries lasting more than three hours.

Stopping chemoprophylaxis: One or two doses only are given.

4.4 Hospital associated respiratory infections

Nosocomial pneumonia is one of the most serious hospital associated infections.

Definition: Nosocomial pneumonia is defined as a lower respiratory tract infection that appears during or after hospitalization of the patient who was not incubating the infection on admission to hospital.

The diagnostic criteria are:

- Fever, cough, development of purulent sputum;
- Radiological changes showing progressive infiltration, and
- Sputum Gram-stain showing >25 WBCs per low field and bacteria.

Specimen: sputum, tracheal aspirate or bronchoscopic aspirate are often cultured.

Results of culture should be interpreted in the light of clinical findings. In patients with tracheostomy, the presence of some WBCs does not necessarily imply pneumonia.

Positive cultures, especially those obtained from patients who are intubated, do not necessarily mean pneumonia.

Colonisation of the respiratory tract with multi-resistant hospital bacteria is very common in patients on broad spectrum antibiotics, receiving mechanical ventilation or following surgery. This can occur within the first 24 hours in a critical care unit.

Ventilator-associated respiratory infections	Prevention
Risk factors	
Duration of intubation	Limit duration
Invasive ventilation	Non invasive ventilation is preferred
Ventilation procedures	
Intubation and suction	Aseptic technique should be used.
Filters	Disposable filters should be used.
Water for oxygen and aerosol therapy	Water should be sterile and changed regularly.
Tracheal toilet	Aseptic technique should be followed.
Tubing, respirators, and humidifiers	Appropriate cleaning and disinfection to limit contamination and subsequent infection
Suction tubes	Sterile, with aseptic technique should be used
Humidifier bottles	Should be sterilized between use, should not be topped up

Respiratory secretions should be disposed in a safe way i.e. treatment with sodium hypochlorite, incineration or autoclaving. Linen and waste should be treated as infected.

Nosocomial respiratory tract infections may occur in several different patient groups. In some cases such as hospital-acquired infection with *Legionella*, the hospital environment may play a significant role.

Colonization of mouth and respiratory passages by hospital bacteria

Multidrug resistant gram negative rods and MRSA can be acquired during tracheal toilet. Sometimes colonization progresses to pneumonia. The clinical outcome of positive cultures from the trachea should be carefully assessed before deciding to start therapy.

Patients on broad-spectrum antibiotics may suffer replacement of the normal oral flora by resistant gram-negative rods. This is usually contamination, not infection.

Prevention of aspiration pneumonia in hospital

- Comatose patients must be positioned on their side to limit the potential for aspiration.
- Oral feeds should be avoided in patients with neurological or swallowing abnormalities.
- Medications which impair consciousness (sedatives, narcotics) must be limited.

Prevention of pneumonia after surgical procedures

- All invasive devices used during anaesthesia must be sterile.
- Anaesthetists must use gloves and mask when undertaking invasive tracheal care.
- Disposable filters (for individual use) for endotracheal intubation effectively prevent the transmission of micro-organisms among patients by ventilators.
- Preoperative physiotherapy helps to prevent nosocomial pneumonia in patients with chronic respiratory disease.

4.5 Urinary tract infections

Urinary tract infections are the most frequent nosocomial infections. The great majority of these infections are associated with an indwelling urethral catheter.

Definition: An infection of the urinary tract that was not incubating at the time of admission.

The diagnostic criteria are:

- Clinical symptoms of fever, suprapubic tenderness, frequency and dysuria.
- Presence of bacteria in the urine in significant quantity, i.e. more than 10^5 per ml.

