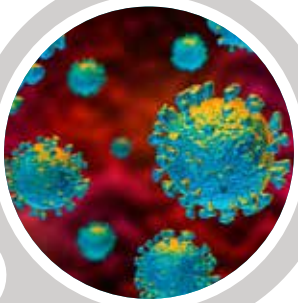
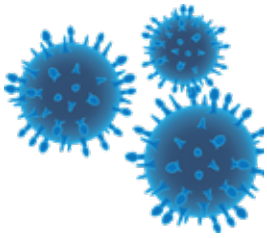
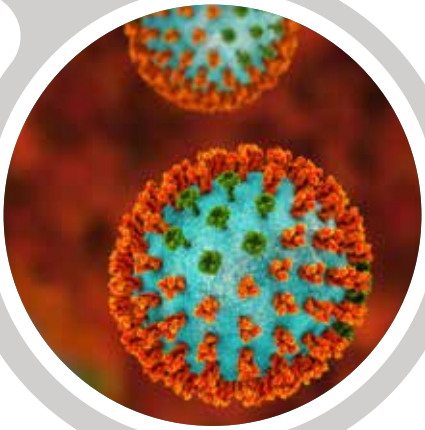
National Guidelines
Infection Prevention & Control

2020







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MESSAGE BY SPECIAL ADVISOR TO PRIME MINISTER FOR HEALTH

Infection Prevention and Control (IPC) refers to measures intended to curtail infections and their spread in healthcare facilities. Infections may be present at the time of admission of the patient or may be of nosocomial origin.

These guidelines on IPC is in response to the amplified concerns about inappropriate IPC practices in our country. The guidelines lay down standards that are required for the practice of IPC in healthcare settings along with its many benefits.

It is expected that these guidelines will be valuable for improving the quality of services regarding IPC in healthcare facilities. They were developed after several meetings and consultations with experts of the assorted areas of IPC. The subject matter is realistic and applicable to the existing local setups in the country. The guidelines will be pertinent to all healthcare facilities in Pakistan.

I appreciate and endorse that this document be used as the reference mate for IPC in healthcare facilities, so as to improve and implement IPC practices nationwide warranting patient safety and the protection of health workers.

Dr. Zafar Mirza
Special Advisor to Prime Minister for Health
Ministry of National Health Services, Regulations & Coordination

FOREWORD

A good quality healthcare system is based on the principle of: "Do No Harm". It is well recognized that infections acquired from healthcare settings are of a huge concern for all countries, irrespective of their level of development, and can affect patients, healthcare workers (HCWs), and visitors. It has been estimated that, at any given time, over 1.4 million patients worldwide suffer from infections acquired in healthcare facilities (HCFs). The risk of acquiring healthcare-associated infections (HAIs) in low- and middle-income countries is 2 to 20 times higher than in high-income countries. This is even worse in babies who are born in hospitals, where infections are responsible for up to 56% of all-cause deaths in the neonatal period. In addition to HAIs, there are recent records of the emergence and re-emergence of new and novel infections (MERS CoV, Ebola, H1N1pdm09, Chikungunya, etc.), and multi-drug resistant microorganisms (MDROs) e.g. XDR Salmonella, Carbapenem-resistant Gram-negative, XDR-tuberculosis, malaria and so on.

The global increase in HAIs and outbreaks and the emergence and re-emergence of life-threatening infections have highlighted the need for an efficient IPC programme in all healthcare facilities. This has necessitated the commitment of the senior management and trained IPC practitioners in Pakistan, towards providing technical expertise and capacity building for the effective implementation of these programmes. The programmes were not only to prevent HAIs but to also help in controlling the spread of communicable diseases and MDROs. The effective implementation of IPC, in turn, safeguards HCWs, visitors and the community at large. Therefore, it is imperative for all healthcare administrators to ensure strict implementation of the IPC in their healthcare facilities along with the provision of adequate resources and support; supplemented by regular monitoring of IPC practices.

These guidelines were developed mainly by using WHO recommendations, supplemented by the evidence-based and best practice guidelines published by the Centers for Disease Prevention & Control (CDC) along with other governmental organizations and professional societies. Practical efforts have been made to keep these guidelines concise and simple; supplemented by illustrations to facilitate understanding.

The principal objective of these guidelines is to provide basic and simple IPC practices which must be implemented at all times for extending safe care in all healthcare facilities (primary, secondary and tertiary healthcare facilities- in both private and public sectors) as a part of the routine (standard) practices for all patients.

Currently, there is no formal IPC programme either at the national, provincial or the facility level. As such, the need to produce National IPC Guidelines was regarded urgent and essential not only to provide a nationally agreed to policy but also to apply these IPC practices throughout the country based on the current evidence in a uniform manner, using basic IPC training material for the teaching of all stakeholders. It is contemplated that these guidelines should be revised on a two-yearly basis to keep them updated in the light of the latest information and developments. Hospitals need to adapt them as suitable to their needs, context and resources without changing the basic IPC principles.

These National IPC Guidelines were prepared with the help of experts from the WHO and a national technical working group comprising medical microbiologists, infectious diseases physicians and consultants in public health from all over the country. The entire process was facilitated by the National Institute of Health (NIH) in Islamabad.
We are optimistic that the effective implementation of these simple IPC practices will have an enormous positive impact in reducing HAIs, and improving patient safety levels. In addition, it will influence antimicrobial consumption and strengthen the Antibiotic Stewardship programme, to reduce the burden of antimicrobial resistance (AMR) which is a global priority.

Maj Gen Prof Aamer Ikram, SI(M)
Executive Director
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ACKNOWLEDGEMENTS

The National Institute of Health (NIH) had the privilege of working closely with many experts and organisations for the development of the IPC guidelines. This document has emerged as a result of their combined hard work, dedication and valuable contributions.

NIH extends deepest gratitude to the World Health Organisation, not only for their continuous support and commitment in formulating the IPC guidelines, but also for their support in organizing the meetings and arranging the logistics. We in particular are grateful to Dr. Palitha Gunarathna Mahipala, WHO Representative in Pakistan and Dr. Maha Tallat, WHO EMRO, Cairo for their support.

Special thanks are due Dr. Nizam Damani and Dr. Javed Usman, experts in the field of microbiology and infection control, for preparing the draft of the guidelines. The contributions of the Technical Working Group are deeply acknowledged.

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Abbreviations

ABHR	Alcohol-based hand rubs
ACH	Air changes per hour
AFB	Acid and alcohol fast bacilli
A&E	Accident and Emergency Department
AER	Automatic endoscope reprocessors
AGP	Aerosol generating procedures
AIDS	Acquired immune deficiency syndrome
AMR	Antimicrobial resistance
ATP	Adenosine triphosphate
BHU	Basic Health Unit
BBV	Bloodborne viruses
BiPAP	Bilevel positive airway pressure
CCHF	Crimean-Congo Haemorrhagic Fever
CVC	Central venous catheter
CRE	Carbapenem-resistant Enterobacteriaceae
CDC	Centers for Disease Control and Prevention
CAUTI	Catheter Associated Urinary Tract Infection
CLABSI	Central Line Associated Blood Stream Infection
CPAP	Continuous positive airway pressure
DHQ	District Health Quarters
DPT	Diphtheria pertussis and tetanus
DR-TB	Drug-resistant tuberculosis
ECDC	European Centre for Disease Prevention and Control
EPA	Environmental Protection Agency
ESBL	Extended-spectrum β lactamase
EPPs	Exposure- prone procedures
ET	Endotracheal tube
FLCF	First level care facility
GD	Government dispensary
HCAI	Healthcare-associated infection

HCWs	Healthcare Workers
HBIG	Hepatitis B immunoglobulin
HBV	Hepatitis B virus
HCF	Healthcare facility
HCV	Hepatitis C virus
HEPA	High efficiency particulate air filter
HFOV	High frequency oscillatory ventilation
HH	Hand hygiene
HIV	Human immunodeficiency virus
ICAN	Infection Control Africa Network
ICU	Intensive care unit
ICC	Infection Control Committee
ICD	Infection Control Doctor
ICN	Infection Control Nurse
ICT	Infection Control Team
IG	Immunoglobulin
IP	Incubation Period
IPC	Infection Prevention and Control
IUSS	Immediate use sterilization system
IV	Intravenous
LMI	Lower middle income
LBWLS	Laboratory based ward liaison services
MCH	Maternal and Child Health
MDROs	Multi-drug Resistant Organisms
MMR	Measles Mumps Rubella
MMWR	Morbidity and mortality weekly report
MRSA	Methicillin-resistant Staph. aureus
NaDCC	Sodium dichloroisocyanurate
NIH	National Institute of Health
NSI	Needle stick injury
NIV	Non invasive ventilation

OHD	Occupational health department
OPA	Orthophthaldehyde
OPD	Outpatient department
OT	Operation Theatre
PHC	Primary HealthCare
PCR	Polymerase chain reaction
PEP	Post-exposure prophylaxis
PI	Period of Infectivity
PPE	Personal protective equipment
PQ	Performance qualifications
QAC	Quaternary ammonium compound
RHC	Rural health centre
RSV	Respiratory Syncytial Virus
RUP	Re-use Prevention
SIP	Sharp injury protection
SOP	Standard operating procedures
SSD	Sterile supply department
SSI	Surgical site infection
THQ	Taluka Head Quarters
TST	Tuberculin skin test
TT	Tetanus toxoid
VAP	Ventilator-associated pneumonias
VHF	Viral haemorrhagic fever
VRE	Vancomycin-resistant Enterococcus
VZIG	Varicella zoster immunoglobulin
VZV	Varicella zoster virus
WD	Washer disinfector
XDR	Extremely-drug resistant
WHO	World Health Organization

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SECTION 1

Basic Concepts in Infection Prevention and Control

Introduction

Healthcare Associated Infection (HCAI) is an infection in a patient during the process of treatment within a hospital or in any healthcare facility, which was not present or incubating at the time of admission. This term replaces both Hospital acquired infections and nosocomial infections. HCAI can occur during healthcare delivery in any setting (e.g. hospitals, long-term care, or ambulatory settings). This term reflects that some patients seek healthcare from various healthcare facilities and it is not always possible to establish, with certainty, as to when these patients acquired the primary infection.

According to the WHO, the four commonest HCAIs in low-and middle-income countries are Surgical Site Infections (SSI), catheter-associated urinary tract infection (CAUTI), central line associated blood stream infection (CLABSI), and ventilator associated pneumonia (VAP) as outlined in Fig 1.1.

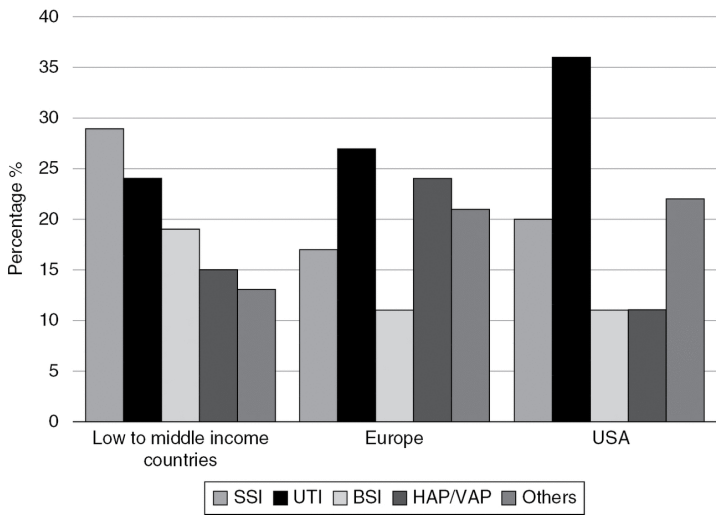

Fig. 1.1: The four major types of healthcare -associated infections. Report on the Burden of Endemic Healthcare - associated Infection Worldwide. Geneva: World Health Organization, 2011.[61]

The most common microorganisms causing HCAI include: Staphylococcus aureus, especially Methicillin-resistant Staph. aureus (MRSA), Vancomycin Resistant Enterococci (VRE), multi-drug resistant Gram-negatives (Extended Spectrum β-Lactamases [ESBLs]) and Carbapenem-resistant Enterobacteriaceae [CRE] e.g. Klebsiella spp., Escherichia coli, Acinetobacter baumannii and Pseudomonas aeruginosa. The list is otherwise vast and the recent emergence of Drug-Resistant TB and yeast infections, like Candida auris have been further added to the list.

Sources of infections

Infections can be acquired from two sources (i) an endogenous route when the source of microorganisms is from the patient's own microflora, e.g. from the gut due to break in intestinal mucosal barriers caused by chemotherapy in cancer patients; or (ii) an exogenous route when the microbes are from outside sources, e.g. from contaminated hands of healthcare workers, items, equipment, and/or the environment.

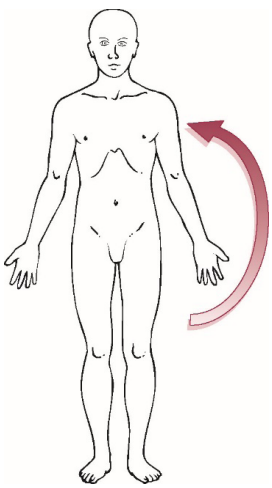

Fig 1.2 Endogenous route of infection
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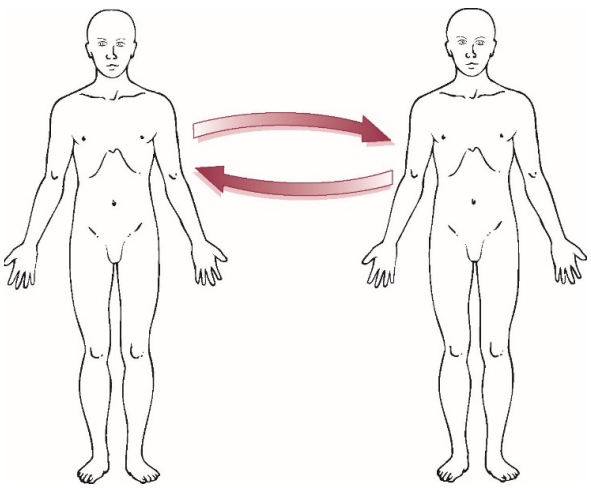

Fig 1.3 Exogenous route or cross-infection
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Factors Influencing Healthcare associated Infections

Factors related to microorganisms

Each microorganism has an infective dose defined as the number of microorganisms required to cause an infection. Microorganisms with low infective doses spread more rapidly. In addition, if the person is immunosuppressed, the infective dose required to cause infection becomes reduced. The pathogenicity of microorganisms or virulence is the capacity of a microbial strain to produce disease.

Factors related to the host.

Fig. 1.4 Susceptibility of an individual to healthcare associated infections.

The human body possesses many natural defence mechanisms for resisting the entry and multiplication of pathogens. When these mechanisms function normally, infection does not occur. However, infection can occur in case of any breach in the defence mechanisms, which occurs in immunosuppressed and immunocompromised patients.

Human susceptibility to infection is enhanced at extremes of age, very young, especially preterm children and the elderly, particularly those with co-morbidities are at higher risk for infection. In newborns, the immune system is not fully developed until about 6 months of age, while old age is associated with declining immune system function, and chronic diseases like diabetes mellitus, which further weakens the host's defenses. In addition, immunosuppressed patients on chemotherapy, patients with AIDS, and transplant patients on immunosuppressive or high dose steroid therapy are also highly susceptible to infections.

The chance of acquiring HCAI also increases among those with open wounds (burns, trauma or surgical wounds) or those who have indwelling devices, such as IV lines, urinary catheters, nasogastric and endotracheal tube, and surgical drain.

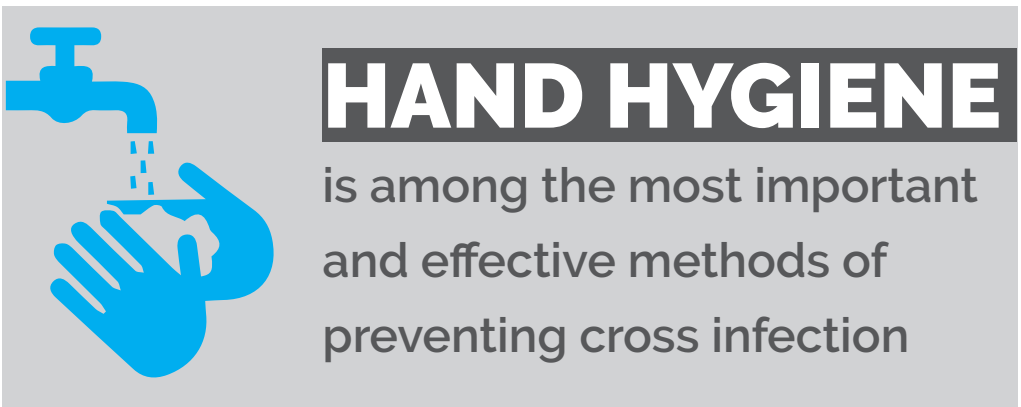
It should be emphasized that even a healthy individual with lack of previous exposure or lack of immunization for vaccine-preventable diseases may acquire infection, especially from emerging and re-emerging microbial agents, e.g. Dengue fever, Crimean-Congo Haemorrhagic Fever (CCHF), Chikungunya, Ebola, MERS–CoV and Zika virus. Additionally, changes in pathogen characteristics in certain microbes like influenza, and norovirus can lead to enhanced susceptibility to infections.

Modes of transmission

Microorganisms can be acquired through various routes, and some of them have the ability to use more than one route of transmission. The most common modes of microbial transmission in healthcare facilities are as follows:

Contact transmission

Contact transmission is the most frequent mode of transmission in any healthcare facility. This occurs either as direct contact when there is physical contact with a patient during medical examination, bathing, dressing changes etc. Microorganisms can also spread by direct contact via contaminated hands and gloves. Thus, hand-hygiene is among the most important and effective methods of preventing cross infection and should also be performed immediately after removal of contaminated gloves. Indirect contact transmission occurs when pathogens are transmitted through an intermediate object i.e. via contaminated items, equipment, and/or the environment. In healthcare settings, effective decontamination of items and medical equipment (Section 5), and cleaning and/or disinfections of environmental surfaces (Section 6), is essential to prevent transmission through this route.



Droplet transmission

Droplet transmission occurs when microorganisms come into direct contact with mucous membranes in the mouth, eyes, and nose. This occurs during talking, singing, coughing, sneezing and during certain medical procedures. Most of the aerosol particles generated during coughing can be found in the air in proximity of 1 metre (~ 3 feet). Within a few seconds, large-size particles (> 5 μm) fall quickly to the ground due to gravitational force, but some larger droplets may desiccate and become smaller while in the air due to loss of the moisture present in saliva. Direct transmission via this route can be prevented by wearing a facial protection (surgical mask and/or face shield) within 2 metres (~ 6 feet) of the patient or upon entry into the patient's room.

Airborne transmission

Airborne transmission efficiency depends on particle size. Smaller size particles (< 5 μm) remain suspended in the environment for a significantly longer time and can be carried by air currents over a long distance. In addition, they bypass the upper respiratory tract and bronchial tree to directly reach the alveoli and cause infections. The most common microorganisms for which airborne precautions are necessary include Mycobacterium tuberculosis, varicella-zoster virus (chickenpox) and measles. In order to prevent cross-infection, it is recommended to replace susceptible healthcare workers (HCW) with HCW immune to these infections either through previous immunization (e.g. measles) or past infection (e.g. history of chickenpox). Refer to Section 3 regarding isolation of patients.

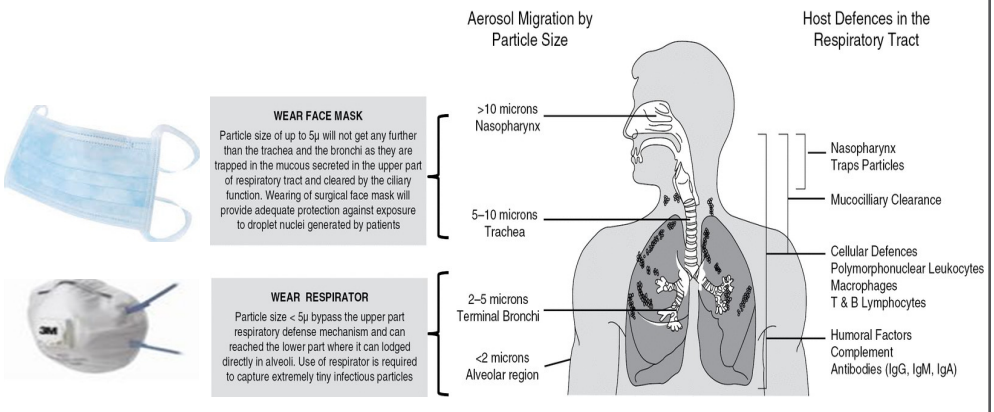


Fig. 1.5 Host defence mechanisms in the respiratory tract and the use of appropriate PPE to protect against the infection spread by droplet and airborne routes.

From: Damani N. Manual of Infection Prevention and Control. Oxford: Oxford University Press, 2019.

Infection in a healthcare facility (HCF) can also occur from inoculation in healthcare workers as injuries acquired from contaminated sharps, due to inappropriate use and disposal. Outbreaks of food poisoning due to ingestion of contaminated food and water in the HCF can occur due to mishandling and improper storage of food. The need for adequate food hygiene facilities is of paramount importance, since the consequences of an outbreak of food poisoning in HCF can be life threatening for susceptible patients. Hospital administrators are responsible for food hygiene in hospitals; they should ensure that a complete independent audit is carried out on a regular basis at least twice a year. The full report of such inspections should be submitted to the hospital administrator and the hospital infection control committee. Refer to ANNEX A for details about Food Safety.

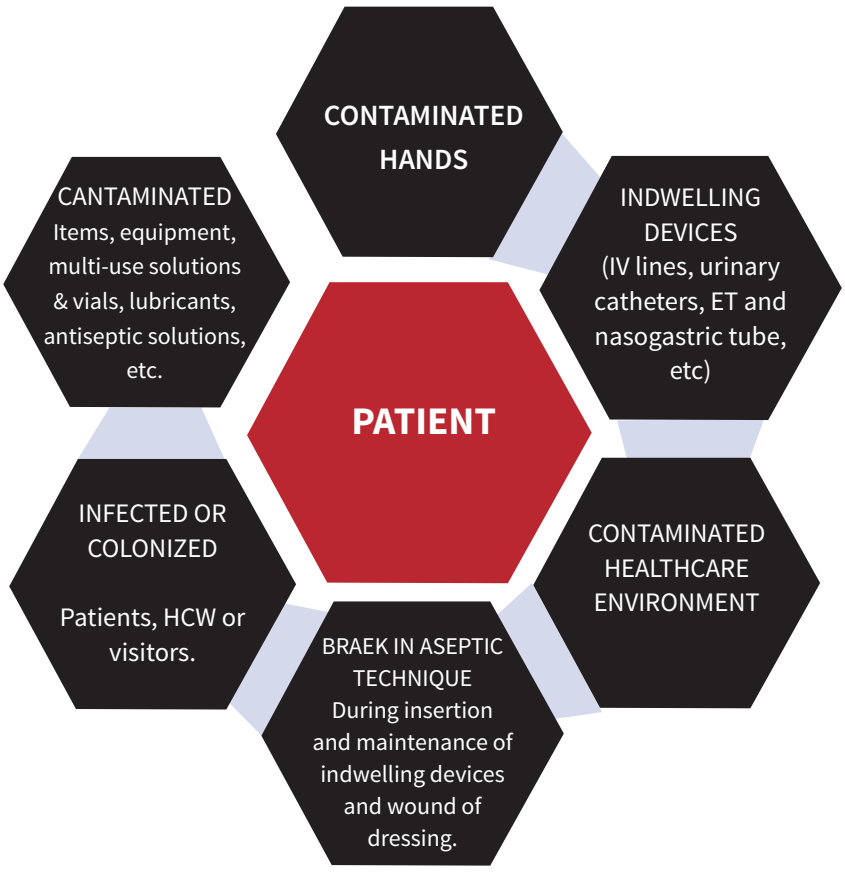


Fig. 1.6 Sources of exogenous healthcare associated infections.
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Chain of transmission of infections

The microorganisms responsible for infectious diseases include bacteria, viruses, rickettsiae, fungi, protozoa, and helminths. Fig 1.7 illustrates the chain of infections and the enabling factors necessary for the transmission of microorganisms.

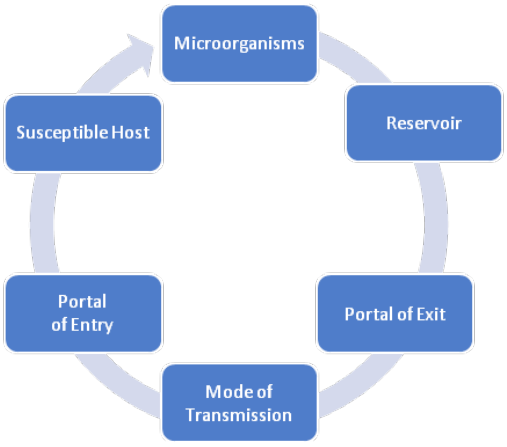


Fig. 1.7 The chain of transmission of infection.

Microorganisms: This could be bacteria, virus, fungus or protozoa; and the transmission depends on the type, virulence, and infective dose of the microorganisms.

Reservoir: It is a place where microorganisms can multiply and/or survive. This could be in humans, animals, water (e.g. Legionella and Gram-negative bacteria in sink), contaminated food items and equipment. It is also important to note that the individual may become a carrier i.e. they may continue to have microorganisms in their body without manifesting any signs and symptoms of infection.

Portal of Exit: A means by which microorganisms can leave the reservoir (through the mouth, respiratory and gastrointestinal tract, aerosols from the contaminated water, etc.) to reach the susceptible individual.

Mode of Transmission: Microorganisms move from one person to another through direct contact via the hands, respiratory droplets/secretions during coughing and sneezing, ingestion of contaminated food and water, and inoculation via needle stick injuries or mosquito bites.

Portal of Entry: An opening that allows the microorganism to gain access to a new person (host).

Susceptible Host: A person that is susceptible to infection.

SECTION 2

Organization of IPC Programme

The need for the IPC programme

The real global burden of healthcare-associated infections (HCAIs) is unknown due to difficulty in gathering reliable data. However, worldwide an estimated more than 1.4 million patients at any given time suffer from infections acquired in healthcare facilities (HCFs). The risk of HCAIs in developing countries is 2–20 times higher than in developed countries. The proportion of patients affected by HCAIs can even exceed 25% in developing countries. [61] During the neonatal period, infections in hospital births account for 4–56% of all cause deaths.

Impact of healthcare associated infections

Establishing and enhancing effective delivery of IPC services is part of the quality and safety of healthcare, which can contribute to the following improvements in health outcomes:

1. Reduction in length of stay.
2. Reduction in cost.
3. Reduction in hospital attendance.
4. Effective utilization of beds.
5. Reduction in the spread of multi-drug resistant organisms (MDROs).
6. Improved patient satisfaction, safety and quality of care.
7. Impact on individuals and families.

National IPC Structures

The administrative structure in Pakistan consists of the federal, provincial, district and sub-district levels, with healthcare provision well established in both the public and private sectors. The public health sector functions through a three-tiered system of primary, secondary, and tertiary healthcare.

Primary healthcare facilities (PHC) include Government Dispensaries (GD), Basic Health

Units (BHU), and Rural Health Centres (RHC). Secondary healthcare facilities include the Taluka Headquarters (THQs) and District Headquarters (DHQs) hospitals. Tertiary healthcare facilities as the highest level of specialized healthcare in both public and private sectors is available in major cities only. Based on the eight core components, [74] the WHO has published guidelines on the minimum requirements of IPC, which are necessary at the primary, secondary and tertiary healthcare facility levels – these recommendations are summarized in Annex 2.[86]

A strong health system, which includes a culture and system of IPC is critical to preventing the spread of infection and responding to disease outbreaks. It is recommended that the establishment of the following national infection prevention and control (IPC) structures be aligned to the administrative setup of Pakistan with composition and terms of reference:

Federal Level

The following two structures should be established at the federal level:

1. National AMR/IPC Steering Committee

An IPC steering committee should be notified with a senior technical health official such as the Minister of Health or the Federal Secretary as the chairperson/head. Members should include representatives from relevant specialties such as infectious disease, microbiology, nursing, dentistry, pharmacy in the public, private sector and military hospitals, regulatory bodies/ councils, academia and senior federal and provincial health decision makers. The national IPC steering committee will oversee the standardization and implementation of IPC policies and standards, provide technical guidance, and facilitate monitoring of IPC activities in all healthcare facilities in the public and private sectors in Pakistan.

It is highly recommended that the national (AMR/IPC governance structure/ steering) committee in Pakistan should preferably include the IPC component.

Terms of Reference

1. Facilitate and coordinate the development of National AMR/IPC setup.
2. Coordinate efforts to standardize IPC guidelines, SOPs and activities in all healthcare settings and at all healthcare levels.
3. Act as an advisory and oversight body for all AMR/IPC related activities in the country.

4. Coordinate and monitor all AMR/IPC related activities in all sectors to ensure system approach is aligned with the objectives & strategic priorities of the national AMR plan.
5. Provide a platform for information sharing with relevant national and provincial stakeholders in human and animal sectors.
6. Meet regularly to ensure all partners are adequately briefed on AMR/IPC.

2. National IPC Unit

There should be an official notification of a formal IPC structure at the federal level with clearly defined objectives, functions, and responsibilities. The IPC unit or department should be responsible for development of the national IPC policy and strategic plan, provide guidance for the institution of IPC programmes at all healthcare institutions and coordinate IPC activities at the federal and provincial levels.

The main functions of the Federal IPC unit should include:

1. Development of national IPC guidelines in collaboration with provinces and other country stakeholders and partners.
2. Design a standardized healthcare associated infections (HCAIs) surveillance programme.
3. Advise on implementation of multimodal strategies to prevent transmission of infections and antimicrobial resistance.
4. Develop/adapt IPC training curriculum, and establish a system for monitoring, evaluating, and reporting key IPC indicators.
5. Prepare and disseminate an annual report of IPC activities at the country level.

An experienced technical full time health professional, preferably experienced in IPC and public health should be assigned as IPC lead. The unit should be duly supported by 2-3 dedicated technical teams from relevant disciplines such as microbiology, nursing, medical epidemiology, IT etc., and should also include administrative support.

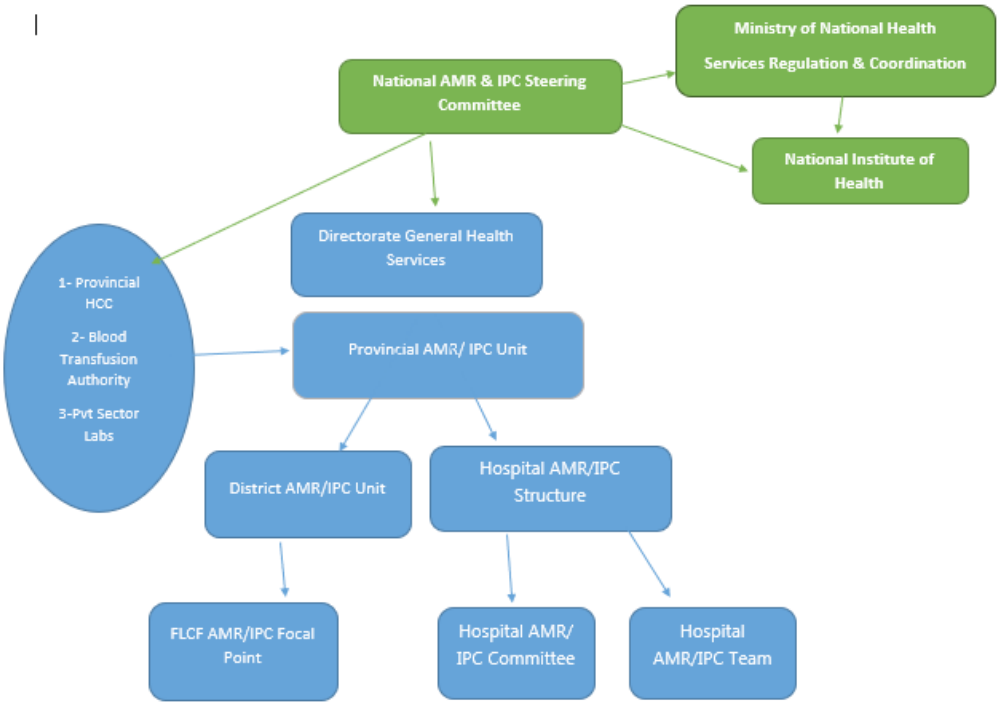


Fig 2.1: IPC Structural Organogram (Federal and Provincial Levels).

Provincial Level

Provincial IPC Steering Committee

The IPC steering or advisory committee created at the provincial level should be headed by the Minister of Health or a senior health professional. Members of this committee should include representatives of all IPC stakeholders from the public and private sectors, infectious disease specialist, microbiology, pharmacy, dentistry, nursing, regulatory bodies, academia NGOs, and professional societies. The head of the provincial IPC steering committee should be represented in the Federal IPC steering committee as well.

The main terms of reference for this committee is to leverage resources for implementation of the provincial IPC programme, ensure availability of IPC infrastructure, material, supplies and equipment necessary for safe IPC practices. The committee should be responsible to approve annual IPC plans, ensure dissemination

and standardization of IPC policies, standards and national guidelines and activities at all healthcare settings in the province in public and private sectors, to ensure implementation of safe IPC practices at the provincial level and address IPC related issues.

Provincial IPC Unit

Establish an IPC unit in the province and assign a health professional as the IPC lead for this unit with experience in IPC, public health, microbiology, or epidemiology duly supported by a team from various disciplines such as nursing, microbiology, medical epidemiology, IT, pharmacy etc.

The provincial IPC lead should create the IPC programme Organogram of the province at all levels (provincial, district, healthcare facility, primary healthcare) with clearly defined objectives, functions, and responsibilities.

The provincial IPC unit will be responsible for:

- Developing provincial IPC action plan with clearly defined objectives, functions, activities and indicators.
- Ensuring implementation of national IPC guidelines, policies and standards.
- Coordinating IPC action to support any outbreak response related to breaches in IPC (community and hospital outbreaks).
- Developing a provincial wide IPC training plan targeting hospital IPC teams and ensure a step-wise implementation of the plan.
- Building an effective linkage with related provincial programmes (TB, Hepatitis and HIV /AIDS).
- Supporting establishment of essential IPC structures required at the hospital/HCF level with IPC teams and committees.
- Developing systems for healthcare associated infections (HCAI), AMR surveillance and implement multimodal strategies to improve IPC implementation and practices at the HCF level.
- Establishing a system for monitoring/audit and evaluation of key IPC indicators.
- Compiling and communicating an annual report on IPC activities in the province.
- Representing IPC discipline in the higher IPC Steering Committee at the provincial and federal levels.

District Level

The District Health Department is responsible for the management of primary and secondary care facilities including Dispensaries, Basic Health Units, Rural Health Centres, Maternal and Child Health (MCH) and TB centres in some districts, the Tehsil Headquarters Hospitals, Civil Hospitals and the District Headquarters Hospitals. In addition, there are multiple private hospitals, clinics and laboratories in a district where implementation of IPC programme is similarly important and the implementation of IPC programme in all these facilities is the responsibility of the District Health Officer.

District IPC Focal Person

The District Health Officer should nominate a district Focal Person for IPC who will oversee implementation of the IPC Programme in all health facilities across the district including private facilities. The Focal Person will coordinate with all the district stakeholders like the Municipality, Water resource and supply departments, Sanitation Services, Trade Unions, Media, the Educational Institutions, and liaison with the provincial level. The Focal Person should ensure that proper IPC organizational structures are in place, the functioning of all facilities and ensure monthly monitoring visits to all the sites.

The District Health IPC Committee may include representatives from all health facilities, public and private, non-health stakeholders and the related NGOs. They must meet once in a month or quarterly per year to review the situation, identify gaps and recommend corrective measures.

First level care facilities / IPC Focal Person

An IPC focal person, preferably a nurse should be assigned for each of the first level care facilities (FLCF) including basic health units, rural health centers, civil dispensaries, MCH centers, TB clinics to liaise with the district IPC focal person/unit.

Hospital Infection and Control Programme

Implementing the IPC Programme is everybody's responsibility and does not rest with the IPC team alone. The health institutions, in both public and private sectors, must ensure adequate management arrangements for implementation and effective delivery of IPC practices, including standard precautions in every aspect of patient care as a routine practice. This requires strategic planning and approval of the IPC plan

based on all the eight IPC core components as outlined in the WHO document [74] for integration and implementation at the facility level.

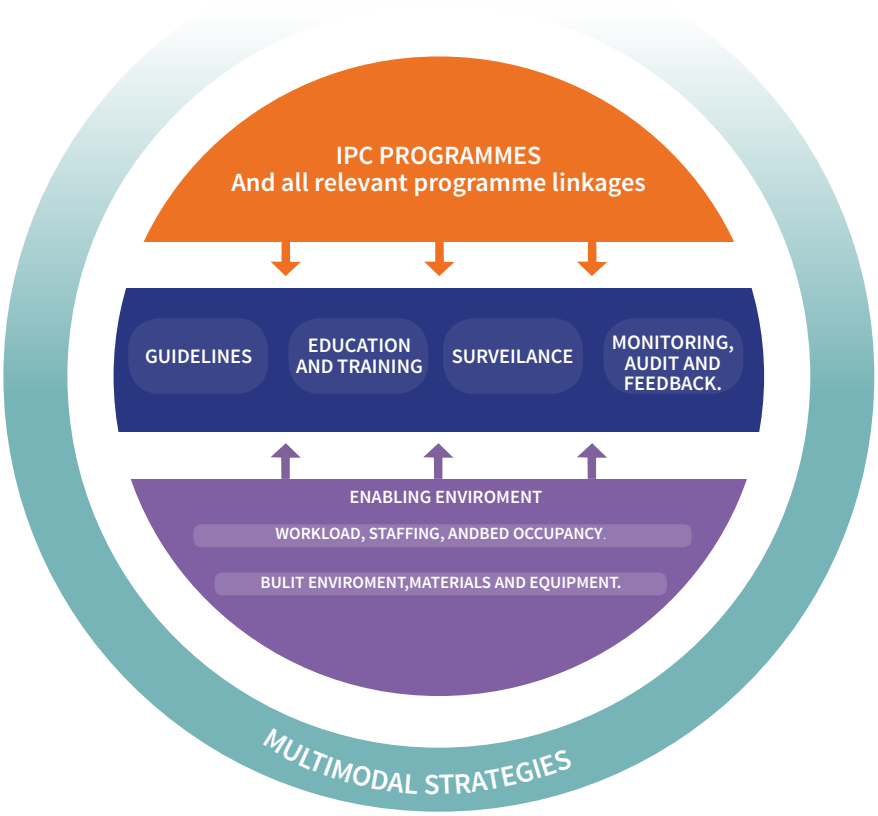


Fig. 2.2 Visual representation of WHO core components of IPC programmes [74].

Note: How the interconnectedness to improve IPC practices and reduce infection outcomes.

Roles and Responsibilities of Hospital Management

Available evidence endorses the fact that the IPC service is not successful unless there is management support of senior clinical staff and hospital administrator/chief executive.

The hospital's chief executive/administrators/ MS/director is ultimately responsible for the provision of IPC services. It is essential that adequate resources, both financial and human, and managerial support are available to the IPC team so that IPC programmes are implemented effectively.

Managers of HCF must ensure that all HCWs are aware of the importance and principles of IPC. They should ensure and emphasize on the importance of mandatory continuing education and practical training for all HCWs. An orientation and induction training to increase awareness and assistance in understanding institutional IPC policies and programmes should be offered to all the new employees (including the temporary staff).

Provision of adequate staffing level

Overcrowding is a recognized public health issue resulting in disease transmission. HCWs staffing levels should be adequately assigned according to the patient workload to ensure effective implementation of IPC practices. The WHO Workload Indicators of Staffing Need method provide health managers with a systematic way of determining how many health workers of a particular type are required to cope with the workload of a given health facility and decision-making.

Role and responsibilities of employers

All employers have a legal obligation to ensure that all employees are appropriately trained and proficient in the procedures necessary for patient care and safety. In addition, the employees should be provided a safe working environment, resources, and material to carry out their tasks effectively.

Every employee is equally responsible for taking all reasonable steps while working to ensure their own health and safety and that of others who may be affected by their acts and IPC omissions at work. It is the responsibility of each individual employee to be aware of their role in IPC and to incorporate good practices into their daily activity to ensure that they do not jeopardize their health and safety or that of any other person. IPAC has developed a set of competencies [33] which are essential for all HCWs involved in patient's care to help prevent transmission of transmissible infections, HAIs, and MDROs.

Key components of an IPC healthcare facility structure

Important components of the IPC programme are:

- Availability of basic infrastructure (hand washing facilities, continuous water supply, soap, drying material and alcohol-based hand (ABHR) product, hand hygiene at the point of care, etc.
- Availability of basic IPC supplies, gloves, personal protective equipment, chemical disinfectant for environmental cleaning, etc.
- Implementation of basic measures for IPC, including triage, isolation of patients with suspected/known communicable diseases and MDROs, and implementation of standard precautions for all patients and additional precautions based on risk assessment.
- Education and training of healthcare workers.
- Availability and regular update of IPC and antimicrobial guidelines with issuance and revision dates.
- Protection of healthcare workers, e.g. immunization and availability of post-exposure prophylaxis (PEP).
- Identification of hazards and unsafe IPC practices and minimizing the risks.
- Implementation of IPC practices essential to the provision of safe patient care e.g. aseptic techniques, usage of single-use disposal devices, adequate reprocessing of reusable instruments, items and equipment, prompt management of blood and body fluid exposure in HCWs, management of medical waste as per national and hospital policy and support to implement antibiotic stewardship programme.
- Environmental management practices, including management of support services e.g. catering, laundry, and pest control.
- Surveillance of healthcare associated infections, and outbreak investigation.
- Regular audits and incident monitoring, and reporting to the appropriate authorities.
- Education, practical training and research.

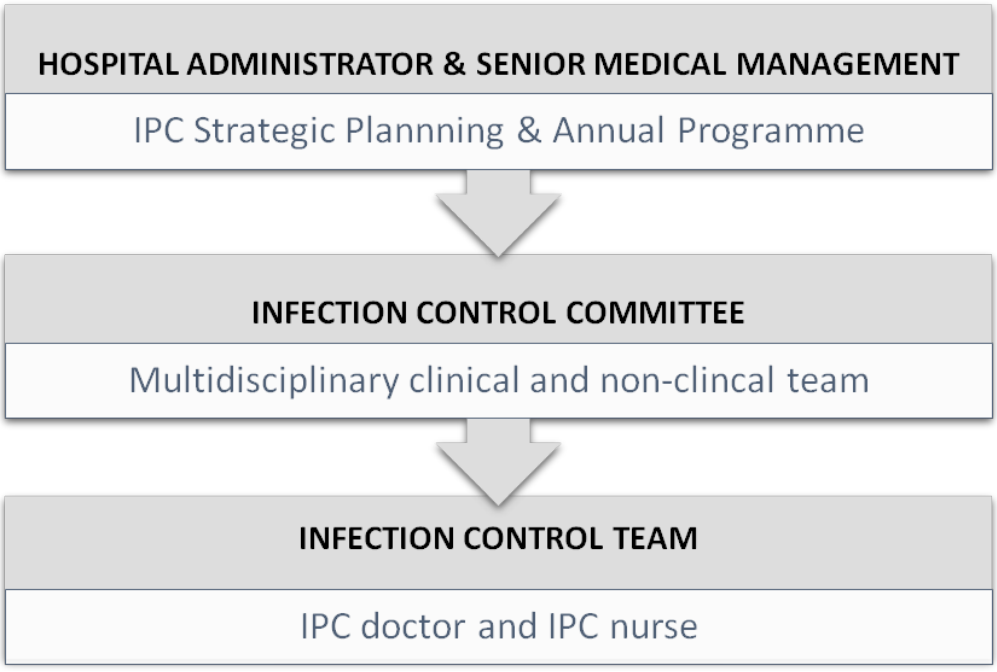


Fig. 2.3 Management and the role of various individuals in implementing IPC practices.

Organizational structure in healthcare facility

The hospital administrator should establish an Infection Prevention and Control Committee (IPC) and an Infection Prevention and Control Team (ICT). The committee must establish clearly defined objectives, prepare and execute an annual work plan based on the local priorities and risk assessments, with the availability of a committed budget and adequate resources to function effectively.

Infection Prevention and Control Committee

The IPC committee plays a supervisory role and provides input, ensures that the policies and procedures are implemented and supervise standardized IPC professional healthcare. The committee must have adequate secretarial support. The IPC committee includes wide representation from relevant departments (Fig 2.1). The committee shall be led/chaired by the hospital administrator or a suitable senior nominee, and must have adequate secretarial support for day-to-day administrative needs.

The Composition of the IPC committee

- Medical Superintendent/Administrator
- Medical Microbiologist
- Infectious Disease Physician
- Hospital Epidemiologist
- Senior member from key clinical specialties and allied departments
- Senior member of Nursing/Matron's office
- Clinical pharmacist
- Head of the Operating theater
- Head of Sterile Supply Department
- Head of the procurement of goods and services and stores department
- Head of the catering department
- Head of sanitary and housekeeping services
- Biomedical Engineer
- Civil engineer
- Another co-opted member as and when required

The role and responsibilities of the IPC Committee:

- Elect a senior member of the committee as the chairperson who should have direct access to the senior management and hospital administrator.
- Ensure adequate resources and supplies are available to implement an effective IPC programme.
- Review and approve the IPC annual programme of activities for audits and surveillance.
- Provide timely feedback of data on audits and surveillance of HCAIs and MDROs to the relevant department.
- Develop and approve IPC policy and procedure manual with issues and revised dates.
- Review audit and surveillance data and identify areas for intervention to facilitate prompt implementation of optimal IPC practices at all levels.
- Ensure enhancement of staff capacities.
- Establish and supervene IPC Control team.

- Direct resources to address any additional identified issue/problem.
- Encourage communication among involved disciplines and different departments.
- Meet regularly, monthly, but not less than three times a year. In an emergency situation, such as an outbreak, the committee must be able to meet promptly and more frequently.
- Act as a multidisciplinary forum to facilitate input and cooperation of key stakeholders and sharing of information to relevant departments.
- Ensure IPC policies and procedures are based on current scientific evidence and aligned with international recommendations.
- Ensure revised and/or new policies and procedures and other information are readily available to all HCWs.
- Responsible for quality and cost effectiveness-based selection and approval of chemical antiseptic & disinfectants, new items, other products, and equipment which has IPC implications.
- Plan training and education of all relevant clinical and non- clinical staff (clinical and non-clinical). The staff should receive education and practical aspect of hands on training where appropriate. The training should be given to new staff upon induction, introduction of new product or procedure on an ongoing basis for updating the knowledge on new research and development.
- Involve in matters related to hospital construction and renovation.
- Monitor and evaluate IPC performance through regular audits and surveillance.
- Consider newsletter publication on a regular basis for providing information, and increase awareness on IPC related issues.
- Submit an activity report and statistical data to the federal committee every six months.

Infection prevention and control team

For effective functioning and delivery of the IPC Programme, it is essential that every acute healthcare facility (HCFs) should have dedicated and trained IPC doctors and nurses. The IPC team comprises of an IPC doctor/office and IPC nurse practitioner. It is essential that for effective delivery of service, all IPC practitioners must meet the core competencies[33] to ensure that they have both the knowledge and skill to execute their tasks effectively.

The number of IPC practitioners required to run an effective programme depends on various factors such as the number of beds, number of HCFs, and the distance, types of acute HCFs with specialized units, tertiary care centre, etc. The ideal recommendation is a minimum ratio of one full-time or equivalent IPC nurse per 250 beds. However, a higher ratio is advised, for example, one IPC nurse per 100 beds due to increasing patient activity and complexity, as well as the multiple roles and responsibilities of modern practitioners (WHO, 2016). If the setup is small, for example, in BHU and RHC only part time IPC nurses can be hired.

Roles and responsibilities of the IPC Team

- It should meet on a daily basis.
- Serve as a specialist advisor and takes the leading role in the effective functioning of the IPC team on a day to day basis.
- Should be an active member of the hospital IPC committee and assists in drawing up annual plans, policies & procedures, and long- term programmes for the prevention of HCAIs and control of MDROs.
- Provide advice on new products and emerging technologies.
- Ensure uninterrupted availability of IPC essential supplies and infrastructure e.g. personal protective equipment, soap, hand drying material, alcohol-based hand rub at all points of care.
- Ensure compliance and adherence to the policy and procedures by performing regular audits and surveillance.
- Identify poor IPC practices and take remedial action by organizing trainings.
- Advise the staff on all aspects of IPC to maintain a safe environment for patients, staff and visitors.
- Monitor healthcare associated infections and report adverse incident.
- Investigate outbreaks within the healthcare facility.
- Develop an annual training plan for healthcare workers and other relevant staff.
- Take-up necessary follow-up measures of needle stick injury (NSI) cases after discharge, including periodic laboratory monitoring.
- Organize employee health programmes as per local policies.
- Participate in the preparation of tender documents for support services and advises on IPC aspects.

- It should be involved in setting of quality standards, surveillance, and monitoring of HCAIs and MDROs.
- Submit monthly reports on activities to the IPC.

IPC assessment at the facility level

HCAIs are now a recognized health issue and provision of an effective IPC programme is essential for all HCFs as part of the patient safety and quality improvement programme. The WHO has published evidence based guidelines, assessment and implementation tools based on the core components for effective implementation and sustainability of the IPC programme both at the national and healthcare facility levels. [74,78, 81]

In addition, it has also developed an IPC Assessment Framework at the Facility Level [80] and implementation manual to support effective IPC practices at the facility level [81] with a view to identify strengths and gaps in IPC practices at the facility level.

It is also important to point out that good quality and cost-effective service can be provided within available resources, by abandoning ritualistic, wasteful, and unsafe IPC practices and diverting resources to implement basic evidence-based practices as outlined in this National IPC Manual.

Infection prevention and control doctor (IPC Doctor)

The IPC doctor/officer must be a registered medical practitioner. Either a medical microbiologist, consultant in infectious diseases or hospital epidemiologist can perform this particular role. Irrespective of the professional background, the IPC doctor must have or acquire knowledge and experience in medical microbiology, infectious disease, hospital epidemiology, surveillance and decontamination methods.

Roles and responsibilities of the IPC Doctor

- Supervise the IPC nurse(s).
- Liaise with the director of IPC and microbiology laboratory.
- Serve as a specialist advisor and take a leading role in the effective functioning of the IPC team.
- Must be able to make day to day decisions on IPC within the guidelines of the Infection Prevention and Control manual.
- Assist the hospital IPC committee in drawing up annual plans, policies and long- term programmes for the prevention of HCAIs.

- Advise the chief executive/hospital administrator directly on all aspects of HCAIs and on the implementation of agreed policies.
- Participate in the preparation of tender documents for support services and advises on IPC aspects.
- Should be involved in setting of quality standards, surveillance, and monitoring of HCAIs. Participates in establishing policies on the use of antimicrobial agents and provides advice on new products and emerging technologies.

Infection Prevention and Control Nurse

An IPC nurse is a registered nurse with an additional academic education and practical training in IPC to enable role and act as a specialist advisor. It is essential that the IPC nurse has the expert knowledge of both general and specialist nursing practice and must also have an understanding not only of the functioning of clinical areas, but also operational areas and services. The IPC nurse should be able to communicate effectively with all grades of staff, negotiate, effect change and influence practice. A recognized qualification in IPC is highly recommended to fulfil this job effectively.

Role and responsibilities of the IPC Nurse

- Visit wards and clinics to detect and record HCAIs and communicable diseases.
- Serve as a specialist advisor and take a leading day- to- day role in the effective functioning of the IPC team.
- Should be an active member of the IPC committee.
- Provide specialist nursing input in surveillance, prevention, monitoring, and control of HCAIs and MDROs.
- Identify and investigate unsafe IPC practices and procedures and take timely action on hazardous practices.
- Advise the contracting departments and participate in the preparation of documents relating to service specifications and quality standards.
- Ongoing contribution to the development and implementation of IPC policies and procedures, participating in the audit, surveillance of HCAIs and develop monitoring tools related to IPC, communicable diseases and MDROs.
- Presentation of educational programmes and membership of relevant committees where input from IPC is required.

- Perform audits of clinical practices related to prevention of infection, e.g., aseptic techniques, isolation of patients, disposal of healthcare wastes.
- Monitoring of food hygiene and health of food handling staff.
- Conduct education programmes on IPC for all new clinical staff (doctors, nursing and paramedical staff) as a part of induction and ongoing training in conjunction with medical and technical officers.
- Prepare IPC reports and statistics on HCAIs, MDROs, and communicable disease for IPC committee, with the help and coordination of ICD (Infection Control Doctor), medical microbiologist and clinical staff.

SECTION 3

Surveillance of healthcare-associated infections

Healthcare associated infection (HCAI) is a patient safety and quality of healthcare issue which contributes to poor patient outcomes and additional costs to the healthcare system. Surveillance is defined as the ongoing systematic collection, analysis and interpretation of health data essential to the planning, implementation and evaluation of public health practice, closely integrated with the timely dissemination of these data to stakeholders and others.

To clinicians and other stakeholders, surveillance and feedback of infection rates is a cornerstone of HCAI prevention programmes. Surveillance to determine the incidence of HCAI is an important part of the strategy to minimize the occurrence of these infections and is the foundation for organizing, implementing, and maintaining an effective infection prevention and control (IPC) programme in healthcare facilities (HCFs).

During the past decade, the delivery of healthcare has undergone substantial changes. Treatment which was once exclusively provided in hospitals is now being delivered in non-acute healthcare settings. In the light of this evolution, the term healthcare-associated infection (HCAI) is used instead of hospital-acquired or nosocomial infection. The new term HCAI refers to infections associated with healthcare delivery in any setting (e.g. hospitals, long-term care, and ambulatory settings). This term underscores the fact that patients seek care through various healthcare facilities and it is not always possible to establish with certainty, the primary source of the infection acquired by these patients.

In addition, it is important to differentiate between community-acquired infection (infection acquired in the community) and community-onset infection, where the infection manifested in the community. In a recently discharged patient from healthcare facilities- these infections are counted as HCAI.

Infection is defined as community acquired if the onset of symptoms occurred in the community or within 48 hours of admission to a HCF. The time frame is modified for infections that have incubation periods less than (e.g. gastroenteritis caused by Norovirus) or greater than (e.g. viral hepatitis B and C) 48 hours. Community-acquired infections may be of great importance, reporting them to public health authorities may be required. However, for the purposes of identifying HCAIs, community-acquired

infections are excluded from the surveillance data. In addition, it is important to differentiate between community-acquired infection (infection acquired in the community in patients who have no direct or indirect contact with any healthcare facility) and community-onset infection where the patient was recently discharged from hospital but the infection manifested in the community. These infections should be recognized as HCAIs. Surgical-site infections (SSIs) are considered as HCAIs if the infection occurs within 30 days after the operative procedure or within 90 days if a device or foreign material is implanted. [11,12]

Objectives

The ultimate aim of the surveillance is to prevent and/or reduce HCAIs. The process of surveillance must incorporate four key stages: collection, validation, analysis, and interpretation of data. The fundamental component of the surveillance is to ensure that the information obtained is conveyed in a timely manner to those who influence practice, implement change, and provide financial resources and managerial support to decrease HCAIs. Collecting and recording surveillance data is a futile exercise if information is not communicated and implemented in a timely manner.