Hospital associated urinary tract infections	Prevention
Risk factors	
Invasive urological procedures	Aseptic technique should be maintained.
Urinary catheter	Catheterization unless compelling indication to be avoided.
Duration of catheterization	Prolonged catheterization should be avoided.
Catheter care	
Selection of catheter size	The smallest size which fits should be used to avoid urethral trauma

Hospital associated urinary tract infections	Prevention
Insertion technique of catheter	Aseptic "no touch" technique, use sterile gloves, hygienic hand and perineal disinfection prior to insertion
Drainage system	Closed system of drainage prevents infections hygienic hand disinfection prior to manipulation of drainage system
Training of health care workers	Education and training helps to avoid infections
Traumatic insertion of catheter	Recommended technique should be followed.

Specimen for culture: Urine should be collected aseptically for culture by needle aspiration from the catheter. Catheter tips and specimens from urine bags are generally unsuitable for culture because the results are hard to interpret.

4.6 Intravascular catheter related infections

Definitions:

- *Exit site infections*: Infections with erythema, tenderness, induration or purulence within 2 cm of the skin at the exit site of the catheter. These are commonly caused by *Staph. aureus* and coagulase-negative staphylococci.
- Bloodstream infections may follow colonization of peripheral or central venous line catheters. Growth of >15 (semi-quantitative) or $>10^3$ (quantitative) CFU from a catheter segment in the absence of accompanying clinical symptoms signifies colonization. Likely organisms include: *Staph aureus*, coagulase-negative staphylococci, *Candida* sp. and diphtheroids (CDC JK group).
- Contaminated infusions can lead to bacteraemia or systemic infection and are mainly caused by gram negative rods. Infusate and intravascular medications can cause primary blood stream infection if they are contaminated. Aseptic technique in preparation of infusate and of single unit dose IV medications are highly recommended.

Key practices for all vascular catheters include:

- Avoiding indwelling intravenous catheterization unless there is a medical indication;
- Limiting the use of catheters to as short a duration as possible;
- Preparing fluids aseptically and immediately before use, and
- Training of personnel in catheter insertion and care

Peripheral Vascular Catheters

- Short peripheral venous catheters are not usually associated with infections.

- There is no significant difference in infection rates amongst the various types of catheter materials.
- A high level of aseptic technique should be used for insertion and handling of catheters.
- Hands must be washed before all catheter care, using hygienic hand wash or rub.
- Skin at the insertion site must be washed and disinfected with an antiseptic solution.
- A dressing change is not normally necessary, unless it is visibly soiled.
- If local infection or phlebitis occurs, the catheter should be removed or re-sited immediately.
- Intravenous lines need not be changed more frequently than catheters themselves, except after the transfusion of blood or intralipids, and for discontinuous perfusions.

Central Vascular Catheters

- Mask, cap, sterile gloves and gown must be worn for insertion.
- Sterile gauze or transparent dressing should be used to cover the catheter site.
- A surgical hand wash or rub is required before insertion of the catheter and the subsequent catheter dressings.
- The dressing should be changed at the time of the change of lines, using surgical asepsis techniques.

Antimicrobial impregnated central venous catheters are associated with fewer line infections. Devices incorporating silver sulphadiazine or chlorhexidine-silver sulphadiazine are less likely to promote emergence of resistance than antibiotic impregnated catheters. However, careful evaluation of these devices is needed to determine the relative benefits of reduction of infections compared with the future risk of antimicrobial resistance.

Infection risks with iv catheters	Prevention
Catheter system	To be avoided unless indicated; Closed system to be maintained.
Duration	Prolonged catheterization to be avoided.
Skin preparation	Strict aseptic technique to be used.
Infection or colonization of catheter	Catheter should be removed.
Technique	Surgical asepsis
Dressing change	Frequency of dressing change to be limited.
Type of catheter	Antibiotic coated catheter for short term is preferred.

5. SURVEILLANCE

5.1 Role of surveillance

Surveillance of hospital associated infections means recording and counting of infections arising in the hospital. Surveillance is done so that we know the extent of any problems that exist.