The main objectives of the surveillance are summarized as follows:

- Establish endemic/baseline HCAIs rate as part of a benchmarking exercise.
- Compare HCAI rates within/between healthcare facilities. This can be part of the mandatory requirement of the country.
- Reduce infection rates by convincing the clinical team to change and adopt evidence-based IPC practices.
- Implement cost-effective interventions based on local priorities, resources, and institutional objectives.
- Identify, monitor and control outbreaks.
- Evaluate the success and sustainability of IPC interventions.

Methods of surveillance

Incidence surveillance is certainly ideal, but is time-consuming and expensive. It provides an accurate method of establishing whether a change, or trend, in the number of HCAIs has occurred. Prevalence surveillance can be done once or twice a year, which gives a snapshot of the size or magnitude of the problem. Targeted surveillance aimed at high-risk areas (i.e., intensive care, neonatal, burns, renal dialysis and transplant units), or device-associated infections (e.g. bloodstream infections associated with the IV and urinary catheters, surgical site infection (SSI) and surveillance of multidrug-

resistant organism (MDROs) is the most cost-effective and manageable option, which should be used in HCFs as a matter of priority. On a day-to-day basis, laboratory-based ward liaison surveillance (LBWLS) is the surveillance method most commonly used by the IPC team. This is conducted through daily visits by IPC practitioners to the wards/ units to collect information on active microorganisms and issue alerts on conditions based on local epidemiology as needed.

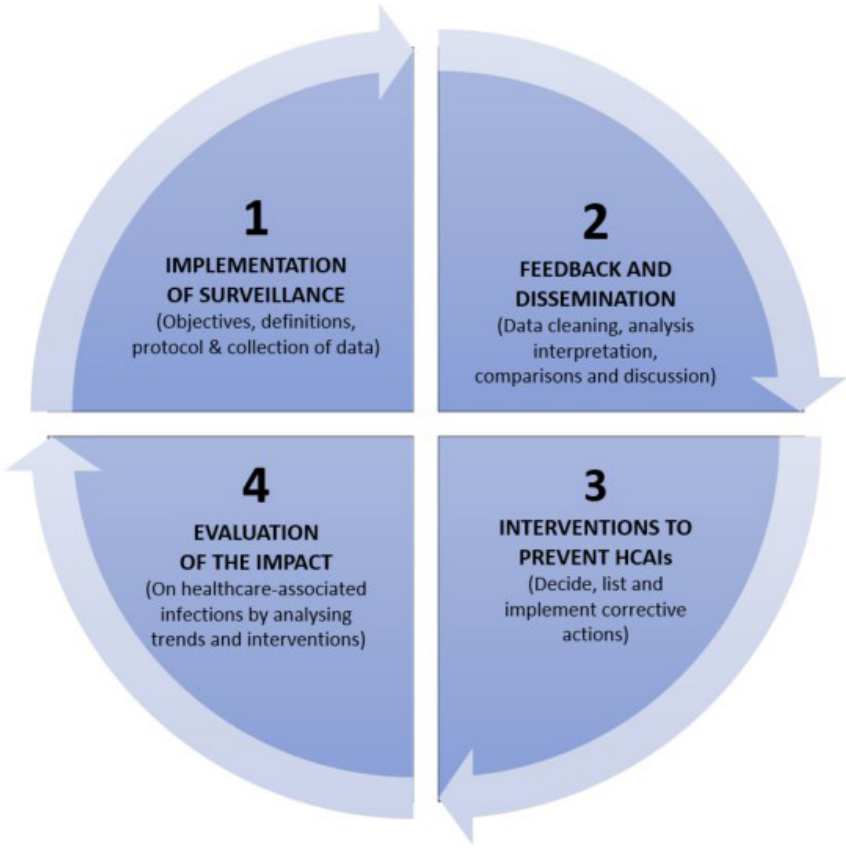


Fig 1.1 Surveillance cycle.

Types of surveillance

There are two types of surveillance: 1) outcome and 2) process (Fig.1.2).

1. Outcome surveillance: Monitoring of specific HCAIs (Surgical site infections, device associated infections (e.g. infection associated with the IV and urinary catheters), diarrhoeal diseases, etc.)
2. Process surveillance: Monitoring of patient care practices, including IPC practices as part of the HCAI Care bundle.

The aim of outcome surveillance is to count the number of HCAIs. Outcome surveillance apprises about the trend or the magnitude of the problem, but does not provide information regarding factors that may contribute to the development of HCAIs. Process surveillance represents a series of undertaken clinical steps that lead to an outcome, such as reduction in the rate of HCAIs. If all steps in the process occur correctly, then the desired outcome will prevent adverse incidents and infections. Therefore, the monitoring of compliance with the best evidence-based clinical practice is the key to its success.

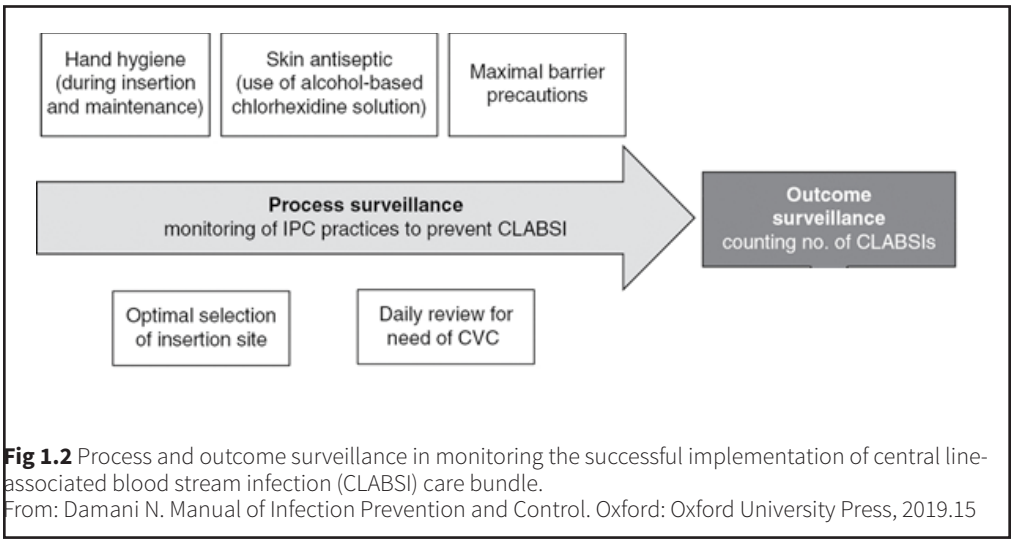


Fig 1.2 Process and outcome surveillance in monitoring the successful implementation of central line-associated blood stream infection (CLABSI) care bundle.
From: Damani N. Manual of Infection Prevention and Control. Oxford: Oxford University Press, 2019.15

Calculating the HCAI rates

Accurate infection rates can only be calculated by employing both the numerator (specific HCAIs rate) and denominator (all patients at risk for the specific HCAI) data and should reflect the 'exposure risk', i.e. the number of indwelling device-days, surgical procedures, and number of patient-days in the unit/hospital. For surveillance purposes, the analysis of numerator data alone is meaningless unless process control charts are used. The HCAI rates can be calculated as follows:

$$\text{Surgical site infections} = \frac{\text{Number of Surgical site infections}}{\text{Number of Surgical procedures}} \times 100$$

$$\text{Device-associated infections} = \frac{\text{Number of device} - \text{associated infections)}}{\text{Number of device days}} \times 1000$$

$$\text{Multidrug-resistant organisms (MDROs)} = \frac{\text{Number of infections with e.}g.\ \text{MRSA}}{\text{Number of patient days}} \times 1000$$

Examples of the Surveillance Activities for Healthcare Facilities with Limited Resources

- Develop a plan to assess whether staff have access to soap and water and towels to dry their hands or alcohol-based hand-rub.
- Monitor hand hygiene compliance and use audit data to improve compliance.
- Ensure that patient care practices are performed according to the best available evidence i.e. use Standard Precautions for all patients and HCAI Care bundles where appropriate.
- Ensure adherence to recommended IPC practices, such as decontamination of all items/equipment that come in contact with patients. Refer to Section 5 for details.
- Monitor compliance with recommended practices for certain high-risk procedures, such as inserting and caring for peripheral and central venous catheters to prevent catheter-associated bloodstream infections.
- Monitor employees' exposure to infections and needle-stick injuries and use the data to develop plans to reduce exposures.

Design and Develop a Surveillance Approach

Choose whether to monitor an outcome or a process measure. Once the specific type of surveillance activities needed by the facility has been prioritized, a decision should be made about whether to conduct surveillance on the type of infection (outcome), or on a process designed to prevent that infection, or both.

- Select the appropriate indicators.
    - It is best to use indicators that have been validated or are commonly used because they will allow results to be compared with those from similar facilities. Examples of the indicators used for IPC include:
        - HCWs' compliance with hand hygiene guidelines (the proportion of compliant hand hygiene opportunities).
        - The surgical site infection rates, e.g. infection associated with caesarean sections and calculate rate with the above formula using the number of surgical procedures.
        - CAUTI rates should be calculated with the above formula using the number of device days.

SECTION 4

Practical aspects of Infection Prevention & Control

Introduction

This section outlines the key principles and practical aspects of IPC, which are most effective. This is done by reducing hazards either by eliminating them or substituting with safer devices, items, equipment, procedures and/or practices. This change may be inexpensive and simple to implement. Fig 4.1 outlines the control methods. The implementation of this system is very effective in substantially reducing cross infection and other hazards in healthcare facilities.

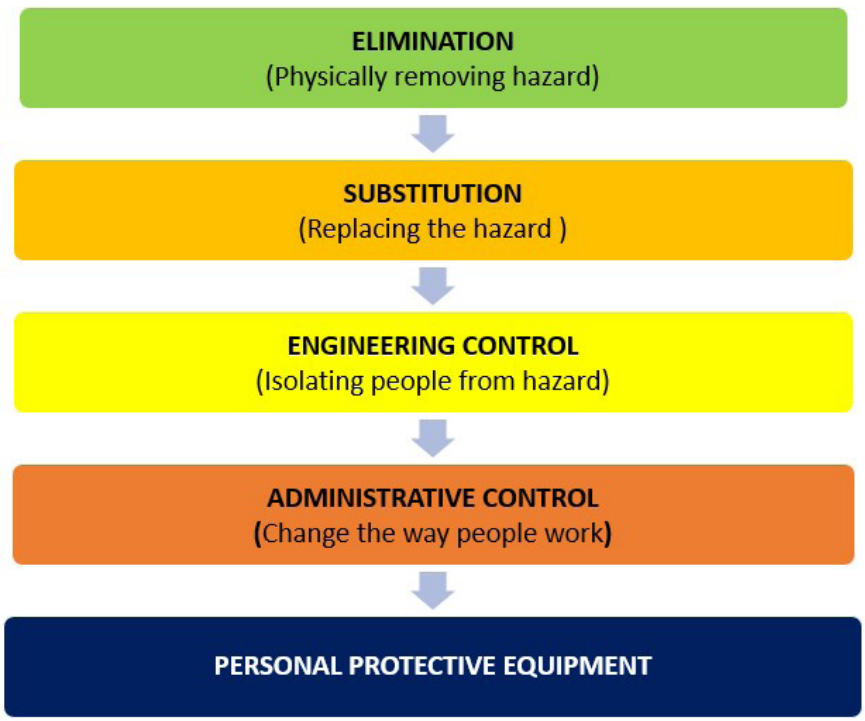


Fig 4.1 Outline of Infection Prevention and Control methods.
Source: CDC & NIOSH
https://www.cdc.gov/niosh/topics/hierarchy/default.html

Table 4.1 Summary of the hierarchy of IPC prevention and control measures.

Hierarchy	Aim	Example
Elimination	Physically removing the hazard	• Do not put sharp boxes on the floor. • If adequate facilities are unavailable, the service can be outsourced to a reliable and preferably accredited contractor e.g. Sterile Supply department, laundry.
Substitution	Replacing the hazard	• If possible, utilize single-use disposable safety engineered 'SMART' syringes i.e. Re-Use Prevention (RUP) and Sharp Injury Protection mechanisms (SIP). • Replace chemical disinfectants which are more harmful to human health with relatively safer disinfectants ensuring that ventilation control is applied for all chemical disinfectants.
Engineering Control	Isolate people from hazards	• Early identification of infectious cases by effective implementation of the triage system in healthcare facilities (esp. in A&E, OPD and GP surgery) to identify and isolate patients as soon as possible to prevent/ minimize exposures to other patients. • Isolate patients in a dedicated room, preferably with en suite toilet. • Isolate patients in a negative pressure room for patients with DR-TB and other airborne communicable diseases spread by airborne routes. • Provide dedicated staff and equipment within the isolation room and cohort area. • Provide well ventilated area in the endoscopy decontamination unit.
Administrative Control	Changing the way people work	• Develop and implement IPC policies and procedures. • Allow staff time to attend the IPC training session, which should include a practical aspect where appropriate. • Place signs to deter unauthorized persons from entering isolation areas. • Limit staff access to patients with suspected or known infectious diseases. Identify staff to look after patients who are immune to disease via previous exposure (e.g. chicken pox) or who are immunized against vaccine preventable diseases. • Limit and control visitors especially with infectious diseases to visit HCF.
Personal Protective Equipment	Protect the HCW with Personal PPE	• After appropriate risk assessment, properly use gloves, gowns, masks, and eye protection as appropriate based on risk assessment. • Remove PPE safety to protect the HCW.

Types of IPC precautions

Standard Precautions

Standard precautions were developed in 1996 to combine the main elements of the universe and isolation precautions into a single set of precautions. Therefore, the use of the term 'Universal precautions' should be avoided. Standard precautions are the basic level of IPC precautions which are to be used routinely as a minimum, in the care of all patients at all times[53]. The core elements of Standard precautions are outlined as follows:

STANDARD PRECAUTIONS

1. Hand Hygiene.
2. Patient placement.
3. Use of appropriate personal protective equipment.
4. Reprocessing of reusable medical equipment and instruments.
5. Environmental cleaning.
6. Safe injection practices – including safe use of sharps and management of sharp injuries.
7. Aseptic technique.
8. Respiratory hygiene and cough etiquette.
9. Waste management – including safe disposal of sharps.
10. Appropriate handling of linen.

The rationale of standard precautions

The application of standard must be done to all patients at all times for the following reasons:

- Patients may be incubating the disease and may not show signs or symptoms of infection at the time of admission.
- Patients may be asymptomatic carriers (hepatitis B & C, Salmonella Typhi, etc.) or colonized with MDROs which are unknown. As a result, Standard precautions apply to all blood, bodily fluids, secretions, excretions (except sweat), non-intact skin and mucous membranes.
- The infectious status of the patients is not confirmed by laboratory diagnosis due to: **(i)** lack or limited availability of the microbiology laboratory facility, **(ii)** infection is not suspected during the initial assessment of the patient

because of the absence of typical signs and symptoms, **(iii)** specimen is not collected due to poor history taking, and **(iv)** patient is unable to give proper history due to the status of consciousness and/or language barrier.

Transmission-based precautions

In addition to standard precautions, the application of additional precautions (also called transmission-based precautions) is necessary and if the patient's status of infection is a known infection. Based on the type of communicable infection and/or colonization of MDROs, various types of additional precautions can be applied. It is important to note that some infections may have more than one mode of transmission (see Table 4.2). The most common modes of transmission of infections in a healthcare facility are by contact, droplet and airborne (Refer to Section 1). In addition to the above three most common routes, infection in a healthcare facility (HCF) can also result from inoculation, especially in healthcare workers due to injuries acquired from contaminated needles during use and disposal (esp. during recapping of needles) and from healthcare waste due to improper disposal of sharps. Remember standard precautions are used in addition to these transmission-based precautions.

Application of Standard Precautions

Transportation of laboratory specimens

Collection, labelling and transportation of laboratory specimens should follow the written policies that reflect local and national guidelines. The specimens should be taken before starting antibiotic therapy. The laboratory specimens must be correctly labelled and packaged, i.e. the request form must be kept separate from the specimen in a self-sealing plastic bag. The specimens must be handled carefully, ensuring that the outside of the container is not contaminated. Specimens from a patient with known or suspected transmissible infection should have a 'Danger of Infection— Take special care' label, attached both on the request form and on the specimen (Fig. 4.2). Specimens from patients with highly dangerous and fatal infectious diseases must not be sent to the laboratory without prior arrangement with the laboratory staff. When a pneumatic tube system exists for transport of specimen, this should only be used after appropriate consideration of the risks. The porters and others who transport specimen must be aware of the procedures for transportation and follow appropriate procedures in the event of spillage or breakage of specimen containers. Up- to- date standard operating procedures should be available for all these processes. Commercial containers are available for safe transportation of specimen to other laboratories. The transportation of infectious material must follow international regulation. [71]

Fig 4.3 Example of 'Danger of Infection' label to be used when sending specimens to the laboratory from patients with suspected or confirmed transmissible infections.

Table 4.2 Summary of infection prevention and control precautions based on the modes of transmission of infection.

ACTIVITY	STANDARD PRECAUTIONS	CONTACT TRANSMISSION
Hand hygiene	Yes	Yes
Triage and patient placement	Single room not required	Single room (Preferable with en suite toilet and shower facility)
Gloves	When likely to touch blood and body fluids*	Wear gloves on entering the room whenever contact is likely with the patient and/or blood, body fluids, contaminated items and equipment#
Apron/gown	Only if soiling is likely, i.e. during procedures likely to generate contamination from blood and body fluids	Wear it on entering the room if clothing will have substantial contact with the patient, environmental surfaces, items and/or equipment in the patient's room#
Face protection	Risk assess and wear surgical mask during procedures likely to generate aerosols*	Risk assess and wear surgical mask during procedures likely to generate aerosols *
Eye protection/ face-shields¥	Wear during procedures and activities which are likely to generate splashes or aerosols.	As per Standard precautions
Equipment decontamination	Yes	Yes
Environmental cleaning	Yes	Yes
Safe injection practices	Yes	Yes
Aseptic technique	Yes	Yes
Respiratory hygiene and cough etiquette	Yes	Yes
Waste management and safe disposal of sharps	Yes	Yes
Safe handling of linen	Yes	Yes

DROPLET TRANSMISSION	AIRBORNE TRANSMISSION
Yes	Yes
Single room Minimize time outside the room and when the patient may wear surgical mask. Provide at least 1 metre (>3 feet or ~ 1 meter) of separation between patients in the cohort, if possible	Single room Ideally with negative pressure ventilation. Minimize time outside the isolation room and the patient may wear surgical mask. Exclude non-essential susceptible people.
As per Standard precautions	As per Standard precautions
As per Standard precautions	As per Standard precautions
Risk assess and wear surgical mask during procedures likely to generate aerosols *	Use of surgical face mask does not provide protection against infection transmitted by the airborne route. Wear high efficiency filtration mask (FFP2 or N95) on entering the room
As per Standard precautions	As per Standard precautions
Yes	Yes
Yes	Yes
Yes	Yes
Yes	Yes
Yes	Yes
Yes	Yes
Yes	Yes

*If gloves are used, then after performing tasks, immediately remove gloves and perform hand hygiene.
#Remove gloves and gown and wash hands before leaving the patient's room.
¥Only in situations that may provoke contamination of the mucous membrane of the mouth and nose. The common procedures that are likely to create significant aerosols are suctioning, dentistry, intubation and chest physiotherapy.

Reproduce with modification from Damani N. Manual of Infection Prevention and Control. Oxford: Oxford University Press, 2019.

Hand hygiene

Hand hygiene (HH) is a major component of the Standard precautions and among the most effective methods of preventing transmission of pathogens associated with healthcare facility. The Price classified bacteria recovered from the hands are in two categories: 1) Resident flora consists of microorganisms living under superficial cells of the stratum corneum, and can also be found on skin surfaces. 2) Transient flora is not part of the normal flora and colonizes the superficial layers of the skin. Remember that it is transient flora which is acquired by healthcare workers (HCWs) during direct contact with patients, staff, and visitors or by indirect contact with contaminated items, equipment, and environmental surfaces that are responsible for the spread of all microorganisms.

The WHO has created tools for the hand hygiene self-assessment framework [57] for healthcare facility and this should be used to assess the gaps. For effective hand hygiene, it is essential that healthcare workers should have short, clean fingernails and not wear artificial fingernails, nail polish or jewellery. Artificial nails should be discouraged as they contribute to increased bacterial counts tears in gloves.

Perform hand hygiene at the right moment as per WHO Five Moments for Hand Hygiene which are summarized in Fig. 4.3, & 4.4 and Table 4.1. In addition to the above, hand hygiene should also be performed at starting/leaving work, eating/handling food/drinks, after visiting toilets, handling waste and laundry, before putting on gloves, using computer keyboard, tablet or mobile device in a clinical area.

Hand Washing with Soap and Water

Perform hand washing using soap and water if hands are visibly soiled, exposed to spore-forming organisms (e.g. C difficile) or parasites or after using the toilet. Ensure availability of hand washing facilities with clean running water and products e.g. soap and single-use clean towels. Air/jet air dryers are slow, noisy, require an electric supply and pose potential risks for airborne dispersal of microorganisms in the surrounding environment; therefore, their use in healthcare facilities is not recommended.

Method: Wet hands with water (quality drinking water is required[83]) and apply soap–rub all surfaces, rinse and dry hands thoroughly with a single use towel – use towel to turn off the faucet. The recommended duration for hand washing is 40– 60 seconds. Remember that soap (bar or liquid) has detergent properties and by mechanical action it removes dirt, organic material, and loosely adherent transit flora. Although water is considered a ‘universal solvent’, water alone is not suitable for cleaning dirty hands as soap is needed with water to remove fats and oils which are often present on soiled hands. To avoid allergic reactions, plain, neutral pH bar soap can be used for

routine hand washing. Added substances (including antimicrobial agents) should be avoided as they have no added benefit and may cause allergies, irritation or dryness of the skin— humectants should be added to the soaps to reduce skin irritation and dryness. [44,55]

Hand Hygiene using Alcohol-Based Hand Rub Products

Alcohol-based hand rub (ABHR) products are more effective and require less time than hand washing and this should be used if the hands are physically clean. Based on WHO formulations, ABHR can be produced locally. [58]

Method: Apply enough alcohol-based hand rub product to cover all areas of the hands; rub hands until dry i.e. 20–30 seconds.

The following points should be taken into consideration to achieve effective hand hygiene:

- Use ***effective compound*** containing alcohol solutions with 60– 80% (60% v/v n-propanol is approximately equivalent to 70% v/v isopropanol and to 80% v/v ethanol) selected for hand hygiene products.
- ***Sufficient amount, i.e.***~ 3 ml or palm full to cover all parts of the hands.
- Use ***correct technique*** to cover all parts of the hands (Fig 4.6 and 4.7) with esp. to clean fingers and thumb.
- The ***recommended duration*** of the entire procedure for using ABHR is 20–30 seconds.
- Performing hand hygiene at the ***right moment***, which can be achieved by the provision of ABHR, at the point of care.
- They should be available at the point of care to improve compliance.
- The use of gloves should never replace the need for hand hygiene. If gloves are used, then they should be promptly removed after use, and hand hygiene should be ***performed immediately after removing gloves.***

Table 4.2 Five moments for hand hygiene and examples of clinical situations.

The five moments		Examples
1.	Before touching a patient	**WHEN** • Shaking hands, helping a patient to move around, get washed. • Applying the oxygen mask, giving physiotherapy, taking pulse, blood pressure, chest auscultation, abdominal palpation, recording ECG, etc. **WHY** • To protect the patient against harmful germs carried on your hands.
2.	Before clean/ aseptic procedure	**WHEN** • During skin lesion care, wound dressing, subcutaneous injection, catheter insertion, opening a vascular access system or a draining system, secretion aspiration, preparation of food, giving medication, instilling eye drops, pharmaceutical products, sterile material, etc. • Before handling an invasive device for patient care, regardless of whether or not gloves are used. • Before moving from a contaminated body site to another body site while taking care of the same patient. **WHY** • To protect the patient against harmful germs, including the patient's own germs.
3.	After body fluid exposure risk	**WHEN** • During skin lesion care, wound dressing, subcutaneous injection, drawing and manipulating any fluid sample, opening a draining system, endotracheal tube insertion, removal and secretion aspiration, clearing up urines, faeces, vomit, handling waste (bandages, napkins, incontinence pads), cleaning of contaminated and visibly soiled material or areas (soiled bed linen, lavatories, urinal, bedpan, medical instruments), etc. • Before moving from a contaminated body site to another body site while taking care of the same patient. • After contact with body fluids or excretions, mucous membrane, non- intact skin, or wound dressing. • After removing sterile or non- sterile gloves. **WHY** • To protect yourself and the healthcare environment from harmful patient's germs.

4.	After touching a patient	**WHEN** • Helping a patient to move around, get washed. • Applying the oxygen mask, giving physiotherapy, taking pulse, blood pressure, chest auscultation, abdominal palpation, recording ECG, etc. • After removing sterile or non- sterile gloves. **WHY** • To protect yourself and the health-care environment from harmful patient's germs.
5.	After touching patient's surroundings	**WHEN** • After contact with inanimate surfaces and objects (including medical equipment) in the immediate vicinity of the patient, perfusion speed adjustment, monitoring, alarm, holding a bed rail, leaning against a bed, clearing the bedside table, changing bed linen, with the patient out of the bed, etc. • After removing sterile or non- sterile gloves. **WHY** • To protect yourself and the health-care environment from harmful patient's germs.

Source: WHO Guidelines on hand hygiene in healthcare. Geneva: World Health Organization, 2009.

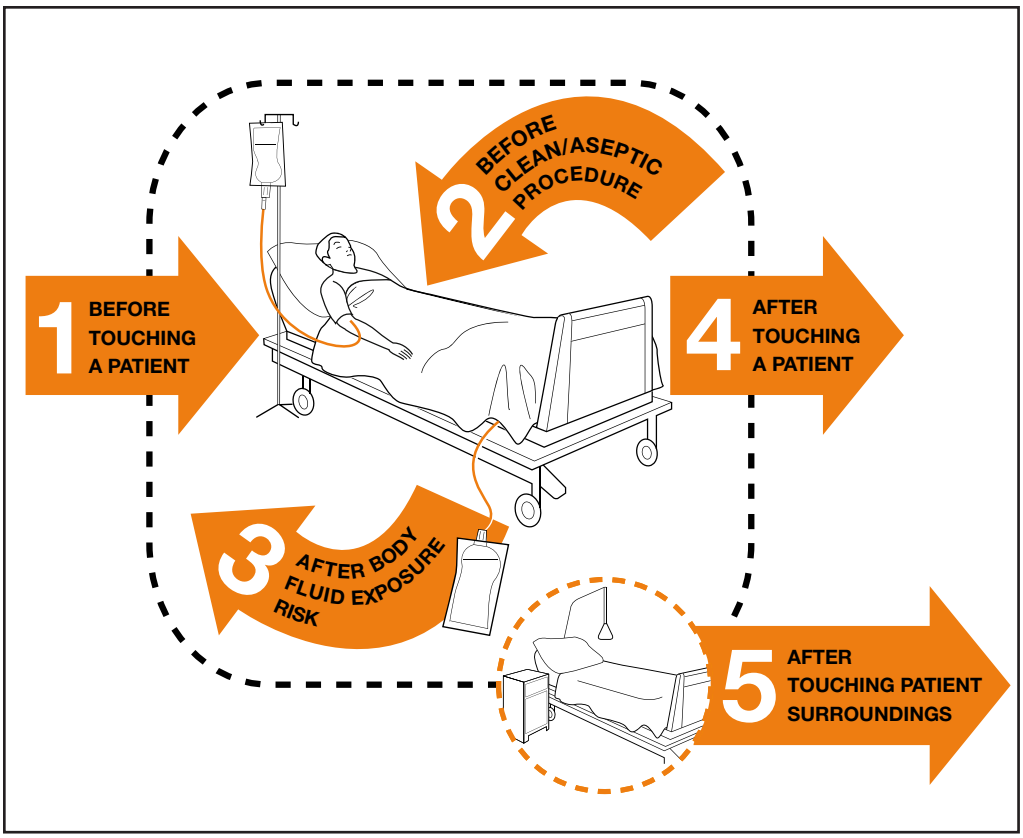


Fig. 4.4 Five moments of hand hygiene. Source: Guidelines on hand hygiene in healthcare. Geneva: World Health Organization, 2009.

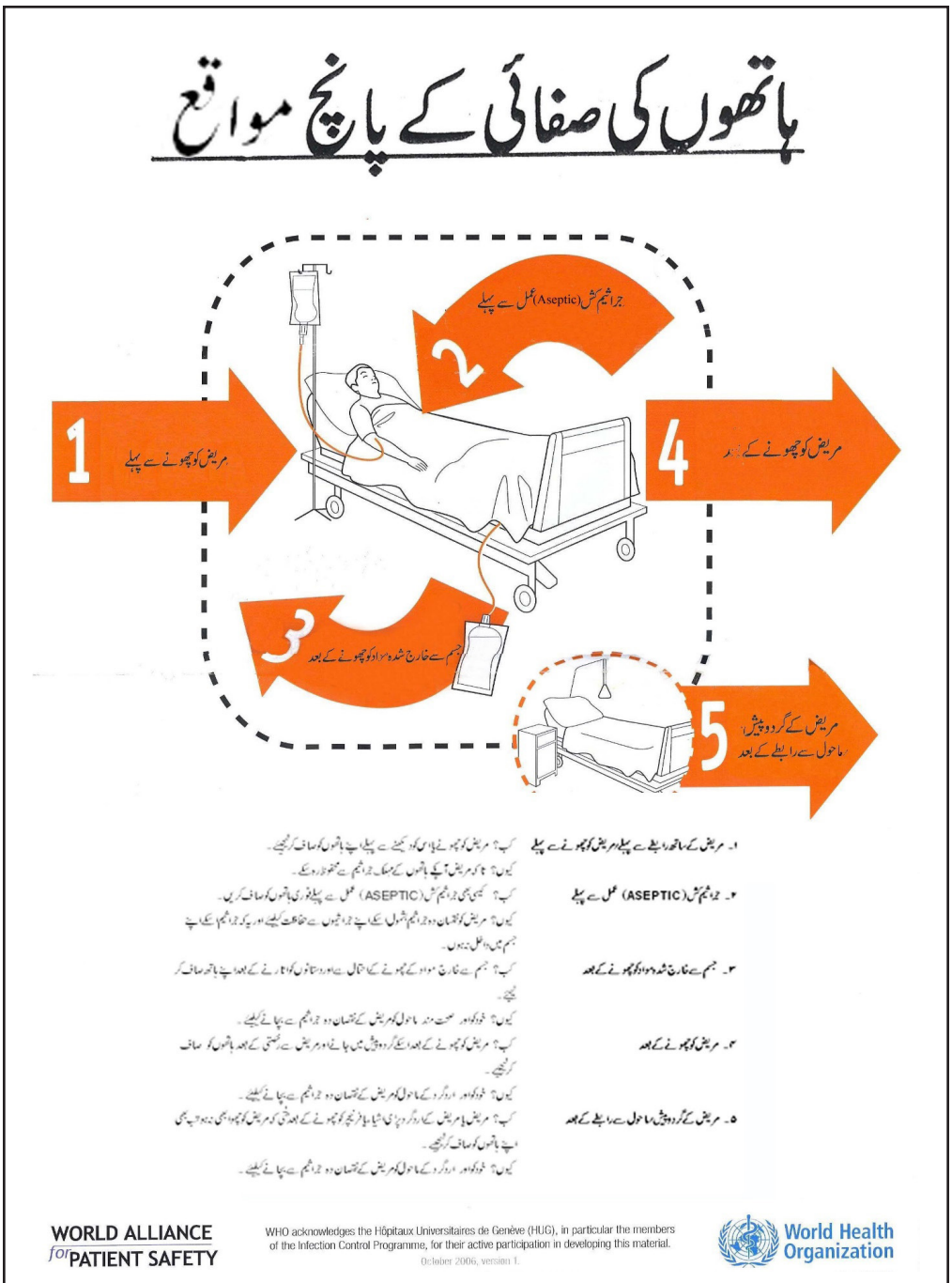


Fig. 4.5 Five moments of hand hygiene in Urdu.

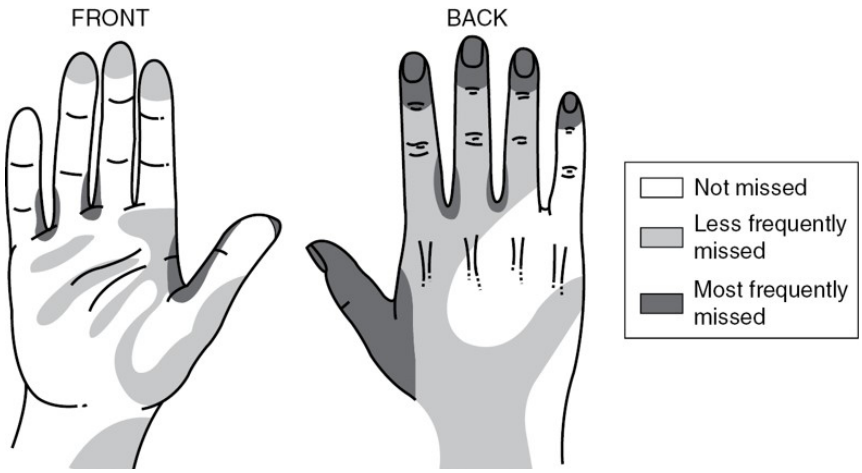


Fig. 4.6 Parts of the hands most frequently missed during hand decontamination.
From: Damani N. Manual of Infection Prevention and Control. Oxford: Oxford University Press, 2019.

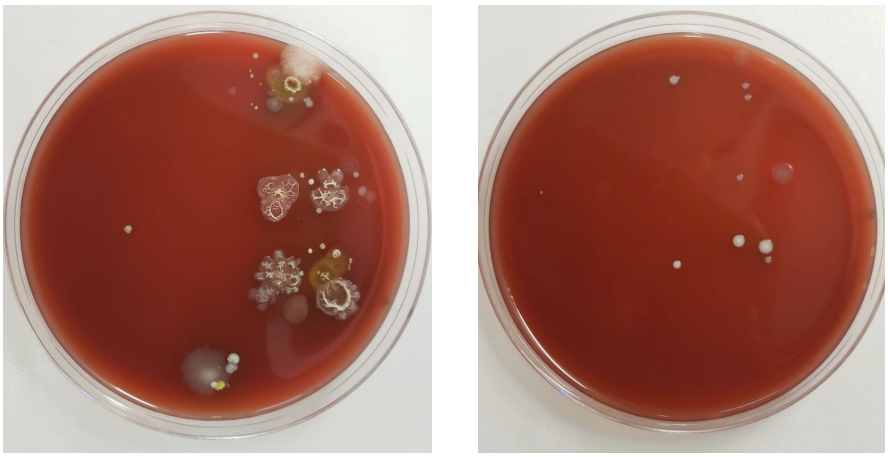


Fig 4.7 Importance of hand hygiene. Number of microbes before and after hand hygiene.


Fig 4.8 Any Jewellery (including ring, watches) should not be worn as it will prevent effective hand hygiene. The second picture shows the number of bacteria grown on the microbiology culture plate under the ring.

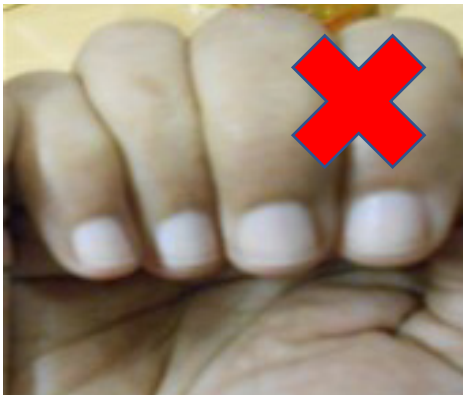



Fig 4.9 Nails must be cut short and kept clean as long nails harbour bacteria.


Fig 4.10 Use of nail polishes and artificial nails should be avoided as they harbour bacteria and hinder effective Hand hygiene.

Fig 4.11 Key points on glove use and hand hygiene. (1) Use glove (2) Discard gloves immediately after use as a clinical waste, and (3) perform hand hygiene on physically clean hands after glove removal.

Fig 4.12 To prevent contamination of sleeve and perform hand hygiene, roll up sleeves or dress bare below elbow.

Fig 4.13 To prevent spread of microorganisms hand wash sink should not be used to dispose of clinical waste irrespective of quantity and do not clean patient care or other items in hand wash basin dedicated for hand washing. Never use a multi - use towel to dry hand as they are responsible for the spread of bacteria and cause outbreaks.

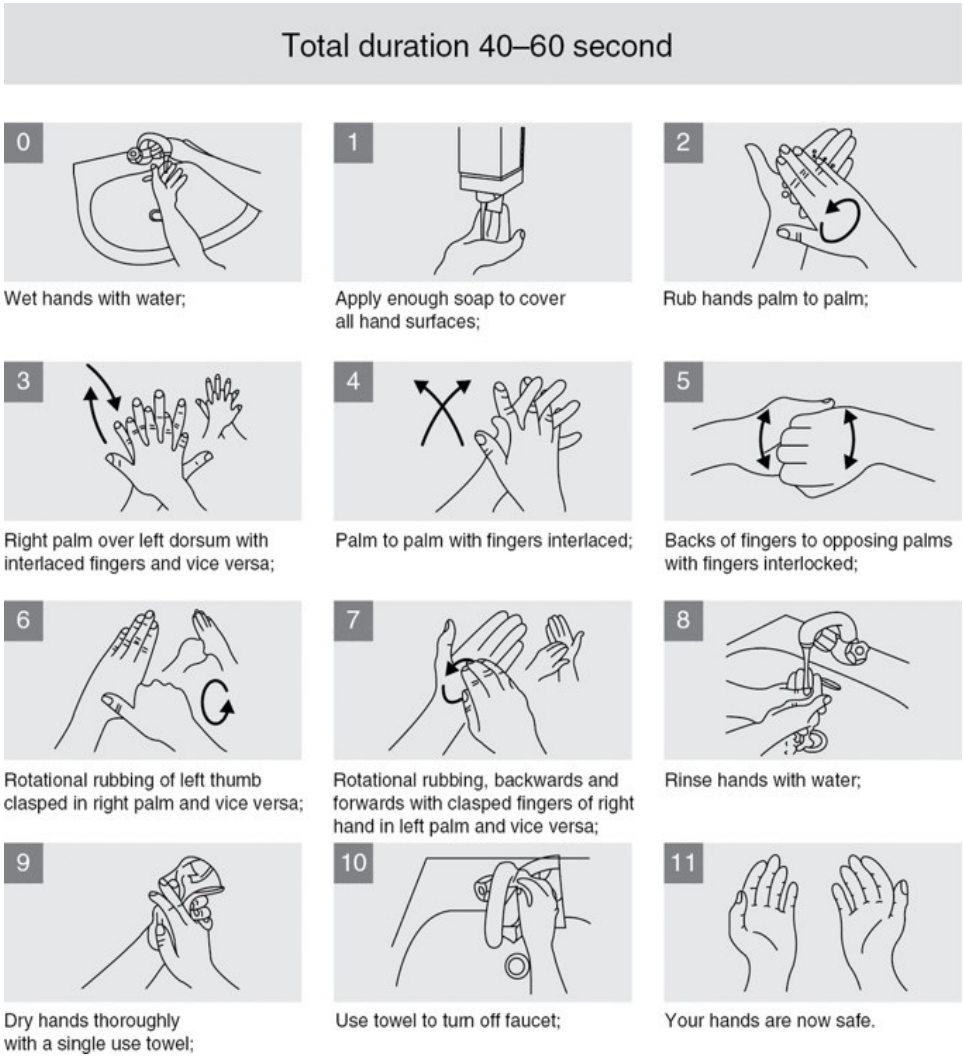


Fig 4.14 Steps on how to properly perform hand hygiene using soap and water.
Source: *Guidelines on hand hygiene in healthcare*. Geneva: World Health Organization, 2009.

Fig.4.15 Steps on how to properly perform hand washing using soap and water, in Urdu.

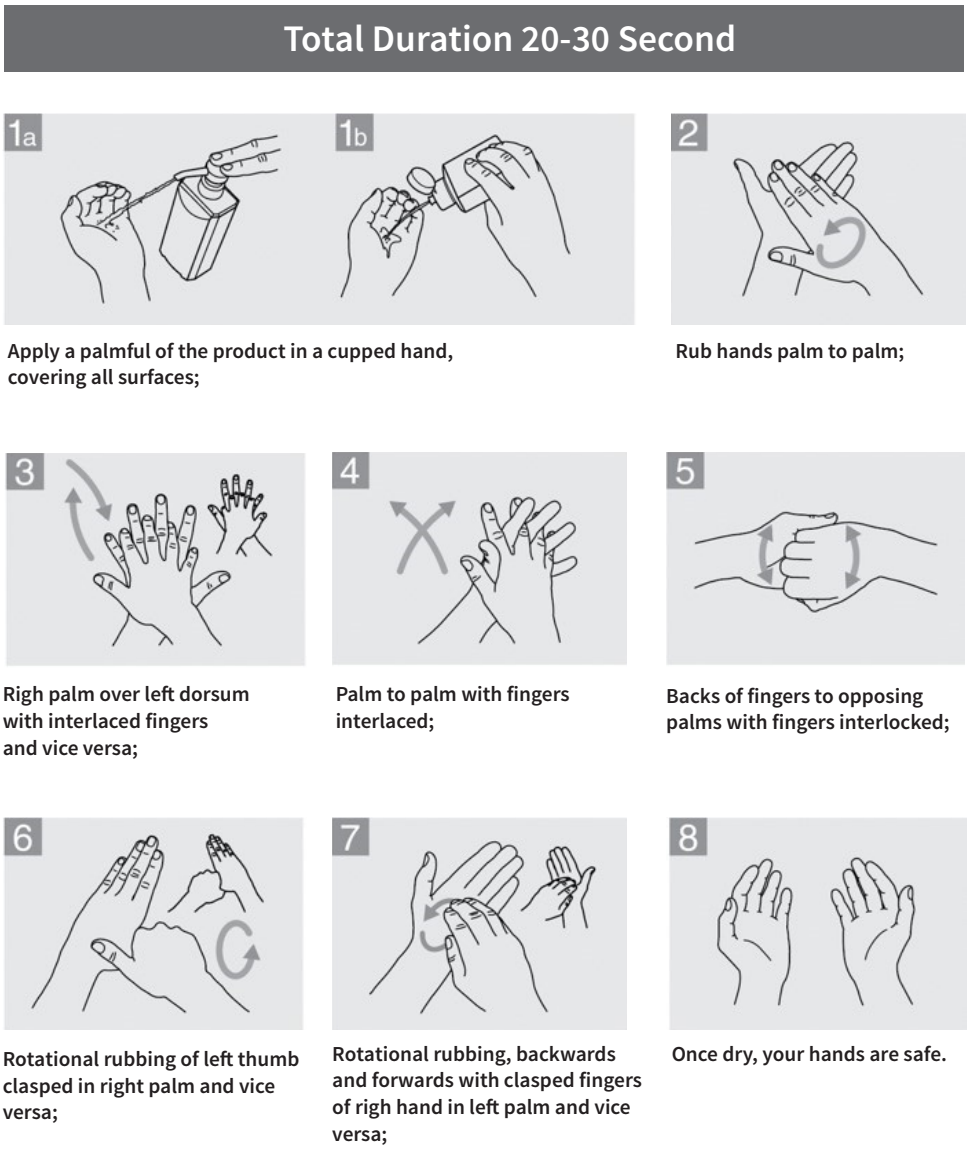


Fig. 4.16 Steps on how to properly perform hand hygiene Alcohol Based Hand Rub.
Source: Guidelines on hand hygiene in healthcare. Geneva: World Health Organization, 2009.

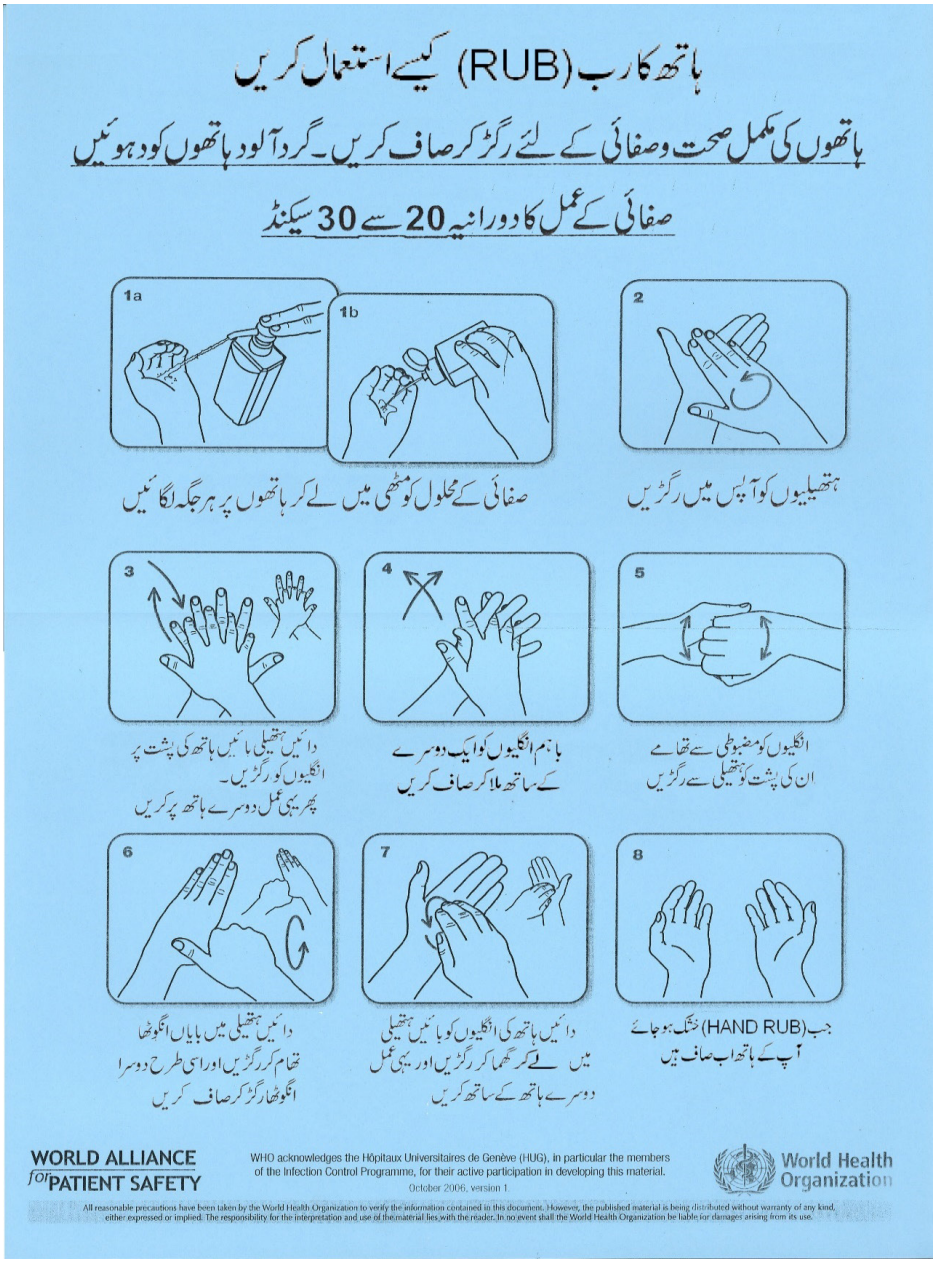


Fig. 4.17 Steps on how to properly perform hand hygiene using alcohol-based hand rub, in Urdu.

Patient placement

The main aim of triage is to assess risk and segregate suspected and/or confirmed infected patients with transmissible infections and patients with multidrug-resistant organisms in a single room, preferably with en suite toilet facility. Implementation of the Triage system in the Accident & Emergency (A&E) and out-patient department is essential in all healthcare facilities to prevent cross-infection due to overcrowding.

It is essential that all healthcare workers in the A&E department must be trained and educated in IPC precautions and understand the mode of transmission of various microorganisms, so that appropriate IPC measures are implemented promptly. This includes identification of highly dangerous infections (e.g. Crimean-Congo Viral Haemorrhagic Fever) and other infections like tuberculosis, HBV and HCV.

Patients should be provided educational materials about hand hygiene and respiratory hygiene/cough etiquette in emergency, receiving and waiting areas and all HCW must apply standard precautions at all times for all patients. Based on the Triage and risk assessment, additional precautions are necessary. Every effort should be made to minimize contact of staff with transmissible infections and effort should be made that only the staffs that are immune should look after such patients, if possible. It is also critical that the A&E department must have adequate isolation facilities to segregate these patients.

Types of Isolation Rooms

Source Isolation Room

Infected patients are nursed in single rooms preferably with en suite toilet and shower facilities and it is essential that an adequate number of single rooms for ***source isolation*** are available for patients with suspected and confirmed transmissible infections or for isolation of patients with MDROs. Some patients with infectious diseases, which are spread by an airborne route, e.g. patients with open tuberculosis (especially multidrug- resistant- TB), measles, and chickenpox/varicella-zoster require a ***negative pressure ventilation room***, en suite toilet facilities, and anteroom. A ***minimum*** of 6– 12 exchanges of air change (ACH) per hour (i.e. an air volume equivalent to 6–12 times the volume of the rooms is extracted each hour from the room) is recommended for the protection of staff and visitors. However, in new buildings 12 air changes/hour are recommended. In addition, there should be adequate temperature and humidity regulation, such that windows need not be opened, and doors can be kept closed when the rooms are in use. The exhaust air from the isolation rooms should be vented to the exterior and extracted air should terminate in a safe location ***away*** from the fresh air supply inlet, ideally 3 metres above the highest part of the building. Where this

is not possible or there are other buildings in close proximity, pre-and high efficiency particulate air (HEPA) filters should be used. The rooms should have an anteroom which should be a minimum of 7 m^2 for donning and removal of PPE, hand washing facilities, and clinical waste.

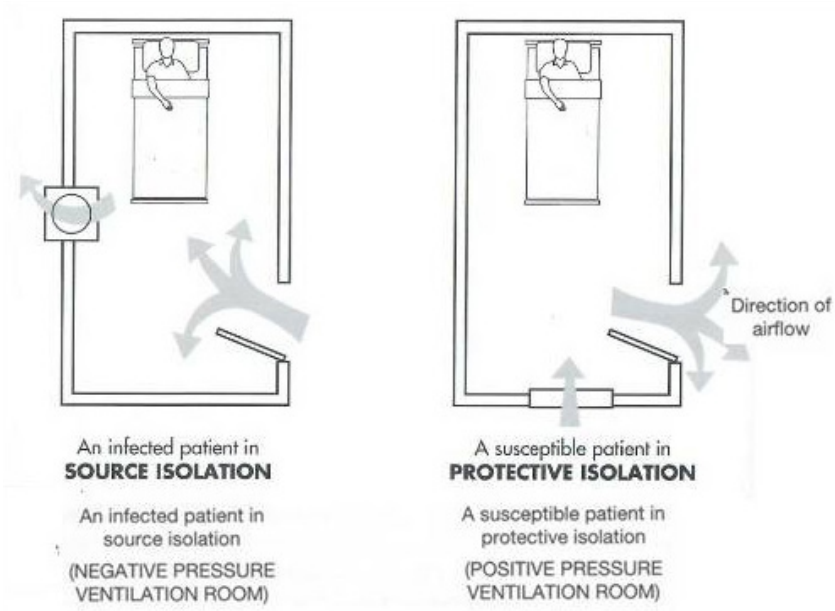


Fig 4.2 Rooms showing the isolation of patients in negative (source isolation) and positive (protective isolation) pressure ventilation rooms.

Reproduced with modification from Damani N. Manual of Infection Control Procedure. London: Greenwich Medical media, 1997.

If a negative pressure room is not available, the use of natural ventilation, including natural, mixed-mode, mechanical ventilation, and recirculated air through high-efficiency particulate air [HEPA] filters) is recommended to reduce ***M. tuberculosis*** transmission to healthcare workers, persons in healthcare facilities or other persons in settings with a high risk of transmission. For details please refer to the WHO document. [56,84]

The use of portable room-air cleaner appliances is not advised as a system of reducing M. tuberculosis transmission to health workers, persons attending healthcare facilities or other personsin settings with a high risk of transmission.[84]

Protective Isolation

The aim of protective isolation is the ***reverse*** of source isolation precaution, i.e. to prevent transfer of infection from inanimate environment and other personnel to immunosuppressed patients. It is important to note that immunosuppressed patients are also at increased risk of ***endogenous infections*** where the source of infection is their ***own*** microflora, e.g. immunosuppressed patients may get an infection from microorganisms residing in his/ her gastrointestinal tract which is damaged by chemotherapy.

Most immunosuppressed patients can be nursed in single rooms with en suite toilet facilities. ***Only*** profoundly immunosuppressed patients, i.e. < 1000 polymorphonuclear cells/ mL for 2 weeks or < 100 polymorphonuclear cells/ mL for 1 week need to be nursed in protective isolation in a ***positive pressure ventilation*** room (positive in relation to the corridor) and clean air is supplied using a HEPA filter— this is to protect them against fungal spores that originate in outdoor air and not normally within the HCF. Patients who are at ***greatest risk*** are individuals who are severely neutropenic, patients undergoing any transplantation, and those who have received intensive chemotherapy. It is essential that the rooms do not have openable windows. This is because infection from airborne contamination of fungal spores (especially ***Aspergillus*** spp.) is a problem, especially in bone marrow transplant and profoundly neutropenic patients. In addition to standard precautions, the following additional precautions should be implemented when dealing with immunosuppressed patients.

In an outpatient waiting room, additional precautions for the control of airborne transmission of disease may be required. **These patients should be seen ahead of others in the waiting room to minimize the time they are exposed to other patients in the waiting area.** Where invasive medical or dental procedures are involved, it is advisable to place immunosuppressed patients at the ***start*** of the operating schedule, if possible.

Personal Protective Equipment

Personal protective equipment (PPE) acts as a physical barrier that prevents healthcare staff, including nurses, from becoming contaminated with blood and other bodily fluids. These include bodily secretions and excretions that may be transmitted from direct contact with a patient or the patient's environment, including infectious airborne particles.