There are various ways of recording and counting the number of hospital infections. One is the clinical outcome of the patient's stay in the hospital i.e. whether or not an infection arises in a patient as a result of their stay. Information as to the site and severity of the infection and its relationship to any operative, investigative or treatment carried out can be recorded and related to the number of patients being treated. There may be records of laboratory cultures or blood tests that would confirm that an infection is present.

Because there are many patients passing through the hospital and so many different types of infection which arise, one has to focus on specific readily recognized infections such as surgical site infection as an index of infection rate. Unless there are suitable laboratory facilities to identity the infection pathogen, little can be done to determine the possible organisms responsible and help in finding the source of the infection. For these reasons, most surveillance systems depend on the use of laboratory cultures to provide the material for quantification of the HAI rates. Accuracy in this case depends on the cultures being made from most clinical infections and a system for recording the clinical data of the infected patients.

In hospitals where little or no surveillance data exists and resources are limited, one has to concentrate efforts on those parts of the hospital, and those procedures, which are common sites for HAI. Surgical site infection is clearly one area, but others include intravenous infusion over a prolonged period leading to septicaemia; urinary tract infection following indwelling urinary catheters; hospital associated respiratory infections particularly in mechanically ventilated patients, and episodes of infective gastroenteritis. Patients who are particularly prone to acquiring infection in hospital include the most severely ill, the aged, those compromised by diabetes, use of steroids, cancer or haematological malignancies. Continuous surveillance is a time-consuming activity and requires detailed work over a period of time to produce beneficial results which can lead to a reduction in the acquired infection rates. Many different hospital staff are involved in monitoring the minimal levels of hospital infections and all must be aware of their role in surveillance. All must be alert to the possible occurrence of an outbreak situation (see below). Both clinical and microbiological data are essential to compile the necessary information. The information gathered is jointly the property of the clinical and laboratory staff. The collection of information should be made as simple as is compatible with obtaining data of value in recognizing the extent and causation of the infections. Unless one has some information of the kind, finding the reasons for an infection is difficult and planning the avoidance of the infection less achievable.

Key factors to be recorded clinically are:

- The severity and the extent of the infection in the patient;
- The type of operation and the extent of bacteriological contamination of the wound, and
- The time period between the procedure and appearance of the infection.

Key records microbiologically needed are the organisms isolated and their antimicrobial susceptibility.

Targeted surveillance

Site-oriented surveillance: Priorities will be to monitor frequent infections with significant impact in mortality, morbidity, costs (e.g. extra-hospital days, treatment costs), and which may be avoidable.

Common priority sites are:

- Ventilator associated pneumonia (a high mortality rate),
- Surgical site infections (extra-hospital days and cost)
- Primary bloodstream infections (high mortality), and
- Infection with multiple-drug resistant bacteria (outbreak situation).

Unit-oriented surveillance: Efforts can focus on high risk units such as intensive care units, surgical units, oncology/haematology, burn units, neonatology, etc.

Priority-oriented surveillance: Surveillance undertaken for a specific issue of concern to the facility (i.e. urinary tract infections in patients with urinary catheters in long term care facilities).

While surveillance is focused in high-risk sectors, some surveillance activity should occur for the rest of the hospital. This may be most efficiently performed on a rotating basis. Time spent on surveillance activities must not be so long that other essential infection control measures, such as staff education, are neglected.

HAI surveillance includes data collection, analysis and interpretation, and feedback leading to interventions for preventive action. The infection control team must be trained for surveillance. A written protocol must describe the methods used, the data to be collected and the analysis that can be expected.

Prevalence rate: The number of infected patients (or the number of infections) at the time of study as a percentage of the number of patients observed at the same time.

Incidence rate: The number of new nosocomial infections acquired per 1000 patient days.

5.2 Data collection and analysis

Sources

Data collection requires multiple sources of information as no method, by itself, is sensitive

enough to ensure data quality. Trained data extractors (training should be organized by the infection control team or the supervisor) performing active surveillance will increase the sensitivity for identifying infections. Techniques for case-finding include:

Ward activity: Looking for clues such as:

- The presence of devices or procedures known to be a risk for infection (indwelling urinary and intravascular catheters, mechanical ventilation, surgical procedures);
- Record of fever or other clinical signs consistent with infection;
- Antimicrobial therapy;
- Laboratory tests, and
- Medical and nursing chart review.