It is important to remember that an understanding of the principles of transmission of microorganisms, alongside effective risk assessment and appropriate selection of PPE, can help in avoiding unnecessary PPE use and reduce wastage. Before using any PPE,

one should *routinely* assess the risk of exposure to blood and body fluid substances or contaminated surfaces *before* any healthcare activity. It is essential that Personal protective equipment should be worn and taken off safely as outlined in Fig 4.18 and 4.19.

HOW TO PUT ON PERSONAL PROTECTIVE EQUIPMENT

1

- **Identify hazard manage risk.**
- **Gather the necessary PPE.**
- **Plan where to put on and take off PPE.**
- **Do you have a buddy? Mirror?**
- **Do you know how you will deal with.**

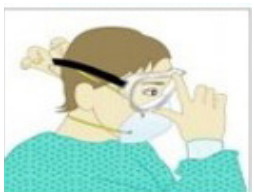
2

Put on gloves (over cuff)

3

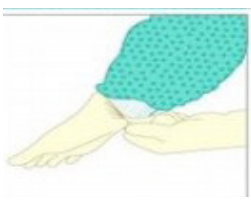
Put on particulate respirator or medical mask; perform user seal check if using a respirator

4



Put on eye protection, e.g. face shield/ goggles (consider anti-fog drops or fog-resistant goggles). Caps are optional: if worn, put on after eye.

5



Put on gloves (over cuff).

Fig 4.18 How to put and remove non-sterile gloves.
Source: Infection prevention and control of epidemic-and pandemic-prone acute respiratory infections. Geneva: World Health Organization, 2014.

HOW TO REMOVE ON PERSONAL PROTECTIVE EQUIPMENT

1

- Avoid contamination of self , other and the environment items first.
- Remove the most healty contaminated items first.
- Remove GLOVES and GOWN by peeling off gown and gloves and roll inside, out
- Dispose of gloves and gown safely as clinical waste.

2

Perform hand hygiene.

3

Remove cap (if worn)
Remove goggles from behind
Put goggles in a separate container for reprocessing.

4

Remove respirator from behind

5

Perform hand hygiene

Fig 4.19 How to remove PPE.

Source: Infection prevention and control of epidemic-and pandemic-prone acute respiratory infections. Geneva: World Health Organization, 2014.

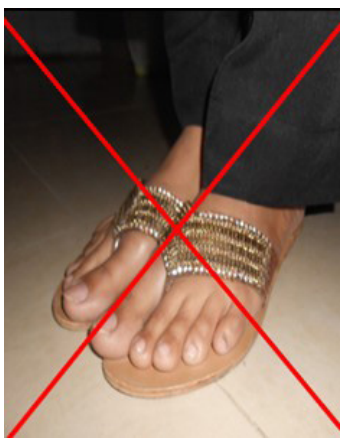
Gloves (Clean Non-Sterile)

When to wear

- Assess risk and wear gloves if potential exposure to blood and bodily fluids is anticipated.
- Wear when touching blood, body fluids, secretions, excretions, mucous membranes, and non-intact skin.

Comments

- Change gloves if torn or heavily contaminated.
- Change ***between*** tasks and procedures on the ***same patient*** after contact with potentially infectious material.
- Ensure gloved hands ***do not*** come into contact with the wearer's face.
- Gloves should always be extended to cover the wrist of an isolation gown, if the HCW is wearing both.
- When removing gloves, the nurse should be aware that the outside of the glove is contaminated; therefore, a non-touch technique should be used to remove gloves and hand hygiene must be performed ***immediately after removal.***
- ***Do not*** touch any surfaces, items, equipment and another patient with contaminated gloves.
- After use, gloves should be placed directly into a clinical waste bin and not left in the clinical environment.



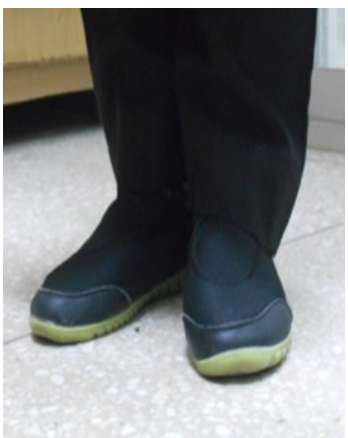


Fig 4.20 For your own protection do not wear slippers or shoe which do not fully cover your forefeet, especially in a ward/unit and areas where there are chances of splashes of blood and body fluids.

Fig 4.21 The use of sticky mat at the entrance door and overshoes is not necessary as putting it on and removing it contaminates hands
©Nizam Damani

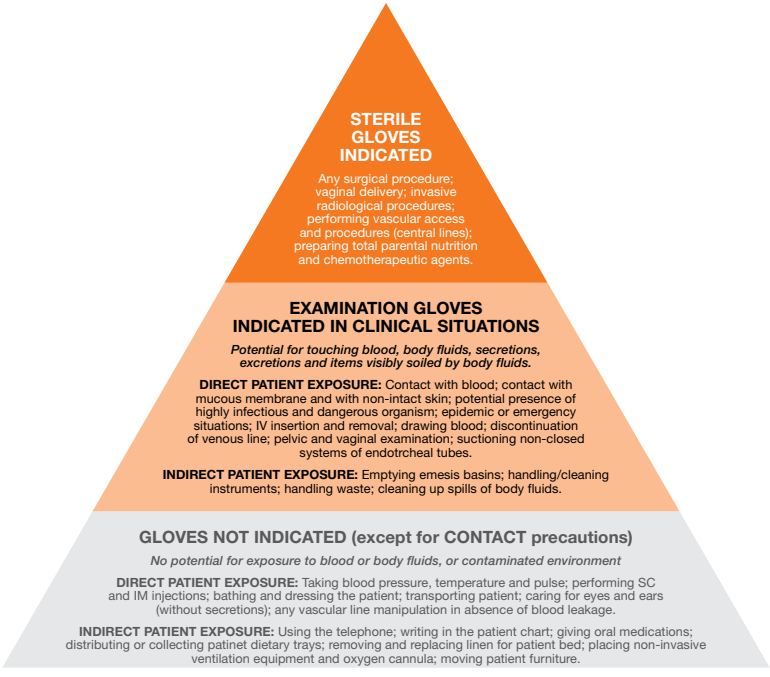
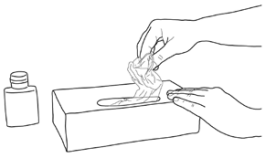


Fig 4.22: Pyramid of indications for type of gloves. Gloves must be worn according to Standard and Contact Precautions. The pyramid details of some clinical examples in which gloves are not indicated, and others in which examination or sterile gloves are indicated. Hand hygiene should be performed when appropriate, regardless of indications for glove use.

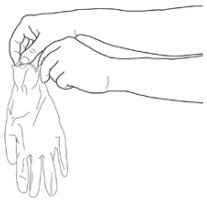
Source: Guidelines on hand hygiene in healthcare. Geneva: World Health Organization, 2009.

When the hand hygiene indication occurs before a contact requiring glove use, perform hand hygiene by rubbing with an alcohol-based handrub or by washing with soap and water.

I. HOW TO DON GLOVES:



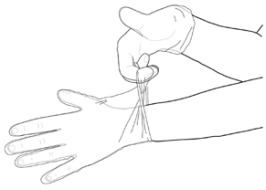
1. Take out a glove from its original box



2. Touch only a restricted surface of the glove corresponding to the wrist (at the top edge of the cuff)

3. Don the first glove

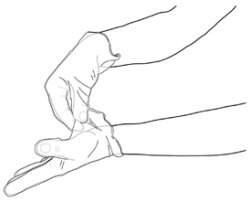
4. Take the second glove with the bare hand and touch only a restricted surface of glove corresponding to the wrist



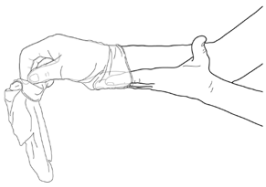
5. To avoid touching the skin of the forearm with the gloved hand, turn the external surface of the glove to be donned on the folded fingers of the gloved hand, thus permitting to glove the second hand

6. Once gloved, hands should not touch anything else that is not defined by indications and conditions for glove use

II. HOW TO REMOVE GLOVES:



1. Pinch one glove at the wrist level to remove it, without touching the skin of the forearm, and peel away from the hand, thus allowing the glove to turn inside out



2. Hold the removed glove in the gloved hand and slide the fingers of the ungloved hand inside between the glove and the wrist. Remove the second glove by rolling it down the hand and fold into the first glove

3. Discard the removed gloves

4. Then, perform hand hygiene by rubbing with an alcohol-based handrub or by washing with soap and water

Fig 4.23 How to don and remove gloves safely.
Source: Guidelines on hand hygiene in healthcare. Geneva: World Health Organization, 2009.

Table 4.3 Types of gloves and suggested uses.

Glove type (materials)	Features and suggested use
Plastic/co-polymer	• Cheap but fit poorly on hands and tear easily. • They are not recommended as isolation precautions for IPC purposes.
Non-sterile latex (Natural rubber latex)	• Strong and good fit, but carry risks of sensitization due to the proteins in latex. • Non-sterile gloves should be used for procedures involving contact with blood and body fluids, non-intact skin or mucous membranes where there is a risk of infection to the HCW.
Sterile latex (natural rubber latex)	• Strong and good fit, but carry risks of sensitization due to latex. • They are used when sterility is required, e.g. for sterile and aseptic procedures to prevent patients from acquiring infection from HCWs. • In addition, they also provide protection against blood and body fluids during surgical, aseptic, and other invasive procedures.
Vinyl (polyvinyl chloride)	• Least expensive but the fit is not as good as latex gloves. • Less risk of sensitization. • More likely to leak relative to Nitrile and latex. • They are used for handling cytotoxic agents.
Nitrile (Nitrile-butadiene rubber)	• More expensive than latex, but less risk of latex sensitization. • The material's molecular structure is very similar to that of latex. • They are not available as a surgical glove and can be used for individuals working with glutaraldehyde. • Nitrile resists perforation better than latex and vinyl.
Neoprene (polychloroprene)	• More expensive than latex and are available as surgical gloves. They can be used for individuals who are sensitive to latex.
Thick latex (Household type gloves)	• They are general-purpose heavy duty or household type gloves. • They are used for cleaning of instruments before disinfection and/or sterilization procedures because they are robust and offer greater protection to HCW. • They should be washed in detergent and stored dry after each use. • They should be replaced if punctured, torn, cracked, or showing signs of deterioration.

From: Damani N. Manual of Infection Prevention and Control. Oxford: Oxford University Press, 2019.

Fluid-Repellent Aprons and Gowns

When to wear

- Assess risk and wear if potential exposure to blood and bodily fluids is anticipated.
- Wear to protect skin and prevent soiling of clothing during activities that are likely to generate splashes or sprays of blood, body fluids, secretions, or excretions.
- Remove contaminated soiled apron/gown as soon as possible and perform hand hygiene immediately after removal.

Comments

- Disposable aprons are recommended when a nurse is undertaking a patient care activity in which there is potential for splashes or sprays of blood or bodily fluids.
- Gowns are only required when there is a likelihood of extensive splashes or sprays of blood or bodily fluids.

Masks With Or Without Face Shield

When to wear

- Assess risk and wear to protect the mouth and nose from inhalation of respiratory droplets or splashing or spraying of bodily fluids into the mouth or nose.
- Wear a face shield (eye visor, goggles) to protect mucous membranes of the eyes, nose, and mouth during activities that are likely to generate splashes or sprays of blood, body fluids, secretions, and excretions.

Comments

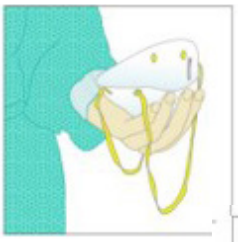
- Surgical masks should be changed when wet. They MUST not be re-used. Masks should be secured by ties or ear loops – do not touch the front of the mask during removal and perform hand hygiene immediately after removal.
- A flexible band should be fitted to the nose bridge.
- The mask should fit comfortably on the face and under the chin.

- Masks should be discarded directly into a waste bin after use and never left hanging around the wearer's neck.
- N95 or FFP2 masks can be used for up to 8 h by the same HCW, provided the integrity of the mask is not compromised. The mask must be replaced after each use and changed if breathing becomes difficult, if the mask becomes damaged or obviously contaminated, and/ or if a proper face fit cannot be maintained.
- The respirator must seal tightly to the face to prevent air from entering through the sides. A good fit is only achievable where there is a good mask- to- skin seal.
- Respiratory masks are unsuitable for HCWs with facial hair, as it affects the seal between the mask and the face. Beards, sideburns, or even a visible growth of stubble will affect the face seal of such masks which rely on close contact between the face and the mask.
- Staff who may be required to wear a respirator mask must be trained on how to fit the mask to their face for maximum benefit. The FFP2 or N95 particulate respirators should be used when caring for patients with known/ suspected open pulmonary or laryngeal tuberculosis. It should also be used when managing patients with highly infectious respiratory tract infections when aerosol-generating procedures (AGPs) are performed. Aerosol generating procedures are listed below.
- A HCW fails the fit test on two separate occasions, then alternative masks/ hoods are considered as one mask type will not fit everyone and in such cases, purchase of additional types of masks is necessary for some staff.
- It is recommended that fit testing should be undertaken on a yearly basis.
- CDC recommends that in the absence of manufacturer's guidance, the number of reuses should be limited to no more than five uses per device and this is to ensure an adequate safety margin. However, in practice, N95 has been reused by the same HCW for up to 7 days.
- If the respirator is reused, it is essential that after use, it is kept in safe condition, i.e. they should not be hung open to avoid contamination. After use, HCWs must perform hand hygiene and keep the mask in a paper bag.
- A clean, breathable container (e.g. paper bag and not in a plastic bag to avoid the build-up of moisture and to prevent fungal growth), and store in a cool dry place away from heat and humidity. The respirator should be clearly labelled with the user's name, so that it is used by the same HCWs to prevent accidental usage by another person. The respirator must be changed if it is soiled and contaminated with body fluids, wet, damaged or becomes hard to breathe through.
- Conduct a seal check before using it. During the use of any mask, it is important to avoid touching the face.

AEROSOL- GENERATING PROCEDURES

- Intubation, extubation, and related procedures, e.g. manual ventilation and open airway suctioning (including tracheotomy care and open suctioning with invasive ventilation).
- Cardiopulmonary resuscitation.
- Bronchoscopy (unless carried out through a closed- circuit ventilation system).
- Surgery and post-mortem procedures in which high- speed devices are used.
- Dental procedures.
- Non- invasive ventilation (NIV), e.g. bi-level positive airway pressure ventilation (BiPAP).
- Continuous positive airway pressure ventilation (CPAP).
- High frequency oscillatory ventilation (HFOV).
- Induction of sputum.
- Collection of lower respiratory tract specimens (e.g. bronchial and tracheal aspirates), and autopsy procedures.
- In a dental practice, it includes the use of hand pieces (especially airz rotor) in the patient's mouth, and scaling using an ultrasound or air scalar (but not hand scaling).

Source: Infection control precautions to minimise transmission of acute respiratory tract infections in healthcare settings. London: Public Health England, 2016.



1) Cup the respirator in your hand with the nosepiece at your fingertips allowing the headbands to hang freely below your hand

2) Position the respirator under your chin with the nosepiece up.

3) Pull the top strap over your head resting it high at the back of your head. Pull the bottom strap over your head and position it around the back the neck below the eras.

4) Place fingertips of both hand at the top of the metal nosepiece. Mould the nosepiece (USING TWO FINGERS OD EACH HAND) to the shape of you nose. Pinching the nosepiece using one may result in less effective respirator performance.

5) Cover the front of the respirator with both hands, being careful not to disturb the position of the respirator.

5A Positive seal check	5B Negative seal check
Exhale sharply A positive pressure inside the respirator=no leakage. If leakage, adjust position and/or tension straps. Retest the seal.	Inhale deeply. If no leakage negative pressure will make respirator cling to your face. Leakage will result in loss of negative pressure in the respirator due to air entering through gaps in the seal.

Fig. 4.24 Sequence of steps in a particulate respirator and seal check.

From: Infection prevention and control of epidemic-and pandemic-prone acute respiratory infections. Geneva: World Health Organization, 2014.

Face Shield/Eye Protection

When to wear

- A face shield is worn to protect mucous membranes of the eyes, nose, and mouth from exposure to splashing or spraying of bodily fluids.

Comments

- Goggles alone protect the eyes, whereas face shields attached to surgical masks protect the eyes and face.

Reprocessing of reusable patient care items and equipment

- Please refer to Section 5 for details.

Environmental Cleaning

- Please refer to Section 6 for further details.

Safe injection practices and safe disposal of sharps

According to the WHO, every year at least 16 billion injections are administered worldwide. Around 90% of these injections are given for curative care, 5% for immunization, and 5% for other indications. Unnecessary and unsafe injection practices are common, especially in low- and middle- income countries and have been associated with the transmission not only of bloodborne viruses (HIV, Hepatitis B, and C), but also viral haemorrhagic fevers (CCHF, Ebola and Lassa fever viruses), malaria, and other infections including bacterial infections and abscesses at the injection site**. It has been estimated that in some countries, more than 40% injections were unsafe and unsafe practices are responsible for 1.6 million Hepatitis B infections, up to 315,000 Hepatitis C infection, and up to 33,800 HIV infections.** This is probably an underestimation as some bloodborne viruses (BBV) have a long incubation period (up to 6 months) and typically asymptomatic course (esp. of Hepatitis C). There is a failure to follow and difficulty of tracing the misuse of vials for injections, it is likely that only a fraction of such outbreaks that occurred have been detected.

According to the published data available, Pakistan has the highest prevalence of BBV infections and various outbreaks have been reported from the use of unsafe injection practices in healthcare facilities. In addition, unsafe IPC practices, especially in dentistry and community are not uncommon.

The following recommendations for safe injection practices are based upon the guidance provided by the WHO and CDC.

Education And Training

It is essential that the HCF provides practical training and education to all staff (including new or temporary staff) on injection safety and on prevention of the misuse of vials when administering injections.

Needle and syringes

- Do not give unnecessary injections to patients.
- Always use sterile needle and syringes— never reuse or decontaminate needle or syringes as they are single-use items only.
- Do not administer medications from a syringe to multiple patients, even if the needle or cannula on the syringe is changed, nor access a medication or solution that might be used for a subsequent patient through any vial with a used syringe or needle.
- If possible, utilize single-use disposable safety engineered 'SMART' syringes (auto-destructible) i.e. Re-Use Prevention (RUP) and Sharp Injury Protection mechanisms (SIP). 77

Skin disinfection

- Apply 60– 70% alcohol- based solution (isopropyl alcohol or ethanol) on the skin for 30 seconds on a single use swab or cotton ball and allow it to dry.
- Do not use cotton balls stored wet in a multi-use container. Do not use methanol or methyl alcohol as these are not safe for human use.

Single-dose vials

- Use single-dose vials for IV medications whenever possible.
- Do not administer medications from single-dose vials or ampoules to multiple patients or combine left over contents for later use.
- Do not use medications packaged as single- dose or single- use for more than one patient.

Multi-dose vials

- Avoid using multi-dose vials (see below).
- Limit the use of multi-dose vials and dedicate them to a single patient and always label with patient's name.
- If multi-dose vials are used, they should be kept and accessed only in a dedicated medication preparation area (see below— Injection equipment and area for preparation of injections). This is done to prevent inadvertent contamination of the vial through direct or indirect contact with potentially contaminated surfaces or equipment that could then lead to infections in subsequent patients.
- Do not keep multi-dose vials in the immediate patient treatment area, store in accordance with the manufacturer's recommendations. Discard if sterility is compromised or questionable.
- Never leave needles or cover with other objects (e.g. sticky tape) in vial entry diaphragms between uses, as this could contaminate the vial's contents.
- Remember that once a multiple- dose vial is punctured, it should be assigned a 'beyond- use' which starts when the vial is entered, or open as multi-dose vials contain antimicrobial preservatives (to prevent the growth of bacteria but have no activity against viruses) — refer to the manufacturer's recommendation regarding duration of use.
- Always use a new sterile needle and a new syringe to access a multi-dose vial.

Disinfection of vial septum

- Disinfect the vial's rubber septum before piercing by wiping and using friction with a sterile 70% isopropyl alcohol or other approved antiseptic swab and allow the septum to dry before inserting a needle or other device into the vial.

Infusion bags or bottles

- Do not use infusion bags or bottles of intravenous fluids as a common source of supply for multiple patients.
- Never leave needles or cover with other objects (e.g. sticky tape) in vial entry diaphragms between uses, as this could contaminate the vial's contents.
- Always use a new sterile needle and a new syringe to access the multi-dose vial.
- Disinfect the vial's rubber septum before piercing by wiping and using frictionwith a sterile 70% isopropyl alcohol or another approved antiseptic swab and allow the septum to dry before inserting a needle or other device into the vial.

Avoid double- dipping

Using the same syringe to inject more than one patient from a multi-dose vial is called 'double- dipping'. Double-dipping is a dangerous and unsafe practice. Fig. 4.26 illustrates cross-infection due to double-dipping in which after a syringe is used to draw medication from a multi-dose vial and inject into a patient, the same syringe is then reused, with or without a new needle, to draw more medication from the vial. When the same syringe is used to enter the vial, even for the same patient the entire multi- dose vial is contaminated.

Fig 4.25 To maintain sterility, do not touch the needle with finger or thumb and ***never*** pre-fill syringes.

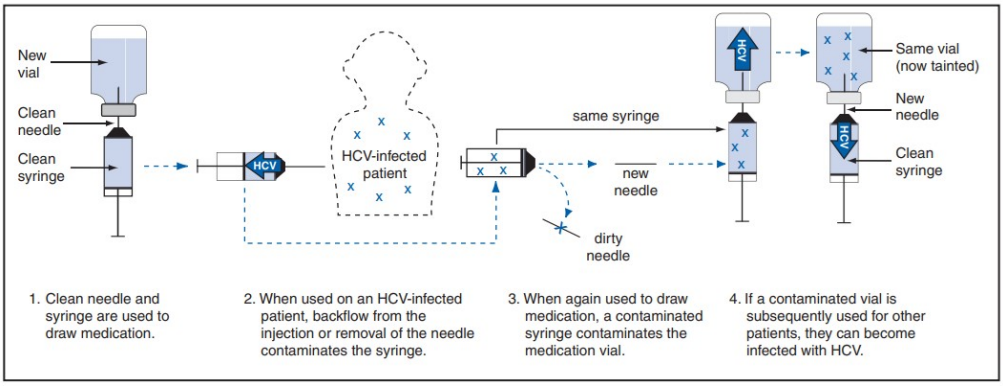
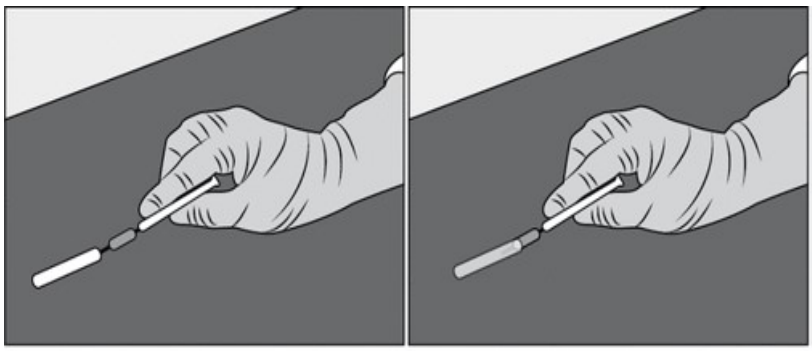
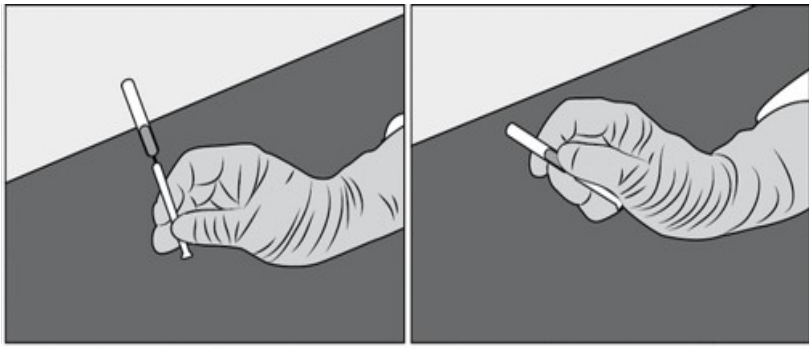


Fig. 4.26: Unsafe injection practices and the circumstances that are likely to result in transmission of bloodborne virus and other pathogens.



Place the needle on a flat (horizontal) surface. By using the same hand, hold the syringe and gently use the needle to scoop up the cap.

Scoop the cap with end of the needle and allow the cap to slide over the needle.



When the cap covers the needle completely, use the index finger and thumb to secure the cap on the needle hub. Remember that the cap must be held at the bottom only. Discard the needle and syringe as a *single unit* in a dedicated puncture resistant sharp container.

Note: Recapping needle is *not* recommended. However, there are times when it's done, it must be done safely by using 'One-handed scoop' method. When using this method, it is essential that the second hand *must* be kept well *away* during the *entire scooping procedure*.

Fig. 4.27 'One-handed scoop' method.
From: *Damani N. Manual of Infection Prevention and Control. Oxford: Oxford University Press, 2019.*

SAFE USE AND DISPOSAL OF SHARPS

Don't put needle in the vial

Don't recap needles to prevent needle stick

Dispose off syringe as a single unit

Use approved puncture resistant sharp boxes

Don't overfill sharp boxes. Closed when they are 2/3

Don't dispose off any sharps in the outside hospital in the community

Use incinerator to dispose clinical waste as per local policy

Aseptic technique

- Avoid contamination of sterile injection equipment by using the aseptic non-touch technique.
- It is essential that HCWs ***must*** maintain aseptic technique during the preparation and administration of injected medications.

Infusion and administration sets

- Use fluid infusion and administration set (IV bags, tubing, and connectors) for one patient only and dispose them appropriately after use. Remember, consider a syringe or needle/canella contaminated once it has been used to enter or connect to a patient's IV infusion bag or administration set.

Injection Preparation Area

- Prepare all injections in a dedicated clean area.
- The injection preparation area or room must be a ***dedicated clean area***.
- It is essential that this area must not be contaminated with blood and/or body fluids.
- Any contaminated items, including blood samples ***must not*** be brought to this room or area.
- This clean area/room should be used to draw up injections, but if the vial is used for the next patient(s), even if new syringes and new needles are used, infections can still be transmitted.
- Needles must be discarded into a robust, sharp container in a dedicated dirty area (i.e. dirty utility).

Safe disposal of sharps

- Needles should not be re-capped, bent, broken or disassembled.
- Handle all sharp instruments or devices (needles, scalpels, etc.,) carefully.
- Dispose all used needles and other sharp instruments in a designated puncture-resistant sharp container.

Dispose of syringe and needle as a single unit- do not bend, break or cut needles after use.

Dispose of syringe with needle as a single unit in the puncture resistant sharp container

Fig. 4.28 Dispose of syringe with needle as a single unit in the puncture resistant sharp container.

Table 4.4. Summary of key principles for providing safe injections.