Laboratory reports: Isolation of micro-organisms potentially associated with infection, antimicrobial resistance patterns and serological tests. One cannot rely on laboratory reports alone. Cultures are not obtained for all infections; specimens may not be appropriate; some pathogens such as viruses may not be isolated; isolation of a pathogen may represent colonization rather than infection. Laboratory reports are reliable for urinary tract infection, bloodstream infections and, multiple-drug resistant bacteria surveillance, because the definitions for these are essentially microbiological.

Other sources of infection data include diagnostic imaging and autopsy data.

Discussion of cases with the clinical staff during periodic ward visits is an essential source of information.

Continuing collaboration among infection control staff, the laboratory, and clinical units will facilitate an exchange of information and improve data quality. Surveillance should also include the post-discharge period. Reduction of the average length of stay increases the importance of identifying late-onset infections.

The information to be collected should include:

- Administrative data (hospital number, admission date…)
- Additional information describing demographic risk factors (age, gender, severity of underlying illness, primary diagnosis, immunological status, and interventions (device exposure, surgical procedure, treatments) for infected and non-infected patients.
- Date of onset and site of infection, micro-organisms isolated, and antimicrobial susceptibility.

Feedback/dissemination

Infection data should be disseminated to the people directly involved in patient care; surgeons need to know about these surgical site infections. Dissemination of information should also be organized through the Infection Control Committees to other units, management, and laboratories.

Reports should not identify individual patients. Codes must also be assigned to units and responsible physicians, to ensure anonymity.

Prevention and evaluation

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 units, to improve practice, and to define and monitor new prevention policies. The final aim of surveillance is the decrease of nosocomial infections with a reduction of costs.

Surveillance is a continuous process and needs to evaluate the impact of changes in practices and to validate the prevention strategy, to see if initial objectives are attained.

6. INVESTIGATION OF AN OUTBREAK

6.1 Identification of an "outbreak"

The occurrence of two or more similar cases relating to place and time is identified as a cluster or an outbreak and needs investigation to discover the route of transmission of infection, and possible sources of infection in order to apply measures to prevent further spread. If the cases occur in steadily increasing numbers and are separated by an interval approximating the incubation period, the spread of the disease is probably due to person to person spread. On the other hand if a large number of cases occur following a shared exposure e.g. an operation, it is termed a common source outbreak, implying a common source for the occurrence of the disease.

6.2 Epidemiological methods

The investigation of an outbreak may require expert epidemiological advice on procedures. Formulation of a hypothesis regarding source and spread should be made before undertaking microbiological investigations in order that the most appropriate specimens are collected.

6.3 Steps to be taken to investigate an outbreak

Step 1

- *Recognition of the outbreak*. Is there an increase in the number of cases of a particular infection or a rise in the prevalence of an organism? Such findings indicate a possible outbreak.
- *Preliminary investigation* must be begun by developing a case definition, identifying the site, pathogen and effected population.
- *Determination of the magnitude* of the problem and if immediate control measures are required. If so general control measures such as isolation or cohorting of infected cases; strict hand washing and asepsis should be immediately applied.
- *Verification of the diagnosis*. Each case should be reviewed to meet the definition.
- *Confirmation that an outbreak exists* by comparing the present rate of occurrence with the endemic rate should be made.

Step 2

The appropriate departments and personnel and the hospital administration should be notified and involved.