General principle	Key points
Clean work space	• A clean and organized workstation is vital for preventing contamination with microorganisms and is an essential requirement for safe preparation.
Hand hygiene	• Healthcare workers must always perform hand hygiene before preparing injections and before and after giving an injection.
Sterile injection material	• Carefully inspect the packaging before opening and discarding the syringe and needle, if the packaging is damaged or moist. • Always use a sterile syringe and needle from a new and sealed package. • A syringe with a re-use prevention (RUP) feature is highly recommended where feasible.
Sterile medications and diluents	• Use single dose vials where feasible and use as outlined in this section. • Each medication/vaccine should be administered aseptically and separately.
Skin cleaning/ preparation	• Clean skin if visibly dirty and apply 60–70% alcohol- based solution (isopropyl alcohol or ethanol) on the skin for 30 seconds on a single use swab or cotton ball and allow to dry. Do not use cotton balls stored wet in a multi-use container. The use of methanol or methyl alcohol is not recommended. • For blood culture collection, disinfect skin with 2% chlorhexidine in 70% alcohol wipes and for disinfection of septum of blood culture bottle use 60–70% alcohol wipes.
Sharps collection	• Never re-cap needles. • Sharps containers should be located at the point of care for easy access. • Always place sharps directly into puncture resistant sharps containers. • Once ¾ full, close and seal shut and store in a secure place until final disposal/treatment.
Waste management	• Dispose of all sharps items carefully and safely to ensure that all persons are protected against possible exposure.

Aseptic Technique

Since microorganisms are naturally present in the environment, it is not possible to achieve a sterile technique in a typical healthcare setting.

Aseptic technique is used to protect patients during invasive clinical procedures e.g. insertion of IV cannula, CVC line, and indwelling urinary catheter, taking blood culture, performing lumber puncture, dressing wounds etc.). Aseptic technique is used for all invasive clinical procedures, and also for the maintenance and use of invasive clinical devices.

Also, aseptic technique is used to prevent contamination of ***key parts*** and ***key sites*** by microorganisms that could cause infection. In aseptic technique, asepsis is ensured by identifying and then protecting key parts and key sites by hand hygiene, non-touch technique, using new sterilized equipment and/or cleaning the existing key parts.

Break in aseptic can be introduced to susceptible sites by contaminated hands and surfaces and by the use of non-sterile items, contaminated lubricants and solutions. Commercial frameworks to assist with implementation of the aseptic technique are available.

To achieve aseptic technique, it is essential to tag along the following steps:

- It is critical that the person who is performing the aseptic technique be well trained and competent.
- Proper hand hygiene must be performed using approved products and techniques before commencing the procedure.
    - All items used during the procedure must be sterile. Never reuse single-use medical devices e.g. syringes, needles, central venous, and indwelling urinary catheters.
    - If it is necessary to touch a key part or key site directly, sterile gloves should be the gloves of choice. Otherwise, non-sterile gloves should be used.
- Throughout the procedure, maintain use of the aseptic non-touch technique, open items partially and keep items in the original sterile packing. Do not through sterile items on towel, as it may not be sterile!
- Apply single-use antiseptic solutions to properly disinfect key sites (intravenous access sites, open or broken wounds etc).
- Remember that the inappropriate use of multi-use antiseptic solutions, sterile saline, water, lubricants, and use of multi-dose vial can result in contamination and documented outbreaks have been reported.
- It is also important that during aseptic procedures, the key parts (i.e. parts of the items, equipment or solutions used) must remain sterile throughout

the clinical procedures. For example, during administration of intravenous therapy, the key parts are usually those that come into direct contact with the liquid infusion—for example, needles, syringe tips, exposed lumens and the tip of IV catheters. Remember that the key parts must be identified and protected at all times and they must only come into contact with other aseptic key parts and/or key sites.

- If the aseptic break occurs due to emergency and/or uncontrolled environmental conditions, then this should be documented and included in the handing-over and the infection risks should be mitigated as soon as possible.

Surgical Asepsis

The principle of surgical asepsis is to prevent SSI used for all operating room procedures. This is achieved by the use of sterile instruments, sutures, dressings and other material,wearing of sterile gowns and gloves by the operating team and performing surgery in an adequately ventilated operating theatre, to reduce the microbial bio-load of the micro-organisms generated by the theatre personnel. It is essential that all members of the operating room who are βsterile" must only touch sterile articles. The people, who are unsterile, must only touch unsterile articles. All sterile packs must be opened using a non-touch technique that will prevent contamination of sterile instruments.

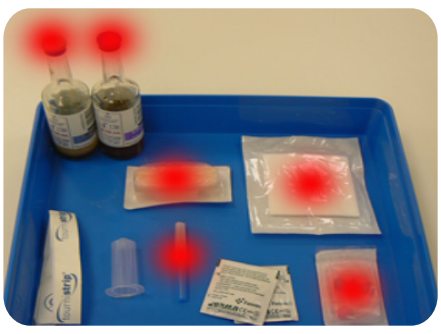


Fig 4.29: Key parts are protected individually.

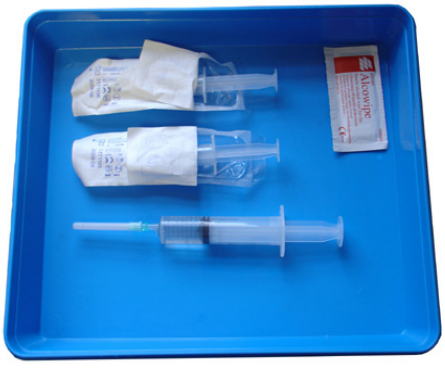


Fig 4.30: Key parts are protected individually. ©http://antt.org© http://antt.org/

Respiratory hygiene and cough etiquette

To prevent the spread of microorganisms dispersed as respiratory secretions into the air, all persons with respiratory symptoms should cover their nose and mouth when coughing or sneezing or wiping and blowing noses with a tissue or mask. Discard used tissues and masks, and perform hand hygiene after contact with respiratory secretions. If no tissues are available, cough or sneeze into the inner elbow then perform hand hygiene.

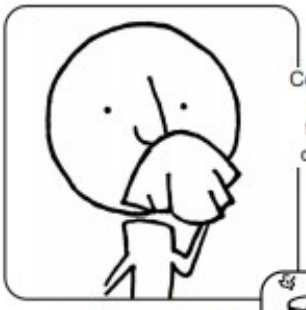
For aerosol generating procedures, N95 mask should be used. A list of aerosol generating procedures have been given in the box below.

Healthcare facilities should:

- Ensure education of health workers, patients and visitors.
- Place acute febrile respiratory symptomatic patients at least 1 meter (3 feet) away from others in common waiting areas, if possible. If not possible, then the patients should sit as far away from others as possible.
- If possible, healthcare facilities should place these patients in a separate area while waiting for care.
- Post visual alerts at the entrance to healthcare facilities, instructing persons with respiratory symptoms to practice respiratory hygiene/ cough etiquette.
- Consider making hand hygiene resources, tissues and masks available in common areas and areas used for the evaluation of patients with respiratory illnesses.

Stop the spread of germs that make you and others sick!

Cover your Cough



Cover your mouth and nose with a tissue when you cough or sneeze

or

cough or sneeze into your upper sleeve, not your hands.

Put your used tissue in the waste basket.

Clean your Hands

after coughing or sneezing.

Wash hands with soap and warm water

or

clean with alcohol-based hand cleaner.

MDH

APIC

Waste management

For details please refer to Section 7.

Handling of linen

It is essential that all healthcare facilities must have documented policies on safe handling of linen. All used linen should be handled and transported with care to avoid dispersal of microorganisms into the environment and to avoid contact with staff clothing. The following steps should be taken for the safe collection, transport and storage of ***all*** used linen (i.e. whether or not transmission-based precautions are required):

- All staff handling soiled linen should wear gloves and a disposable plastic apron.
- Appropriate PPE is worn during handling of soiled linen to prevent exposure of skin and mucous membrane to blood and body substances and prevent clothing contamination.
- Used linen must be handled gently at all times to prevent dispersal of microorganisms in the environment.
- All used linen must be put into the appropriate bag, sealed at the bedside, and removed directly to the dirty utility area or to the collection point as per the local policy.
- Linen soiled with body substances should be placed into leak-proof laundry bags for safe transport.
- Washing must involve the use of an appropriate detergent, thereafter it should be disinfected.
- Hand hygiene is performed following the handling of used linen.
- Clean linen must be stored in a clean and dry place that prevents contamination by aerosols, dust, moisture and vermin, and is separate from used linen.
- Soiled linen and items from CCHF infected patients must be incinerated.

Safe burial practices

The overall essence of after-death procedures is to present the body in an aesthetically acceptable state for the bereaved to pay their last respects and to proceed with their after-death procedures or ceremonies.

As a general rule, standard IPC precautions should be continued after death.

If the person has died of a communicable disease, the risk of transmitting infection is usually less and occurs mainly from contact with the infected body and any fluids that leak from it or when the procedures are performed (e.g. embalming or post- mortem) in which case the transmission of infection can occur via:

- Contact with blood and body fluids.
- Sharps injury.
- Exposure of infectious materials via broken skin.
- Through splashes of blood and body fluids to the mucous membranes of the eyes, nose, and mouth.

If a person is known or suspected to have died of a serious communicable disease (e.g. CCHF), it is the duty of those with knowledge of the case to ensure that those who need to handle the body, including mortuary staff, post-mortem room, and funeral personnel are aware that there is a potential risk for transmission of infection.

For aesthetic reasons, it is necessary that the body must be kept in cold conditions to prevent decomposition. This can be achieved by keeping the body in a cold room and it is essential to minimize the number of times the remains are removed from cold storage. Storage of bodies at 6°C is recommended provided that the bodies are to be held for less than 48 hours; for longer-term storage, the bodies should be kept at ≤ 5°C. Early burial should be encouraged.

When performing post-mortem examination, the principles of safe practice for the mortuary must be adhered to irrespective of the infective state of the body. When a post- mortem is carried out on such patients, all those concerned must be informed and trained in safe procedures. They must follow the local written protocol. Strict banning of eating, drinking, and smoking must be enforced within the work areas. Detailed discussion on this topic is beyond the scope of this manual. Please refer to the reference section for more information. 24,29

Table 4.4: Types of isolation precautions for various communicable diseases and multi-drug resistant organisms.

Note: Standard IPC must be applied to ***all patients*** at ***all times*** irrespective of their infective status. The ***additional*** precautions outlined is recommended based on the mode of transmission of various microorganisms. It is important to note that some infections are transmitted by ***more than one route.***

Communicable diseases and multi-drug resistant organisms	**Standard**	**Contact**	**Droplet**	
Acquired immune deficiency syndrome (AIDS)	X			
Amoebiasis (dysentery)	X	X		
Abscess and draining wound (Staphylococcal, Streptococcal and other microorganisms)	X	X		
Ascariasis (roundworm)	X			
Aspergillosis	X			
Campylobacter gastroenteritis	X	X		
Brucellosis	X			

	Airborne	Comments
		Mode of Transmission: Person- to- person by sexual contact, percutaneous inoculation (e.g. unsafe injection practices and needle stick injuries), infected blood or blood products, and vertical transmission from an infected mother. **Period of Infectivity (PI):** Till patient is viraemic.
		Mode of Transmission: Faecal–oral route, usually due to the ingestion of faecally contaminated food or water containing amoebic cysts. **PI:** As long as cysts appear in the stool which may be for years.
		Mode of Transmission: Contact with infected secretions. **PI:** Till wound is draining pus and antibiotic course is completed.
		Mode of Transmission: By ingestion of mature eggs in water or uncooked food- stuff which have been contaminated with soil containing infected faeces. **PI:** Till mature fertilized worms are present in the intestine.
		Mode of Transmission: Caused by inhalation of *Aspergillus* spp. spores, usually associated with building work. **PI:** No person to person transmission.
		Mode of Transmission: Ingestion of contaminated food, usually unpasteurized milk, undercooked poultry, and non-chlorinated water. Also, by contact with infected puppies, kittens, and farm animals. **PI:** As long as the organisms are in faeces, an average of 2 to 3 weeks after symptoms have resolved.
		Mode of Transmission: By direct or indirect *contact* with tissues, blood, urine, vaginal discharges, aborted foetuses, and placentae of infected animals through breaks in the skin, or by *ingestion* of unpasteurized milk and dairy products of infected animals. Airborne *inhalation* of the organism in laboratories or in slaughterhouses. **PI:** No person to person transmission.

Conjunctivitis	X	X		
Conjunctivitis (Ophthalmia neonatorum)	X	X		
Candida spp. including *C. auris*	X	X		
Chickenpox (Varicella)	X	X	X	
Chikungunya	X			
Clostridium difficile associated diarrhoea	X	X		
Cryptosporidiosis	X	X		

		Mode of Transmission: Contact with discharge from the conjunctivae or respiratory tracts of infected persons from contaminated fingers, clothing, or other articles. **PI:** During the period of active infection.
		Mode of Transmission: By direct contact with the infected cervix and secretions during the birthing process. **PI:** Till secretions are present or 24hrs after start of antibiotics.
		Mode of Transmission: In hospital, spread can occur in intensive care, neonatal, transplant, burns, and renal units by contact with secretions or excretions of mouth, skin, vagina, and faeces from carriers. **PI:** Till discharge from hospital.
	X	**Mode of Transmission:** From person to person by *direct contact, droplet,* or *airborne* spread of vesicle fluid or secretions of the respiratory tract of chickenpox cases, or of vesicle fluid of patients with herpes zoster (shingles). May also be spread by *indirect contact;* from the environment which have been freshly contaminated with discharges from vesicles and mucous membranes of infected people. **PI**: Infected person is *contagious* from 1-2 days before rash onset until the lesions have crusted.
		Mode of Transmission: No person to person spread. **PI**: During the febrile phase virus is transmitted to humans by the bites of infected *Aedes aegypti* and *Aedes albopictus* mosquitoes.
		Mode of Transmission: Endogenous infection precipitated by antibiotic therapy due to overgrowth of *C. difficile* in the gut and toxin production. Exogenous infection by ingestion of spores from a contaminated environment. **PI**: Person-to-person spread till active diarrhoea is present.
		Mode of Transmission: Transmitted by the *faecal– oral* route by ingestion of oocysts. **PI**: This includes person- to-person, animal- to- person, waterborne and foodborne routes. **PI**: From the onset of symptoms till several weeks after resolution of symptoms.

Cytomegalovirus infection	X	X		
Dengue fever	X			
Diphtheria: Cutaneous	X	X		
Diphtheria: Pharyngeal	X	X	X	
Gastroenteritis (Viral and bacterial)	X	X		
Hepatitis type A and E virus	X	X		
Herpes simplex virus	X	X		
Impetigo	X	X		
Influenza virus	X	X	X	

		Mode of Transmission: Intimate exposure by mucosal contact with infectious tissues, secretions, and excretions. The fetus may be infected in utero or virus may be transmitted to the infant during the birthing process. **PI:** Many months after primary infection and may persist episodically for years.
		Mode of Transmission: No direct person- to- person transmission. Transmitted by the bite of infective mosquitoes, especially *Aedes aegypti.* Vector control in hospitals and patients with fever (viraemic phase) should be kept under impregnated bed nets. **PI:** Till febrile phase.
		Mode of Transmission: Direct contact with a patient or carrier, or contact with articles, which have been contaminated with discharge from the lesions of infected people. **PI:** Till 14 days after the antibiotic course is completed, if culture is available in three negative skin swab cultures at least 24hrs apart.
		Direct contact with a patient or carrier mainly via respiratory route. **PI:** Till 14 days of appropriate antibiotic therapy.
		Mode of Transmission: Faecal–oral by direct or indirect contact with a symptomatic person or asymptomatic carrier. Diapered or incontinent persons. **PI:** Duration of diarrhoea.
		Mode of Transmission: Faecal–oral by direct or indirect contact with a symptomatic person or via diapered or incontinent persons. Hepatitis A is most contagious *before* jaundice and is infectious in the early febrile phase of illness. **PI:** 7 days before and 7 days after onset of jaundice.
		Mode of Transmission: Direct transmission by contact with the active lesions of infected individuals. **PI:** Until vesicles are crusted.
		Mode of Transmission: By direct contact with infected people or indirectly by contaminated articles. **PI:** 24hrs after start of effective antibiotic therapy.
		Mode of Transmission: Droplet spread by inhalation or by direct inoculation to the mucous membranes through indirect contact with infectious respiratory secretions. **PI:** Patients are able to infect others 1 day before symptoms develop and up to 5 to 7 days after becoming sick.

Measles	X	X	X	
MERS-Coronavirus	X	X	X	
Multidrug-resistant microorganisms: Infection or Colonization (MRSA, VRE, ESBL, CRE etc.)	X	X		
Mumps	X	X	X	
Mycobacterium tuberculosis: Laryngeal and Pulmonary disease	X			
Mycobacterium tuberculosis: extra-pulmonary draining lesion	X	X		
Mycoplasma	X	X		
Parvovirus B19: erythema infectiosum	X	X	X	
Pertussis (whooping cough)	X		X	
Respiratory infectious disease e.g. RSV (infants, young children and adult)	X	X	X	

	X	**Mode of Transmission:** Airborne, close contact and direct inoculation of mucous membranes with secretions of an infected person's respiratory tract. **PI:** Infected people are considered contagious from about five days before the onset of rash to four days afterwards.
	?	**Mode of Transmission:** Close contact and direct inoculation of mucous membranes with secretions of an infected person's respiratory tract. **PI:** Till patient is symptomatic.
		Mode of Transmission: By direct contact with the infected site and indirectly by contact with fomites and the hands of HCWs. **PI:** Till patient is admitted and up to 6-12 months (No definitive duration).
		Mode of Transmission: Droplet transmission and direct contact with the saliva of an infected person. **PI:** The infectious period is considered from 2 days before to 5 days after parotitis onset.
	X	**Mode of Transmission:** Airborne transmission via open case. **PI:** Infectious until 2 weeks of effective therapy or three negative sputum smear results for DR-TB.
		Mode of Transmission: Direct contact with cutaneous secretions. **PI:** Till 2 weeks after effective therapy.
		Mode of Transmission: Respiratory secretions. Direct contact with an infected person and indirectly by inoculation of mucous membranes.
		Mode of Transmission: Contact with respiratory secretions. **PI:** Once the rash appears, the person is no longer infectious, 6 days before to 3 days after symptoms.
		Mode of Transmission: By contact with discharges from the respiratory mucous membranes of an infected person. **PI:** Most contagious early in the illness. Persons who have completed five days of appropriate antibiotics are no longer contagious. Without treatment, one can spread pertussis during the first 3 weeks till they are coughing.
		Mode of Transmission: Respiratory secretions. Direct contact with an infected individual and indirectly by inoculation of mucous. **PI**: RSV infected patients are usually contagious for 3 to 8 days.

Rabies	X	X		
Poliomyelitis	X	X		
Rubella	X	X	X	
Scabies	X	X		
Staphylococcal and Streptococcal infections (pressure sore, open wound, furunculosis, scalded skin syndrome, burns, etc.)	X	X		
Streptococcus group A disease: pharyngitis and scarlet fever (infants and young children)	X	X	X	
Typhoid and paratyphoid	X	X		
Varicella-zoster: Disseminated disease, localized disease in immunocompromised patient	X	X	X	

		Mode of Transmission: Animal bite, saliva, tissue and organ transplant. Person to person risk of transmission is rare. **Incubation Period:** 1-3 months Vaccine available.
		Mode of Transmission: Infected respiratory secretions, faeces via faecal– oral route. Also, via contaminated hand via changing diaper. **PI:** The poliovirus can stay in the throat for about 7 days and in the faeces for 3 to 6 weeks.
		Mode of Transmission: Transmitted by droplet or by contact with the nasopharyngeal secretions of infected people. **PI**: A person with rubella may spread the disease to others up to one week before the rash appears, and remain contagious up to 7 days after.
		Mode of Transmission: By direct contact with infested skin and indirectly by contact with undergarments and bedclothes, if these have been contaminated by infested people immediately beforehand. The **incubation period** for **scabies** can be up to eight weeks. **PI:** The infested person can be *contagious* till completion of appropriate treatment.
		Mode of Transmission: Contact with infected secretions. **PI:** Until culture becomes negative after effective antibiotic therapy.
		Mode of Transmission: From infected respiratory secretions. **PI:** Until culture becomes negative after effective antibiotic therapy.
		Mode of Transmission: Faecal- oral and by ingestion of food and water contaminated by faeces and urine of patients and carriers. Human transmission via patients and convalescent carriers. **PI:** Until effective treatment is completed or duration of diarrhoea.
	X	**Mode of Transmission:** From person to person by *direct contact, droplet,* or *airborne* spread of vesicle fluid or secretions of the respiratory tract of chickenpox cases, or of vesicle fluid of patients with herpes zoster. **PI:** Infected person is *contagious* from 1-2 days, before rash onset until the lesions have become crusted.

Viral haemorrhagic fevers due to Lassa, Ebola, Marburg, Crimean-Congo fever viruses	X	X	X	
Zika virus	X			

PI: Period of infectivity

		Mode of Transmission: Blood and secretions are highly infectious. Person- to- person transmission occurs by direct contact with infected blood, secretions, ti ssue, organs, or semen. **PI:** Until the patient becomes symptomatic.
		Mode of Transmission: The vast majority of infections are not contagious from person to person. However, it may be passed from person to person during sex. **PI:** Until resolution of symptoms and sexual transmission, 93 days after the onset of illness.

SECTION 5

Disinfection and Sterilization

Introduction

Contaminated medical and surgical devices may serve as vehicles for the transmission of infection both to patients and healthcare workers (HCWs). Therefore, decontamination of items and equipment is essential. The term ***decontamination*** used in the USA does not include cleaning. However, in the UK and Europe, decontamination encompasses the *entire process*, including *cleaning, disinfection, and sterilization* and this term has been adopted by the WHO and is used in this manual.[73]

Cleaning: It is the first step required to physically remove contamination by foreign materials, e.g. dust and soil. It also removes organic materials, such as blood, secretions, excretions, and microorganisms, to prepare a medical device for disinfection or sterilization.

Disinfection: It is the process of reducing the number of viable microorganisms to a less harmful level. This process may not, however, inactivate bacterial spores, prions, and some viruses.

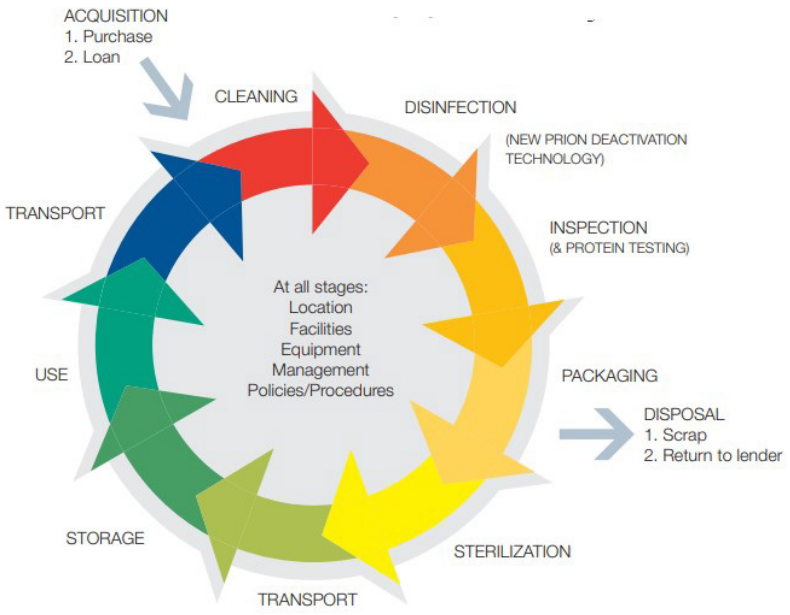
Sterilization: It is a validated process used to render an object free from viable microorganisms, including viruses and bacterial spores, but ***not*** prions.
It is also essential that *prior to the purchase* of *any* items/equipment which require decontamination, a pre-purchase questionnaire is used that requires input and acceptance from the SSD. Also, infection prevention and control (IPC) teams should ensure that the equipment is adequately decontaminated after purchase, ensure that chemical disinfectant(s) are available in the country and sterilization facility is available locally to comply with the manufacturer's instructions.

> Cleaning before disinfection, and/or sterilization is essential as it allows physical removal of microorganisms which, not only prevents inactivation of the disinfectant by organic matter, but also allows complete surface contact during further decontamination procedures. Therefore, thorough cleaning of items is a prerequisite before disinfection and sterilization is commenced.

It is also essential that equipment manufacturers provide written and validated instructions on how to decontaminate the devices they supply, and ***all*** medical devices should have a written decontamination procedure that complies with the manufacturer's recommendations. Fig 5.1 outlines the life cycle of decontamination of reusable instrument and Fig 5.2 shows the symbols used in medical devices and their packaging.

Decontamination Policy

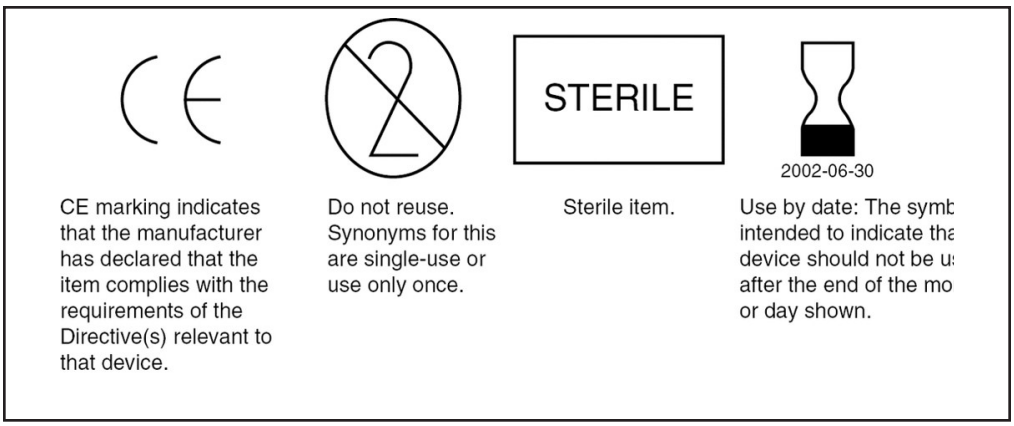
It is essential that all healthcare facilities (HCFs) must have a comprehensive decontamination policy, to ensure that all re-usable medical items and equipment are adequately cleaned, disinfected, and/or sterilized before use. The policy must be drawn up in consultation with the IPC team, SSD manager, the key stakeholders; and the recommendations must be made in accordance with the manufacturers' instructions based upon the national and international guidelines. For ***effective*** implementation and monitoring, it is essential that every HCF should have a nominated 'Decontamination Lead' who has overall managerial responsibility for ensuring adequate decontamination of all medical devices. The Lead Person should be responsible for all the operational issues which include implementation and



monitoring of the decontamination policy.

Fig 5.1. The reusable surgical instrument cycle.

From: UK (2016). Health Technical Memorandum 01-01: Management and decontamination of



surgical instruments (medical devices) used in acute care. London: Department of Health. ©Crown copy right.

Fig 5.2 The Symbols used on medical devices and their packing.

Training and education

The Staff who is responsible for the decontamination of medical devices and equipment ***must*** have education and ***practical training*** both at indication and regular update must be provided to ensure competence in the relevant decontamination procedures. The training must be updated on a regular basis and when new equipment is purchased. Records of training must be maintained by the head of department. All personnel responsible for cleaning, handling, and reprocessing of contaminated items must receive appropriate vaccinations. It is also the responsibility of each HCW not to allow the use of an unsafe device for a patient. Therefore, all staff should be trained in the checks to be made before the use of any medical device.

Installation and maintenance of equipment

All equipment used for sterilization or disinfection ***must*** be commissioned on installation, regularly serviced, maintained, and tested in accordance with the manufacturer's instructions and any up to date advice from the national and international regulatory authority. The equipment's performance must be monitored to ensure that accepted standards of safety are achieved as per the guidance and a written record in the form of a logbook of each instrument must be kept by the head of the department. Where applicable, equipment must be adequately decontaminated prior to service, inspection, or repair.