Step 3

- *Additional cases* must be searched for by examining the clinical and microbiological records.
- *Line listings* for every case, patient details, place and time of occurrence and infection details should be developed.
- *An epidemic curve* based on place and time of occurrence should be developed, the data analyzed, the common features of the cases e.g. age, sex, exposure to various risk factors, underlying disease etc. should be identified.
- *A hypothesis* based on literature search and the features common to the cases; should be formulated to arrive at a hypothesis about suspected causes of the outbreak.
- *Microbiological investigations* depending upon the suspected epidemiology of the causative organism should be carried out. This will include (a) microbial culture of cases, carriers and environment (b) epidemiological typing of the isolates to identify clonal relatedness.
- The *hypothesis* should be tested by reviewing additional cases in a case control study, cohort study, microbiological study.

Step 4

- *Specific control measures* should be implemented as soon as the cause of outbreak is identified.
- *Monitoring for further cases* and effectiveness of control measures should be done.
- *A report* should be prepared for presentation to the ICC, departments involved in the outbreak, administration.

Immediate control measures

Control measures should be initiated during the process of investigation. An intensive review of infection control measures should be made and general control measures initiated at once. General measures include:

- Strict hand washing;
- Intensification of environmental cleaning and hygiene;
- Adherence to aseptic protocols, and
- Strengthening of disinfection and sterilization.

Epidemic curve

This is constructed to study the epidemic pattern of the disease. An epidemic curve is a graph (histogram) in which the cases of disease that occurred during the outbreak are plotted according to time of onset of HAI of the cases.

The epidemic curve is constructed to help determine whether the source of infection is common and continuing, and identify the probable time of exposure of the cases to the source of infection and probable incubation period.

Microbiological study

Microbiological study is planned depending upon the known epidemiology of the infection problem. The study is carried out to identify possible sources and routes of transmission. The investigation may include cultures from other body sites of the patient, other patients, staff and environment. Careful selection of specimens to be cultured is essential to obtain meaningful data.

Epidemiological studies

Case control study:

- A group of uninfected patients (the control group) is compared with infected patients (the case group).
- The differences in characteristics, susceptibility and exposure factors are compared. These factors include age, sex, time, place, duration of stay, intervention, antibiotic therapy and other therapies.
- A statistically significant difference between the groups is identified and the problem can be delineated.

Cohort study:

- Depending upon the infection problem, a defined high-risk population (cohort) is identified and followed prospectively.
- This high-risk population is followed prospectively for the development of infection.
- After following these cases for some time, the differences in host factors between the patients that develop the infection and those that do not becomes evident and will identify the source of the problem.

Specific control measures

Specific control measures are instituted on the basis of nature of agent and characteristics of the high-risk group and the possible sources. These measures may include:

- Identification and elimination of the contaminated product;
- Modification of nursing procedures;
- Identification and treatment of carriers, and
- Rectification of lapse in technique or procedure.

Evaluation of efficacy of control measures

- The efficacy of control measures should be evaluated by a continued follow-up of cases after the outbreak clinically as well as microbiologically. Control measures are effective if cases cease to occur or return to the endemic level.
- The outbreak should be documented.

7. HEALTH CARE STAFF

7.1 Transmission of infection from health care workers to the patients

Health care workers with infections should report their illnesses to the staff clinics when they are at risk of transmitting infection to patients. The closer the contact they have with the patients, the more likely they are to transmit the infection. The list of communicable diseases (Chapter 8) indicates which infections may be transmissible but organisms of special concern in hospitals are as follows:

(1) ***Staph. aureus**:* About 30% of normal persons carry staphylococci in their nose, but normally there is no transmission to patients from this site. Some persons e.g. with eczema, heavily colonized with staphylococci, may be shedding staphylococci in a ward environment. If there is any evidence indicating spread of *Staph. aureus,* the shedder status should be investigated by collecting swabs from the nose, skin, hair and perineum. If heavily colonized, they should be treated with mupirocin ointment 1% and given daily bath/shampoo with triclosan 1% or chlorhexidine 2% for 5 days, and status checked before their return to normal work. Theatre and ward staff with purulent skin lesions due to staphylococci should remain away from duty until the lesions have healed.