Risk assessment of contaminated items

In 1968, Earle Spaulding devised a classification of medical devices and equipment based on the degree of risk of infection from these items: Table 5.1. Later, an additional category of 'minimal

risk items' was added to Spaulding's original classification of items and environmental surfaces that do not come into close contact with patients. The risk of transferring microorganisms from instruments and equipment is dependent on the following factors:

- The presence of microorganisms, their number, and their virulence.
- The type of procedure that is going to be performed (invasive or non-invasive).

Single-use items are not designed for reprocessing as manufacturers will not guarantee their safety and performance after reprocessing.

- The body site where the instrument or equipment will be used.

Table 5.1 Spaulding's classification of equipment decontamination.

Category of Items	Level of microbicidal action	Method of decontamination	Example of common items/equipment
High (critical) Medical devices that are involved with a break in the skin or mucous membrane or entering a sterile body cavity or blood stream.	Kills all micro-organisms, including bacterial spores.	Sterilization (usually heat if heat stable or chemical if heat sensitive). Heat-sensitive items may be treated with low-temperature steam and formaldehyde, ethylene oxide, hydrogen peroxide (vapour or plasma) or by irradiation.	Surgical instruments, implants, delivery sets, dental instruments, rigid heat stable bronchoscopes, laparoscopes, cystoscopes, implants and ultrasound probes used in sterile body cavities. Note: Needles and syringes, IV, urinary catheters, cardiac catheters are single-use disposal devices.
Intermediate (semi-critical) Medical devices in contact with mucous membranes or non-intact skin,	Kills all microorganisms except high numbers of bacterial spores.	Clean thoroughly as soon as possible after using. High-level disinfection by heat or chemicals (under controlled conditions with minimal toxicity to humans).	Respiratory therapy and anaesthetic equipment, some endoscopes, vaginal speculate, laryngoscope blades, anorectal manometry catheters, diaphragm fitting rings, reusable bedpans and urinals. Probes including trans oesophageal echocardiogram, transrectal ultrasound and transvaginal probes (Store to prevent environmental contamination).

Low (non-critical) Items in contact with intact skin.	Kill vegetative bacteria, fungi, and lipid viruses.	Clean as necessary with detergent solution. Low level disinfection, i.e. cleaning.	Stethoscopes, sphygmomanometers, blood pressure cuffs, mercury thermometers, non-invasive ultrasound probes. Intravenous pumps and ventilators, ECG lead, etc. Store in a clean, dry place to prevent environmental contamination.

Table 5.2: Dangers of reusing single-use items.

Risks	Reasons
Safety	Reuse of single-use items may compromise the item's intended function and performance. Some single-use items may not be designed for thorough and proper decontamination. Reuse of a single-use item may alter its characteristics, so that it no longer complies with the original manufacturer's specifications. Single-use items have not undergone extensive testing, validation and documentation to ensure that they are safe to reuse.
Transmission of infection	Reuse of single-use items poses risks for transmitting healthcare-associated infections (this is of greatest concern). The risk of transmission increases when reusing single-use items due to the inability to access all microorganisms when decontaminating – often a result of poor design; e.g. narrow lumens and materials that are difficult to decontaminate entirely.
Inability to decontaminate	It can be difficult to access all surfaces for single-use items – e.g. acute angles, coils, long or narrow lumens – and use of specialist surface coatings may not be possible. It is not possible to have complete validation of removal of all microorganisms.

From: Modified from Damani N. Manual of Infection Prevention and Control. Oxford: Oxford University Press, 2019.

Decontamination Methods

The choice of decontamination method depends mainly upon the (i) type of material to be disinfected, (ii) level of decontamination required for the procedure, and (iii) the microorganisms involved. To achieve effective decontamination, it is important to have a clear understanding of the following terms used in this context.

Cleaning

All medical devices that are reprocessed, such as surgical instruments, must undergo ***rigorous cleaning prior*** to decontamination and sterilization procedures. Soaking contaminated medical devices in disinfectants prior to cleaning is ***not*** recommended.

Cleaning of instruments ***before*** decontamination is essential, as it allows physical removal of microorganisms which, not only prevents inactivation of the disinfectant by organic matter, but also allows complete surface contact during further decontamination procedures. Therefore, the cleaning of items is a prerequisite before commencement of disinfection and sterilization. Cleaning should ***only*** be carried out by trained staff.

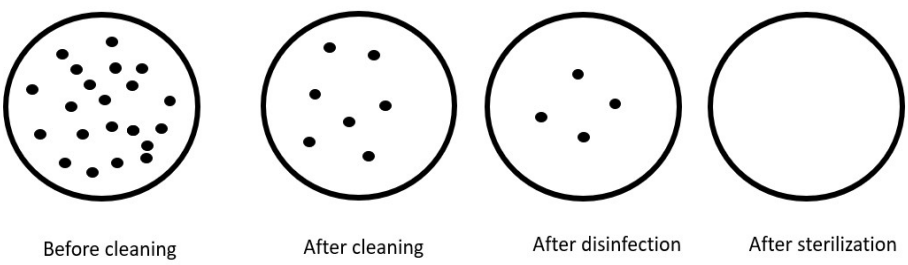


Fig 5.3 Effect of cleaning, disinfection and sterilization.

Micro-organisms	Examples	Level of disinfection
Prions	Agents for Creutzfield-Jakob disease	Prion reprocessing
Bacterial spores	Bacillus subtilis, Clostridium sporogenes, Clostridium difficile, etc.	Sterilization
Coccidia	Cryptosporidium	
Mycobacteria	Mycobacterium tuberculosis	High level disinfection
Nonlipid or small viruses	Poliovirus, Coxsackie virus, Rhinovirus, etc.	Intermediate level disinfection
Fungi	Trichophyton spp., Cryptococcus spp., Candida spp., etc.	
Vegetative bacteria	Pseudomonas aeruginosa, E. coli, Staph. aureus, Salmonella spp., Neisseria meningitidis, Enterococci, etc.	Low level disinfection
Lipid or medium-sized viruses	Herpes simplex, Cytomegalovirus, respiratory syncytial, Hepatitis B, Human Immunodeficiency Virus (HIV), etc.	

Fig. 5.4 Descending order of resistance to germicidal activity of chemical disinfectants against various microorganisms.

From: Damani N. Manual of Infection Prevention and Control. Oxford: Oxford University Press, 2019.

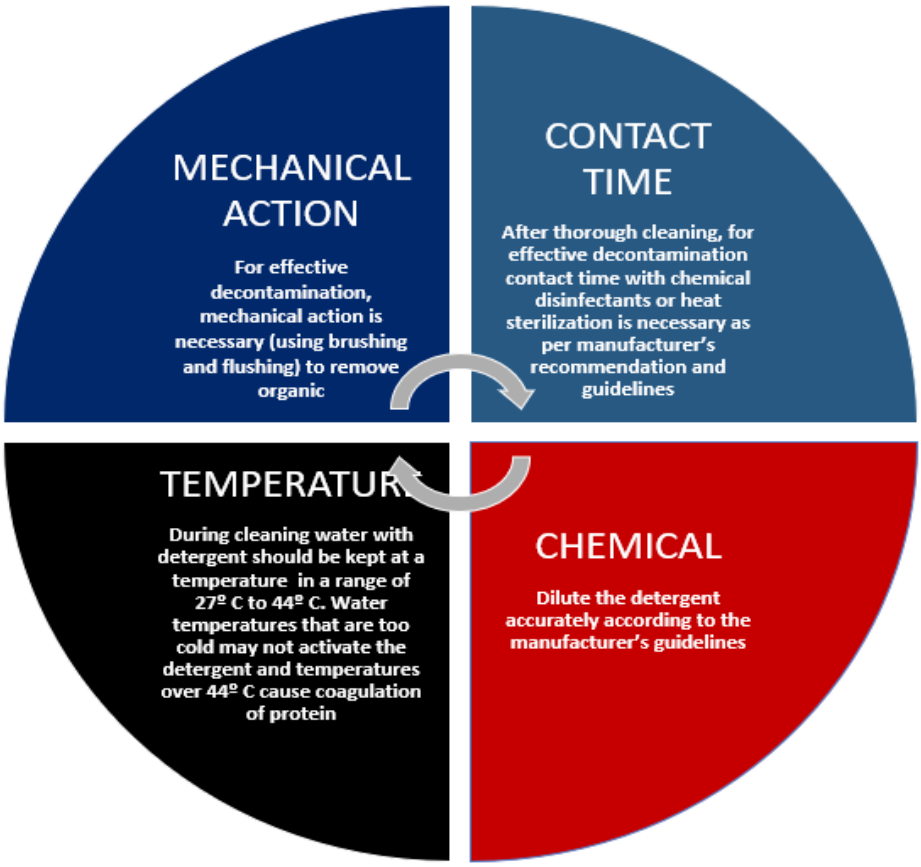


Fig 5.5 The Sinner cycle for cleaning of instruments (Dr Herbert Sinner, 1959).

Manual cleaning

During the cleaning, care should be taken not to produce splashes, high pressure sprays, or aerosols. Manual cleaning by hand requires well-trained operators to wear appropriate personal protective equipment (PPE) i.e. waterproof aprons, domestic gloves, face and eye cover to protect mucous membranes, and head cover.

For effective cleaning, it is essential that the detergents are prepared at the concentration recommended by the manufacturer/supplier. To achieve the correct concentration, the correct volume of concentrated detergent has to be added to the correct volume of water at the correct temperature. The following calculation is used for preparation of the correct strength of detergent:

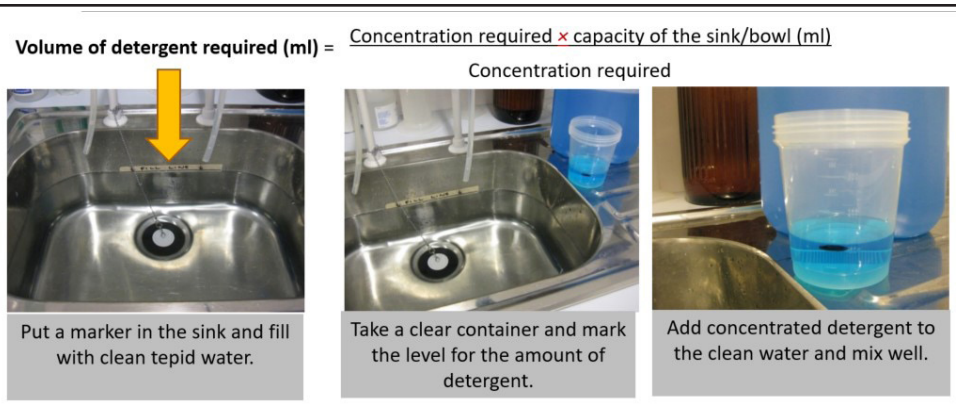


Fig 5.6: Detergent preparation using precise measurement of water and concentrated detergent for dilution.

Source: WHO. Decontamination and Reprocessing Manual for Healthcare Facilities. Geneva: World Health Organization, 2016.

The **two sink method** should be used for manual cleaning. The first sink should have tap water and the correct concentration of detergent for cleaning and the second sink should have tap water for thorough rinsing. They must dilute the detergent accurately according to the manufacturer's guidelines, open up all the hinges of the devices, and clean by holding the item ***below*** the surface of the water while using a ***soft nylon*** brush to remove debris.

Visual inspection of the hinges, teeth, and serrated edges should be carried out to ensure cleanliness. Any lumens should be irrigated with detergent. During cleaning, water with detergent should be kept in a temperature range of 27 to 44°C (80 - 110°F). Temperatures over 44°C cause coagulation of protein and thus prevent removal of protein substances. Water temperatures that are too cold may not activate the detergent. There is no controlled validation of manual cleaning apart from protein detection which is expensive. The water or air pressure guns are used to blow through and clear lumen devices.

Automated cleaning

Automated cleaning in an automated washer disinfector is the preferred option. However, some instruments may require washing by hand. Reprocessing medical devices through a washer disinfector (WD) is safer and usually more efficient.

The devices are cleaned using water jets, then washed with detergent and warm water, followed by a thermal disinfection cycle (some machines have a drying cycle). The load is substantial, some WD reprocess up to 60 trays per hour. Most importantly, each cycle is validated with physical and biological parameters. The staff performing these procedures must be trained in safe systems of work and must wear appropriate PPE.

Disinfection

Disinfection by either heat or chemicals will destroy microorganisms, but not necessarily bacterial spores. Chemical disinfection does not necessarily kill all microorganisms present but reduces them to a level that is not harmful to health. Chemical disinfection should only be used if heat treatment is impractical or may cause damage to the equipment. 'High-level' disinfection refers to a process using an agent which is normally used for disinfection purposes, but under specific circumstances, when used in sufficient concentrations and with suitable extended exposure times, can destroy bacterial spores. Sometimes this process is referred to as 'chemical sterilization' and the agent as a 'chemical sterilant', however, usage of this term ***should be avoided***. The outcome of a disinfection procedure is affected by:

- Presence of organic load (bioburden) on the item.
- Type and level of microbial contaminant prior to cleaning of the object.
- Concentration of disinfectant.
- Exposure time.
- Physical structure of the object.
- Temperature and pH of the disinfection process.

Besides effective ***cleaning*** of the items or equipment, the ***concentration*** and ***contact time*** are critical factors that determine the effectiveness of the disinfection process. Rinsing may be required to remove disinfectant residues before use on a patient. The microbiological quality of the water should not recontaminate the device.

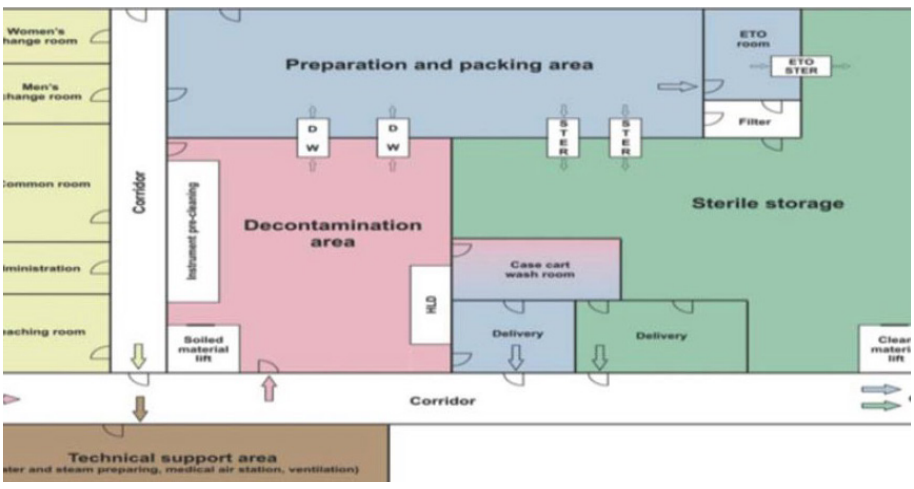


Fig 5.7 Suggested design of a Sterile Supply Department. Please note the flow of devices and staff from clean to dirty areas to avoid recontaminations of items and instruments.

Source: WHO. Decontamination and Reprocessing Manual for Healthcare Facilities. Geneva: World Health Organization, 2016.

Sterilization

Sterilization by heat is the preferred method for ***heat-resistant items*** and equipment. It is inexpensive and efficient, and equipment is easily maintained, compared with chemical sterilizers, and is widely available. For heat sensitive items, other sterilization methods are available but are beyond the scope of this manual (see References).

Sterilization by heat is inexpensive, efficient, easily maintained compared with chemical sterilizers, and widely available. Moist heat sterilization (using steam under pressure, much the same as a pressure-cooker) is the most widely used method of sterilization and can be achieved in an autoclave or sterilizer. Moist heat is a much more efficient conductor of heat than dry heat and has far more penetrating power, hence it is ***more effective*** in killing microorganisms. The cycles most frequently used for sterilization are ***much briefer*** than dry heat methods. Sterilizers have pressure gauges and thermometers that monitor the sterilization process.

Moist heat sterilization

A sterilizer or autoclave is used for heat sterilization where steam is introduced under pressure into the chamber and held within for the necessary time and then vented from the chamber. Steam makes contact with the load in the chamber and releases the heat, thus resulting in sterilization. Pre-vacuum steam sterilizers are the most widely used sterilizers and are suitable for sterilization of wrapped clean instruments, gowns, drapes, towelling, and other dry materials that are required for surgery. For effective sterilization, the following steps must be followed:

- All items must be thoroughly cleaned and dried before loading into the sterilizer.
- The time of steam contact with the devices is crucial and is known as the ‘holding time’. Refer to Table 4.2 for the recommended time and temperature cycle.
- The sterilizers have pressure gauges and thermometers that monitor the sterilization process.
- For effective sterilization, the sterilizer should not be overloaded.
- Written records should be kept of all the testing and maintenance carried out on every sterilizer.
- The records should ideally be kept in a logbook unique to each sterilizer.
- Permanent records should also be kept of every sterilization cycle.
- Sterilization performance must be checked frequently including routine biological, mechanical, and chemical monitoring to ensure that all

parameters of sterilization are met before using the instrument on patients, as outlined in the WHO Decontamination and Reprocessing Manual (WHO, 2016b).

- If 'flash' or 'immediate-use sterilization system' (IUSS) is used to process surgical items, it should meet the criteria. This is used only in emergencies.
- The overloading of autoclaves must be avoided, and all staff must be trained in autoclave operation and safe handling.

Dry-heat sterilization

For dry-heat sterilization, hot-air ovens are used because they can reach high temperatures. It is desirable that they should be equipped with a fan for even distribution of heat. To achieve optimal temperature (Table 4.2), ***preheating is essential*** before starting the sterilization cycle. Although they are simpler in design than autoclaves, hot-air ovens are suitable for sterilization of glassware, metallic items, powders, and anhydrous materials (oil and grease).

Cloth must not be placed in them to avoid the risk of fires. They cannot be used for sterilization of plastics, rubber, and paper. In addition, liquids cannot be sterilized (as they will simply boil off), neither can laboratory growth media, nor any flammable loads.

In addition, dense loads are often a problem as the convection/ conduction method used to heat the chamber does a poor job of ***penetrating*** them. In addition, this method has disadvantages over moist sterilization, in that only limited items can be sterilized. It requires higher temperatures for much ***longer exposure*** periods, and lengthy post-sterilization cooling time.

Table 5.3 Time temperature relationships in the thermal sterilization procedure.

Process	Temperature (°C)	Holding period (min)	Comments
Heat			
Moist heating (autoclaving)	121	15	Sterilization
	126	10	Sterilization
	134	3	Sterilization
Dry heat1*	160	120	Sterilization
	170	60	Sterilization
	180	30	Sterilization
Boilers2	100	5-10	Disinfection
Washer disinfectors			

Bedpans	80	1	Cleaning and disinfection
Linen	65	10	Cleaning and disinfection
	71	**3**	**Cleaning and disinfection**
Chemical[3]			
Ethylene oxide	55	65–360	Sterilization
Peracetic acid (0.2–0.35%)	Room temperature	5	Disinfection
Chlorine dioxide (1000–1500 parts/10^6 avalable ClO_2)	Room temperature	5	Disinfection
2% Glutaraldehyde	Room temperature	10–60	Disinfection
Ortho-phthalaldehyde (0.55%)	Room temperature	5	Disinfection

Reproduced with modification from: Fraise AP. Decontamination of the Environment and Medical Equipment in Hospitals. In: ***Principles and Practice of Disinfection, Preservation, and Sterilization***, 5th ed, pp. 445–458. Oxford: John Wiley & Sons, 2013.

[1]All temperature and times quoted for dry heat are minimum.

[2]At higher altitude, a longer time is required because the boiling point of water becomes lower the higher one gets from sea-level, due to the decreased atmospheric pressure.

[3] Some chemicals that will kill bacterial spores are termed 'sterilants'. However, rinsing is required to remove chemical residues. This introduces a risk of recontamination during the final rinse.

Table 5.4: Measurements for validation of decontamination processes.

Process	What is measured	
Cleaning	• Daily • Use of detergent and disinfectant.	• Per item. • Cleaning results by visual control or by using a cleaning test.
Disinfection	• Daily • Use of disinfectant by concentration, temperature and pH of disinfectant.	• Per load. • Time exposure.
Chemical sterilizers.		• Per process. • Biological indicator. • Chemical indicators. • Physical indicator. • Per item. • External indicators.
Moist heat (stem sterilizers)	• Daily • Bowie-Dick for steam penetration in porous loads (pre-vacuum autoclave). • Helix test for hollow lumen instruments, if available. • Clean chamber every week.	• Per process. • Biological indicator. • Chemical indicators. • Physical parameters met as per PQ. • Per item. • External indicators.

Source: WHO. Decontamination and Reprocessing Manual for Healthcare Facilities. Geneva: World Health Organization, 2016.

Bench table top sterilizers

These are used to sterilize simple items and are mainly used in outpatient departments, dental surgeries, and some family planning clinics. Traditional or ***gravity displacement*** bench top sterilizers are those which displace air ***passively*** from the chamber and load by steam, generated within the sterilizer chamber or in a separate chamber within the sterilizer's casing. Only ***unwrapped*** instruments without crevices or lumens may be processed in these machines. ***Vacuum benchtop sterilizers*** are those which have a pump or some other ***active*** method of removing air from the chamber and load. 'Porous loads' i.e. instruments which are hollow, tubular, have crevices, or are wrapped, can be processed in these machines. Vacuum bench top sterilizers are much more complicated machines than traditional bench top sterilizers. They therefore require greater care in their use and maintenance to ensure that they function effectively and

also require regular and rigorous testing. Bench top sterilizers should only be used as an alternative if the items cannot be decontaminated in the SSD. If bench top sterilizers are used in healthcare facilities then it is essential that they are properly used, adequately maintained, and monitored according to manufacturer's instructions.

MAINTENANCE OF BENCH TOP STEAM STERILIZER

- Before use, all bench top steam sterilizers must be installed and validated in line with the manufacturer's recommendations and recorded in the logbook which must be retained with the sterilizer.
- It is essential to ensure that all persons who will operate the machine are properly trained and deemed competent.
- A schedule for periodic testing must be drawn up at the time of validation and the owner/user of the bench top sterilizer must ensure that these tests are performed according to the schedule as outlined in the relevant documents.
- Maintenance should be performed routinely as recommended by the manufacturer. The test schedule should be carried out on daily, weekly, quarterly, and yearly intervals as specified in the manufacturer's documents. These tests are always preceded by safety checks to ensure that the sterilizer is safe to use.
- In addition to the periodic testing, routine monitoring of the process is necessary to ensure that sterile loads are consistently being produced.
- Examine printouts from the sterilizer's record to ensure that they are within the prescribed limits and the printed records of every cycle retained with the sterilizer logbook is with date and cycle number and types of items sterilized. The results of the daily test must also be recorded in the logbook.
- The use of an inappropriate indicator may give misleading results.
- Do not process wrapped, tubular, or textile products in a conventional bench top steam sterilizer–process them only in a suitable vacuum bench top steam sterilizer. It is essential that water is drained, and the chamber and reservoir are cleaned at the end of each day and left to dry. Replenish with sterile water for irrigation from an unopened container. The sterilizer's pressure system should be checked for safety and a record must be maintained of all checks and repairs to the pressure system.

From: Damani N. Manual of Infection Prevention and Control. Oxford: Oxford University Press, 2019.

Chemical Disinfectants

The efficacy of chemical disinfection has often been uncertain and, wherever possible, disinfection by heat is preferable to chemical methods.

Disinfectant: It is a chemical agent which, under defined conditions, is capable of disinfecting. It is a substance recommended for application to inanimate surfaces to kill a range of microorganisms.

Antiseptic: It is the equivalent agent, which kills microorganisms present on skin and mucous membranes. Two factors must be evaluated in determining the effectiveness of antiseptics, i.e. the agents must have effective antimicrobial activity and must not be toxic to living tissues. Tables 5.5 and 5.6 present a summary of antimicrobial activity disinfectants and antiseptics.

Staff Safety

Chemical disinfectants are hazardous substances and may cause damage on contact with the skin, eyes, or mucous membranes by inhalation of vapours or by absorption through the skin. Some individuals may be allergic/ more sensitive to individual disinfectants. This may take the form of skin rashes, contact dermatitis, or, in rare cases, difficulty in breathing. Therefore, it is important that relevant safety precautions are observed when using chemical disinfectants.

Concentrated disinfectants should always be stored and handled with care and appropriate protective equipment must be worn. For certain chemical disinfectants (e.g. glutaraldehyde) proper ventilation is required. The following points should be kept in mind when using chemical disinfectants:

- All chemical disinfectants must be clearly labelled and used before the expiry date. They should be freshly prepared and must be used at the correct concentration and stored in an appropriate container.
- Disinfectant or detergent solutions must not be prepared and stored in multi-use containers for occasional use. Solutions prepared and stored in this manner may easily become contaminated with microorganisms.
- Disinfectants can be corrosive and may damage fabrics, metals, and plastics.
- Manufacturers' instructions must be consulted on compatibility of materials with the method of sterilization or disinfection.

Table 5.5 Antimicrobial activity of antiseptic agents.

Group	Gram-positive bacteria	Gram-negative bacteria	Mycobacteria
Alcohols	+++	+++	+++
Chlorhexidine (2–4% aqueous)	+++	+++	+
Hexachlorophane (3% aqueous)	+++	++	+
Iodine compounds	+++	+++	+
Iodophors	+++	+++	+
Phenol derivatives	+++	+	+
Triclosan	+++	++	+
Quaternary ammonium compounds	+	++	–

Activity: +++ = Good; ++ = Moderate; + = Poor; – = no activity or insufficient activity.

Table 5.6 Antimicrobial activity and summary of properties of disinfectants.

Disinfectant	Antimicrobial activity				
	Bacteria	Mycobacteria	Spores	Viruses	
				Enveloped	Non-enveloped
Alcohol 60–70% (ethanol or isopropanol)	+++	+++	–	++	++
Chlorine-releasing agents (0.5–1% available chlorine)	+++	+++	+++	+++	+++
Clear soluble phenolics (1–2%)	+++	++	–	++	+
Glutaraldehyde (2%)	+++	+++	+++	+++	+++
Peracetic acid (0.2–0.35%)	+++	+++	+++	+++	+++
Peroxygen compounds[1] (3–6%)	+++	±	±	+++	±

Activity: +++ = Good; ++ = Moderate; ± = Variable; – = no activity or insufficient activity. [1]Activity varies with concentration.

Fungi	Viruses	Speed of action
+++	+++	Fast
+	+	Intermediate
+	+	Intermediate
++	+	Intermediate
++	+	Intermediate
+	-	Intermediate
–	+	Intermediate
–	+	Slow

From: Damani N. Manual of Infection Prevention and Control. Oxford: Oxford University Press, 2019.

Other properties			
Stability	Inactivation by organic matter	Corrosive/ damaging	Irritant/ sensitizing
Yes (in closed container)	Yes (fixative)	Slight (lens cements)	No
No (<1 day)	Yes	Yes	Yes
Yes	No	Slight	Yes
Moderately (14–28 days)	No (fixative)	No	Yes
No (<1 day)	No	Slight	Slight
Moderately (7 days)	Yes	Slight	No

From: Damani N. Manual of Infection Prevention and Control. Oxford: Oxford University Press, 2019.