(2) **Multi-resistant *Staph aureus*:** Nasal carriers of MRSA may be found among health care staff during investigation of outbreaks. The subject should be swabbed to determine the extent of colonization and subsequently treated with mupirocin / triclosan / chlorhexidine to remove carriage.

(3) **Multi-resistant *Staph epidermidis:*** Staff colonized with MRSE do not require any intervention.

(4) **Diarrhoeal disease:** Staff with diarrhoea should report this to the staff health department. Some staff e.g. food handlers may need to be excluded from duty during this period. For other staff, careful application of enteric precautions is essential.

7.2 Preventing infection in health care personnel

Large hospitals generally have a clinic for resident and non-resident staff. Among the tasks of such dinics is the monitoring of infection risks both to staff who are at risk of acquiring infection from patients and to patients who may have an infection that may be transferred to patients.

Hepatitis B

Hepatitis B virus can be transferred from patients to staff and vice-versa by minute quantities of blood. The main way of preventing this transmission is by immunization of health care staff. All staff who may come into direct contact with patients or their secretions, should have their hepatitis B status determined by measurement of blood markers for hepatitis B. Non-immune staff need to be immunized. Staff who have hepatitis B antigen present in blood, particularly the envelope antigen, are capable of spreading hepatitis B to patients and may be excluded from high risk duties in the hospital to prevent transmission.

Sharps injuries

Minor injuries to the hands of health care workers commonly occur while performing invasive procedures on patients. The commonest are needle-stick injuries during phlebotomy or while giving injections. Sometimes sharp instruments contaminated with blood may also be involved.

Such injuries should be immediately treated by encouraging bleeding and washing thoroughly with running water and an antiseptic solution. The infection control team should be consulted for further measures in use locally. The risk of hepatitis B, hepatitis C and HIV infection should be assessed and appropriate immunization or chemoprophylactic steps taken if necessary.

Tuberculosis

Tuberculosis may be a high risk for some staff e.g. microbiology laboratory workers and some clinical staff. Some monitoring system e.g. monitoring at entry to the occupation or during employment is needed depending on the degree of risk involved.

Meningococcal meningitis

Transmission of meningococci to health care staff is most likely within 24 hours of admission of the patient. Health care workers in close contact with such cases should receive chemoprophylaxis with ciprofloxacin or an effective alternative agent.

8. CONTAINMENT OF COMMUNITY ACQUIRED INFECTIONS

Patients with infectious disease are frequently admitted to hospitals. Such patients need to be assessed and appropriate measures taken to contain the infection. The following table highlights the said precautions. However, standard precautions should be applied when handling blood and body fluids.

Infection / Pathogen	Isolation / infection control precautions*
Actinomycosis *Actinomyces israelii*	None
Adenovirus	Respiratory precautions
Anthrax *Bacillus anthracis*	Transfer to isolation unit
Acquired immune deficiency virus Human immunodeficiency virus (HIV)	Single room if bleeding. Blood precautions
Aspergillus	None.
Brucellosis *Brucella abortus* and *melitensis*	Label all specimens with biohazard / danger of infection
Candidiasis *Candida albicans*	None.
Chicken pox *Varicella zoster virus*	Single room, respiratory and contact precautions
Cholera *Vibrio cholerae* **Cytomegalovirus**	Stool precautions until faeces negative Contact
Dengue	None .
Diarrhoea – Infective *Campylobacter* *Cryptosporidium* Enteropathogenic *Escherichia coli* Rotavirus Small ground structured viruses e.g. Norwalk and other viruses.	Stool precautions

Infection / Pathogen	Isolation / infection control precautions*
Diarrhoea – Toxigenic *Bacillus cereus* *Staphylococcus aureus* *Clostridium botulinum* *Clostridium difficile* *Clostridium perfringens* Type A strains	Stool precautions
Diphtheria *Corynebacterium diphtheriae*	Isolation unit
Dysentery Amoebic *Entamoeba histolytica*	Stool precautions
Bacillary *Shigella numerous types, e.g. sonnei*	Stool precautions
Enteric fever *Salmonella typhi* *Salmonella paratyphi* Salmonellae sp e.g. *S.typhimurium*	Stool precautions
Gas gangrene *Clostridium perfringens* *Cl.oedematiens* *Cl.septicum*	None
Giardiasis *Giardia lamblia*	Stool precautions
Glandular fever Epstein-Barr virus (EBV)	None
Gonorrhoea *Neisseria gonorrhoeae*	None
Hepatitis - A & E virus - B , C and D virus	 Stool precautions Blood precautions
Herpes simplex Herpes virus *hominis* type I	None
HHV6 **HIV** Human immunodeficiency virus	None Blood precautions
Influenza Influenza A Influenza B	 Respiratory precautions
Legionnaires' Disease *Legionella pneumophila*	None
Leprosy *Mycobacterium leprae* Lepromatous Leprosy Tuberculoid Leprosy	 Contact precautions None

Infection / Pathogen	Isolation / infection control precautions*
Leptospirosis *Leptospira icterohaemorrhagica*	None
Lice *Pediculus humanus* *Phthirus pubis*	 Contact precautions Contact precautions
Listeriosis	Stool precautions
Lyme disease *Borrelia burgdorferi*	None
Malaria *Plasmodium* sp	None
Measles *Paramyxovirus morbilli*	 Respiratory precautions
Meningitis *Neisseria meningitidis* (meningococcus) *Haemophilus influenzae* *Streptococcus pneumoniae*	 Respiratory precautions Respiratory precautions None
Mumps *Paramyxovirus parotitis*	Respiratory precautions
Mycobacterium Atypical	None / Respiratory precautions
Plague **Pleurodynia** Coxsackie virus B	Wound and skin precautions. Respiratory precautions Stool precautions
Pneumocystis carinii	None
Poliomyelitis Polio virus	Stool precautions
Psittacosis *Chlamydia psittaci*	Respiratory precautions
Q fever	Respiratory precautions
Rabies *Rhabdovirus* group	Contact precautions
Relapsing fever *Borrelia recurrentis*	Blood precautions
Respiratory syncytial virus (RSV)	Respiratory precautions
Rubella (Rubella virus) Adult Newborn	 Respiratory precautions Respiratory, stool and urine precautions
Scabies *Sarcoptes scabiei*	 Contact

Infection / Pathogen	Isolation / infection control precautions*
Shingles *Herpes zoster*	Single room, respiratory and contact precautions
Staphylococcal infection *Staphylococcus aureus* Skin Lung	 Skin contact precautions Respiratory precautions
Methicillin-resistant *Staphylococcus aureus* (MRSA)	Contact precautions
Streptococcal infection Beta-haemolytic	None
Syphillis *Treponema pallidum*	None
Tetanus *Clostridium tetani*	None
Toxoplasma gondii	None
Trichomonas vaginalis	None
Tuberculosis *Mycobacterium tuberculosis* Pulmonary Cervical Abdominal Other sites Renal TB	 Respiratory precautions None None None Urine precautions
Viral Haemorrhagic Fevers e.g. Crimean-Congo Haemorrhagic Fever Ebola-Marburg Virus Disease Lassa Fever (Adenovirus group)	 Isolation Unit Contact
Worms *Ancylostoma* (Hookworm) *Ascaris lumbricoides* (Roundworm) *Enterobius vermicularis* (Threadworm/Pinworm) *Strongyloides stercoralis* *Taenia solium* (Pork Tapeworm) *Taenia saginata* (Beef tapeworm) *Trichuris trichura* (Whipworm)	 None Stool precautions Stool precautions Stool precautions Stool precautions None Contact precautions
Whooping cough *Bordetella pertussis*	Respiratory precautions

* See chapter 4 for details

9. SUGGESTED FURTHER READING

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Annex 1

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