Transport of contaminated surgical instruments

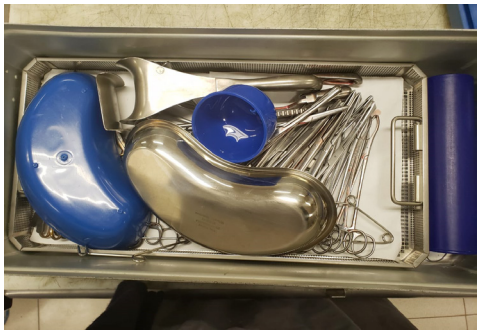
Used medical devices (e.g. surgical instruments from the operating room (OT) are sent to the SSD by, firstly, counting and collecting the devices, allowing excess water to drain away, and placing them in a closed leak and puncture-proof container or tray. Soaking of medical devices in ***any*** disinfectant solution (see Box) prior to cleaning or during transportation is not recommended, as there is a danger of spilling contaminated fluids and possible damage to instruments. The items should be covered with a moist towel with water (not saline) or foam, spray, or gel specifically intended for this purpose. These trays (and accompanying checklist) should be transported in a robust trolley (preferably with closed sides) to the decontamination area. Used devices should be received, checked, and sorted for cleaning in the 'dirty' area. Cleaning is normally done either manually or by automated methods as outlined in this section.

DO NOT SOAK INSTRUMENTS IN DISINFECTANT PRIOR TO CLEANING

- Soaking of instruments in 0.5% hypochlorite (bleach) solution or any other disinfectant solution during transport or before cleaning is not recommended for the following reasons:
- It may damage/corrode the instruments.
- The disinfectant may be inactivated by blood and body fluids, which could become a source of microbial contamination and formation of biofilm.
- Transportation of contaminated items soaked in chemical disinfectant to the decontamination area may pose a risk to healthcare workers and result in inappropriate handling and accidental damage.
- Soaking may contribute to the development of antimicrobial resistance to disinfectants.

Reproduced from: WHO. Decontamination and Reprocessing Manual for Healthcare Facilities. Geneva: World Health Organization, 2016.

Collection of used/soiled items



Open Box with used/soiled items

Collection of used/soiled items

Closed box with used/ soiled items

Transport of sterile equipment and supplies from CSSD to OR.

Fig.5.8 Instruments should be opened and kept moist either by spraying with an enzymatic spray or cover with a moist towel with water (not saline) or foam, spray, or gel specifically intended for this purpose. Do not transport in containers with water, as water is a splash hazard.

Storage of sterile items

Irrespective of the method of decontamination used, all reprocessed items must be stored properly to prevent damage or recontamination. If heat sterilization is used, it is essential that the items and packs are removed and allowed to cool. Proper storage of sterile instruments and equipment is essential in ensuring that the product maintains its level of sterilization or disinfection and the integrity of the wrapping must be protected. Most instruments and equipment are dry and packaged once they have been sterilized. Below are the requirements for the storage of sterile packs:

- The storage area should be separate, enclosed, and located next to, or connected to, the area where sterilization occurs. In smaller clinics, this area may be just a room. The area should be used solely to store sterile and clean supplies for patient care.
- Access to the area should be restricted.
- Store items in a clean, dry environment (i.e. far from sources of moisture) that is protected from any damage. It is recommended that the storage containers should not be made of absorbent material such as wood.
- The area must be bright, light, and airy with a good circulation of air. The temperature must be between 15–28°C and humidity between 30% and 50% without wide fluctuation during the day.
- The storage area should have an adequate level of lighting and the walls should be smooth and easy to clean.
- The packs should be placed on open racks as a single layer, rather than on closed shelves, to prevent moisture from accumulating between them. The shelving should be smooth with no sharp edges that could damage packs.
- The labels must be visible and clear.
- The pack inspection register should be clearly visible. The racks must be at least 10 cm off the ground and the ceiling.
- Before use, packages should be inspected to verify barrier integrity and dryness and that it meets the requirements of a sterile product. If the packaging is compromised, the items should not be used.

Decontamination of endoscopes

Each year, for diagnostic and therapeutic reasons, there is an increase in the number of endoscopic procedures used on patients. Cross infections with endoscope can only be avoided by maintaining the highest standards of decontamination after each use. This protects the patient from infection and is also essential to prolong the life of the equipment.

Types of Endoscopes

Rigid endoscopes are mainly heat tolerant, easier to clean, disinfect, and sterilize as they do not have the sophistication of functionality, construction, channel configuration and compatibility issues that exist with flexible endoscopes.

Flexible endoscopes are complex and difficult to clean and disinfect. They are ***heat sensitive*** and require chemical disinfection (or low temperature disinfection). Therefore, effective decontamination of endoscopes requires the expertise of an instrument manufacturer who is familiar with the design and function of the item and its compatibility with heat and chemical disinfectants.

Ensure compatibility with the existing hospital decontamination processes, chemical disinfectant and compatibility with the washer disinfector, when purchasing *endoscopes.*

Endoscopy accessories, which are used for invasive procedures, ***must be sterile*** after each use; alternatively, single-use accessories may be used.

Table 5.7 Types of endoscopes and the recommended level of decontamination.

Types of endoscopes	Rigid endoscopes	Flexible endoscopes	Level of decontamination
Invasive: passed into normally sterile body cavities or introduced into the body through a break in the skin or mucous membrane.	Arthroscope Laparoscope Cystoscope	Nephroscope Angioscope Choledochoscope	Sterilization by steam or a low temperature method, e.g. gas plasma.
Non-invasive in contact with intact mucous membrane, but does not enter sterile cavities.	Bronchoscope	Gastroscope Colonoscope Bronchoscope	High-level disinfection, e.g. immersion in glutaraldehyde, peracetic acid, chlorine dioxide.

Reproduced from: WHO. ***Decontamination and Reprocessing Manual for Healthcare facilities***. Geneva: World Health Organization, 2016.

The source of infection and/or contamination may be as a result of the following:

- The previous patient or inadequate decontamination of the endoscope before reuse.
- Contaminated lubricants, dyes, irrigation fluid, or rinse water.
- Inadequate decontamination of the reprocessing equipment.

Major problems leading to inadequate decontamination include ***inadequate cleaning,*** which may lead to failure to remove deposits of blood, faeces, tissue, mucous, microorganisms, or slime. This may result in infection, misdiagnosis, or instrument malfunction. In addition, if an automated endoscope reprocessor is used, many factors have been associated with contamination of machines namely: (i) inadequate cleaning and maintenance of the machine which may result in the formation of biofilm within the machine, (ii) inadequate cleaning of the endoscope resulting in inadequate decontamination, (iii) use of static water within the pipe work or tank and, (iv) use of water with poor microbiological quality and/or use of hard water.

Staff Health

All personnel working in an endoscopy unit must be educated about the biological, chemical, and environmental hazards. Staff should also be immunized against the hepatitis B virus. They should wear gloves and a disposable waterproof apron. Gloves should be used for short contact time (15–20 minutes); nitrile gloves can be worn for longer contact times. Gloves should be removed, and hands washed between tasks. Eye protection should be used to prevent conjunctival irritation and to protect the wearer from splashes. An approved vapour respirator should be available in case of spillage or other emergencies.

Manual Cleaning

Manual cleaning is ***essential*** to ensure that the endoscopes and accessories are cleaned prior to processing in an automated endoscope reprocessor or washer disinfector. Thorough ***manual cleaning*** of the instrument and its internal channels with detergent, by flushing, is the ***most important*** part of the disinfection procedure. Irrigation pumps are available for flushing instrument lumens and components. Prior to flushing with detergent, channel cleaning brushes or a similar device should be used in accessible channels. The brush should be of a suitable length and diameter for the channel being brushed. Without this, dry residual organic material, such as blood or mucous, may lead to channel blockages and prevent penetration of the disinfectant. It also ensures better contact between the disinfectant (or 'sterilant') and removal of any remaining microorganisms in the subsequent stages of decontamination. Cleaning with warm water and a neutral or enzymatic detergent is recommended. However, advice on suitable cleaning agents should be sought from the endoscope's manufacturer.

Table 5.8 Stages of reprocessing for flexible endoscopes.

STAGES	WHY
Bedside procedure (pre-clean) (In the Endoscopy Procedure Room)	• To remove readily detachable organic matter. • Bedside cleaning, rinsing and flushing of all channels function control, this will help to reduce the possibility of drying and causing channel blockages, especially if there is a delay before manual cleaning takes place. Transport from the endoscopy room to the reprocessing area and start of manual cleaning steps within approximately 30 minutes.
Leak test	• To ensure the integrity of the endoscope. • Any damage to the outer surface could allow body fluids or chemicals into the internal workings of the endoscope.
Manual clean	• Brushing of accessible channels and flushing of all channels to remove organic matter. • This stage will also allow the detection of channel blockages.
Rinsing	• To remove detergent residues that may affect the performance of the disinfectant.
Drying	• To expel excess fluid that may dilute the disinfectant.
Disinfection	• To eradicate potentially pathogenic microorganisms, i.e. bacteria, including mycobacteria and viruses.
Drying	• To expel excess fluid before use on the patient or storage.

Reproduced with modification: from Damani N. Manual of Infection Prevention and Control. Oxford: Oxford University Press, 2019.

Endoscopy Unit

The endoscopy unit facilities, where endoscopes are used and disinfected, should be designed to provide a safe environment for healthcare workers (HCWs) and patients. Decontamination of flexible endoscopes should take place in a dedicated, well ventilated room (up to 12 air changes per hour), ***away*** from the procedure room. There should be adequate ventilation to remove potentially harmful disinfectant vapours. The room should be equipped with a sink having sufficient capacity to accommodate the largest endoscopes, and a dedicated hand wash basin equipped with soap and disposable paper towels. There should be a workflow direction within the room, from ***dirty to clean***, to avoid the possibility of recontamination of decontaminated endoscopes from those just used on a patient. There should be sufficient storage of the consumables for use, during the decontamination procedure, e.g., PPE, including chemicals and cleaning brushes. There should be sufficient capacity for waste disposal.

Storage Of Endoscopes

Endoscopes must be stored in an area that is clean, well-ventilated and dust-free, in order to keep the endoscopes dry and free of microbial contamination. An endoscope that is not dry must be reprocessed before use. Endoscopes should hang freely so that

they are not damaged by physical impact. Endoscopes should be stored in accordance with the manufacturer's manual and in the storage cabinet.

Record keeping

A log must be maintained of all endoscopes and decontamination equipment used, to ensure that the correct decontamination process is being used. It is also important to keep the details of the procedure and the patient's name, medical record number, the endoscopist who performed the procedure, and the serial number or identifier of the endoscope used, to ensure that all endoscopes can be tracked throughout the decontamination process and traced to the patients on which they were used. The log should also include proof of the decontamination procedure, the equipment and the method used. This is essential for the look-back exercises.

Water quality

The quality of water is important as hard water may result in the build-up of limescale on the internal pipework of the washer and washer disinfector. The poor microbiological quality of water may result in microbial contamination. Tap water contains microbes, including ***Pseudomonas*** spp. and ***Mycobacterium*** spp. (e.g. ***M. chelonae)***., and its use has resulted in infection and misdiagnosis of tuberculosis.

The failures in decontamination, particularly for flexible endoscopes, have been reported due to the inability to access all channels of the endoscope. Irrespective of the method of disinfection or sterilization, ***cleaning is essential.*** In the decontamination procedure, the manufacturer's instructions should always be followed. An endorsement of the compatibility of the endoscope with the decontamination process is essential.

It is essential that ***all*** staff, including new staff, involved in the decontamination process are fully trained. This training should be regularly updated as appropriate for ensuring that they are aware of the complexities of the endoscopes they are processing and that the construction of the endoscope is fully understood. ***Competency testing*** of personnel should be carried out on commencement of employment and then at least on an annual basis, or when there is a change in either endoscopes or the introduction of new disinfectants or reprocessors. A record of the training received should be retained.

Automatic Endoscope Reprocessors (AER)

There are many AERs available that are capable of cleaning as well as disinfecting endoscopes. However, it is essential that ***manual cleaning*** is performed ***before*** usage to ensure the effectiveness of subsequent processing and prevent the machine and

the disinfectant from becoming contaminated with excess organic matter or bodily fluids. If an AER is used, the number of channels in each endoscope should be checked. Confirm that they can all be connected to the washer disinfector using the correct connectors/connection sets according to the manufacturer's instructions, to ensure exposure of ***all*** internal surfaces to the high-level chemical disinfectant. All tanks and fluid pathways in endoscope washer disinfectors ***must be disinfected daily*** to prevent microbial contamination of the AER which could be responsible for decontamination of processed endoscopes and subsequent misdiagnosis of infection. The final rinse water must be of a suitable quality with respect to hardness and freedom from microbiological contamination. A record must be kept of the number of machine cycles, to ensure that the disinfectant is not unreasonably diluted or neutralized by organic matter. Only validated processes should be used, following the manufacturer's instructions and the appropriate standards, e.g. the BS EN ISO 15883 series.

Process validation

Report any equipment problems relating to the endoscope, washer disinfector, or disinfectant to the appropriate regulatory authority. Have regularly planned preventive maintenance in place, with records kept for all endoscopes and decontamination equipment. Ensure that all processes are controlled using an appropriate quality system, e.g. BS EN ISO standard requirements for regulatory purposes and that all equipments are operated and controlled in accordance with the manufacturer's instructions.

Chemical disinfectants

Use only chemicals compatible with the endoscope, its accessories, and the automated endoscope reprocessor. Throughout the decontamination process, the chemicals used, must be at the correct concentration, temperature, and contact times as recommended by the manufacturer. The problems associated with using the most commonly applied disinfectant, glutaraldehyde, have prompted the development of non-aldehydes alternatives. However, it is important to note that ***before*** any new chemical disinfectant is introduced, written approval must be obtained regarding the compatibility of the product with both the endoscope and endoscope washer disinfector. For effective disinfection, the manufacturer's recommended time for immersion must be followed. Since the harmful effects of new disinfectants are not fully evaluated, it is essential that a risk assessment is carried out, as they may have to be used under exhaust-ventilated conditions using appropriate PPE.

NEVER USE THESE CHEMICALS TO DISINFECT ENDOSCOPES

- Benzalkonium chloride
- Iodophors
- Hexachlorophene
- Alcohol
- Chlorhexidine gluconate
- Cetrimide
- Quaternary ammonium compounds
- Glutaraldehyde (0.13%) with phenol

Note: Glutaraldehyde (2%), Peracetic acid (0.35%) and Ortho-phthalaldehyde (OPA) are the most common chemical disinfectants used to disinfect endoscopes. Please follow the manufacturer's instruction for use. Test strips are available to check the concentration. Glutaraldehyde is not effective if the concentration falls below 1.5 %.

Monitor The Concentration of Glutaraldehyde & Peracetic Acid

Check the solution on a daily basis (or more frequently) and document the results. If the chemical indicator shows that the concentration is less than the minimum effective concentration, the solution should be discarded. For example, the concentration of glutaraldehyde in the solution should not be allowed to fall below 1.5% and solutions must not be used beyond the manufacturer's recommended post-activation life. Test kits are available which indicate glutaraldehyde and peracetic acid concentrations.

SECTION 6

Environmental Cleaning

The constant contamination of the environment with microorganisms occurs from infected and/or colonized patients, staff, and visitors. Their survival in the environment depends on various factors, i.e. moisture, temperature, humidity, and type of material. The published evidence indicates that a contaminated environment plays an important role in the spread of microorganisms in a healthcare facility.

Therefore, ***regular and thorough*** cleaning of environmental surfaces, items and equipment is essential to reduce bioburden, to minimize transfer of pathogens directly via hands touching the contaminated environmental surface or indirectly via contaminated hands, items, and equipment.

This section briefly outlines the importance of environmental cleaning. More details are available from the CDC and ICAN ***Best Practices for Environmental Cleaning in Healthcare Facilities in Resource-Limited Settings.*** [13] https://www.cdc.gov/hai/pdfs/resource-limited/environmental-cleaning-508.pdf

Types of housekeeping surfaces

Housekeeping surfaces can be divided into two groups:

- Surfaces which come into frequent contact with hands or 'high frequency hand touch surfaces', i.e. door handles, tabletops, work surfaces (Fig. 6.1 and Fig 6.2), and
- Surfaces that have minimal contact with hands (low frequency hand touch surfaces, i.e. floors, walls, ceilings and window sills.

Most environmental surfaces in patients' rooms and throughout a healthcare facility are non-critical and ***do not*** require routine disinfection – thorough cleaning with ***detergent would be sufficient***. However, '***frequently hand-touched surfaces'*** must be thoroughly ***cleaned*** and ***disinfected more frequently, particularly*** those in a patient's immediate surroundings. In addition to these factors, the frequency of cleaning and disinfection should take into account high risk units, e.g. adult and paediatric intensive care units, neonatal, burns, renal, oncology, and transplant units.

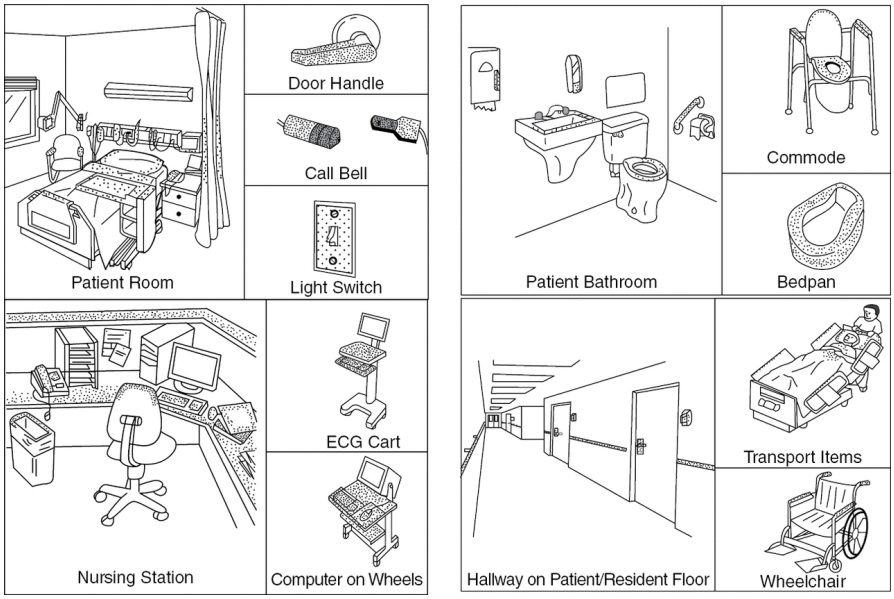


Fig. 6.1 Examples of 'high-touch' items and surfaces in the healthcare environment.

Adapted with permission from PIDAC (2018), Best Practices for Environmental Cleaning for Prevention and Control of Infections in All Healthcare Settings, 3rd ed. Ontario: Provincial Infectious Diseases Advisory Committee. Copyright © 2012 PIDAC.

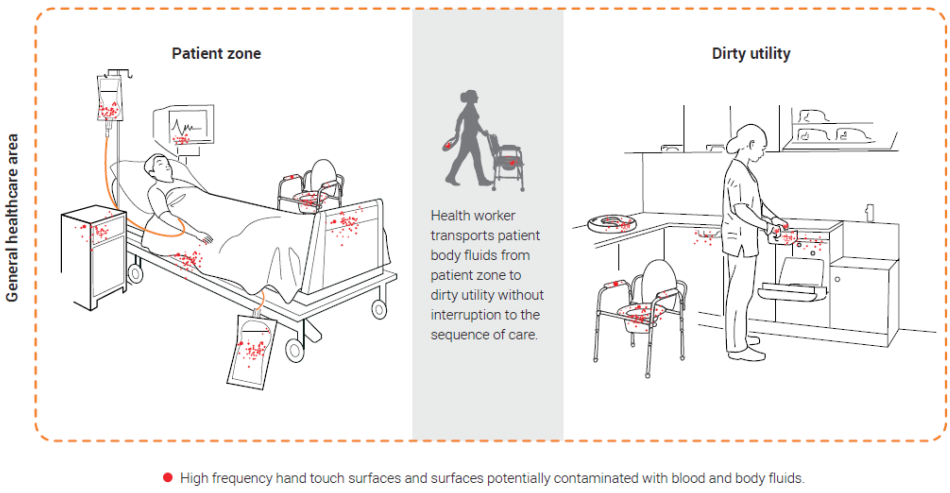


Fig 6.2 Visualizing high frequency hand touch surfaces/surfaces potentially contaminated with blood and body fluids within the context of the patient's zone.

From: Implementation manual to prevent and control the spread of carbapenem-resistant organisms at the national and healthcare facility level. Geneva: World Health Organization; 2019.

Cleaning methods

Rooms ***must*** be terminally cleaned when patients are discharged. Routine environmental swabbing to monitor the effectiveness of the cleaning process is ***not*** recommended (see Table 6.3).

Effective cleaning requires ***detergents,*** and the ***physical action of scrubbing.*** Adding detergent aids cleaning as it mixes well with water and also with organic matter. Cleaning is ***essential*** as it removes organic matter and visible soils— all of which interfere with microbial inactivation if chemical disinfectants are used. Warm water and detergent are sufficient for most purposes. In certain situations, after thorough cleaning of the environment, the use of disinfectants is also necessary as some pathogens especially ***C. difficile*** spores, ***Acinetobacter*** spp., MRSA, and VRE can survive in the environment for prolonged periods of time. The following points should be taken into consideration when cleaning is undertaken:

- All personnel should be educated and provided with practical training so that they can perform their duties effectively.
- There should be guidelines and protocols as to who is responsible (nursing personnel or housekeeping staff) for cleaning various surfaces, items and equipment.
- Staff who is performing cleaning should wear appropriate PPE and follow local procedures and protocol.
- To prevent cross contamination, cleaning must always be carried out from the cleanest area first and finish in the dirtiest area last, and always clean from the top first and bottom last.
- Colour- coded cleaning equipment should be used for each area, i.e. clinical, non- clinical, kitchen, and sanitary area, according to the local policy.
- Special emphasis must be placed on cleaning and disinfecting high frequency hand touch surfaces and these areas should be cleaned more frequently.
- Damp dusting (using pre-moistened cleaning cloths with water and detergent) of horizontal surfaces should be done daily as they gather dust more easily, and more frequently than vertical surfaces.
- The frequency of cleaning must be increased in an outbreak situation.
- Walls, blinds, and window curtains should be regularly cleaned to ensure that they are free from dirt, stains, splatters, or fungi.
- Dispersal of microorganisms into the air from the floor must be avoided. Dry sweeping with a broom should never be used as it disperses microorgan-

isms from the floor into the air. Also avoid cleaning methods that produce mists or aerosols, or disperse dust e.g. spraying, dry mopping, or dusting.

- Dust-retaining materials, which are specially treated or manufactured to attract and retain dust particles, should be used as they remove more dust from dry surfaces. This type of material represents a hygienic adaptation of the broom that it replaces and is ideal for avoiding the dispersion of contaminated dust in the environment.

- Never use formaldehyde and do not use fumigation to disinfect a patient's room – routine terminal cleaning with detergent followed by disinfection is sufficient.
- Do not routinely use 'No touch' methods of room decontamination e.g. ultraviolet (UV) devices and hydrogen peroxide systems.
- Do not use a broom (sweeping) within hospital to prevent dispersal of microorganisms from the floor into the air.

Fig 6.3 Broom *must not be used* in healthcare facilities as it disperses dust and bacteria into the air.

A ***microfiber cloth*** or mop can also be used for wet dusting and mopping. It is important to point out that ***all*** microfiber wipes are ***not*** equally effective, and if not used properly, there is some evidence that they may actually spread bacteria to other surfaces. In addition, the durability of microfiber cloth is adversely affected by hypochlorite (bleach) solution and high temperatures used during the laundering and drying process, and that their performance may decrease after multiple washings. When microfiber cloths are used for damp cleaning, ***only clean water*** should be used— an addition of detergent is not necessary. This is because grease and oil stick to polymers of microfiber cloths, and as a result, these cloths are difficult to rinse out effectively, and like conventional cleaning cloths, provide an ideal growth medium for microorganisms. Microfiber cloths are too expensive to be single use. After use, they

need to be washed in a cycle that includes thermal disinfection and then dried.

It is possible for ***vacuum cleaners*** to serve as dust dispensers if they are ***not*** operating properly. If a vacuum cleaner is used, then it ***must*** be fitted with high- efficiency particulate (HEPA) air filters on the exhaust. Doors to patients' rooms should be closed when vacuuming areas where immunosuppressed patients are located, to prevent dispersal of fungal spores. The collection bag of the vacuum cleaner must not be allowed to get too full. If used daily, the vacuum cleaner (including the cord) must be cleaned every day. In addition, the dust filter in the exhaust opening must be checked. In the event of visible blocking (dusty layer on filters) it must be replaced and/or cleaned. Bacterial and fungal contamination of filters in cleaning equipment is inevitable, and these filters should be cleaned regularly or replaced according to the equipment manufacturer's recommendations.

The moist method, using the *double bucket method,* is the most commonly used method. One bucket is for ***clean water*** to which detergent (± disinfectant) solutions are added and the other bucket contains clean water for rinsing. This method helps minimize recontamination of cleaned areas and is the preferred method of cleaning. When using the ***single bucket method,*** the solution should be changed when it is dirty, even if cleaning of the area is not complete, and ***before*** moving to another area. After each use, mop buckets should be emptied, and left ***upside down to drain*** and dry. In high-risk areas, mops should be disinfected in a thermal washing process once a day and weekly in low-risk areas. An acidic (descaling) agent can be used to prevent and remove scales from wash basins, showers, bathtubs, and toilets.

The **two bucket method** is recommended for cleaning of the healthcare environment using the following four methods:

- Wash hands, put on PPE and display the warning signs for slippery floor.
- Prepare the detergent solution in one of the mop buckets as per manufacturer's instructions provided in your training. Do not mix chemicals.
- Half fill the second bucket with clean water.
- Attach the mop head to the mop handle.
- Submerge the mop into the detergent solution and remove excess using the wringer, so that the mop is fairly dry.
- Mop the floor in 1-2 metre square sections.
- Mop edges with straight strokes and then continue working from side to side in a backwards direction, using a figure-of-eight pattern for the remainder of the section, turning the mop frequently. The floor should be fairly dry on completion.

- During the cleaning process, as the mop becomes dirty, submerge it into the second (dirty) bucket and wring out.
- Move to the next section and repeat the process.
- Replace the mop head and water solution as required throughout the cleaning process, placing the mop head in the laundry bag.
- On completion, remove the final mop head and place in the laundry bag, clean and dry all equipment and store safely and tidily in a secure storage area, segregated according to colour-coding where appropriate.
- Remove gloves and wash hands.

Three bucket method: One bucket contains the detergent or cleaning solution; one contains rinse water and the last one contains the disinfectant or disinfectant solution. This allows the mop to be rinsed and wrung out before it is re-dipped into the prepared solution. This extends the life of the solution (i.e. fewer changes are required) which saves both life and material costs.

Fig 6.4 Two bucket method

Fig 6.5 Three bucket method [13]

Source: CDC and ICAN Best Practices for Environmental Cleaning in Healthcare Facilities in Resource-Limited Settings, 2019.13 Cleaning equipment

It is essential that the chosen methods of cleaning produce minimal mists and aerosols or dispersion of dust in the patient-care areas. ***Bucket solutions*** become contaminated almost immediately during cleaning, and continued use of the solution transfers increasing numbers of microorganisms to each subsequent surface to be cleaned. Some bacteria can grow in both detergents and disinfectant solutions. Therefore, it is essential that the ***fresh cleaning solution should be made daily*** *and* any remaining solution discarded after use.

Another source of contamination in the cleaning process is the ***cleaning cloth or mop head***, especially if left soaking in dirty cleaning solutions. Therefore, it is essential

that the detachable heads of used mops must be machine laundered in a cycle that includes thermal disinfection, and dried daily. When not in use, mop buckets must be rinsed, dried, and *stored inverted* to drain fully. A simplified approach to cleaning involves replacing soiled cloths and mop heads with clean items, each time a bucket of detergent is emptied and replaced with fresh cleaning solution. If a scrubbing machine is used, then the reservoir must be drained after use and stored to dry.

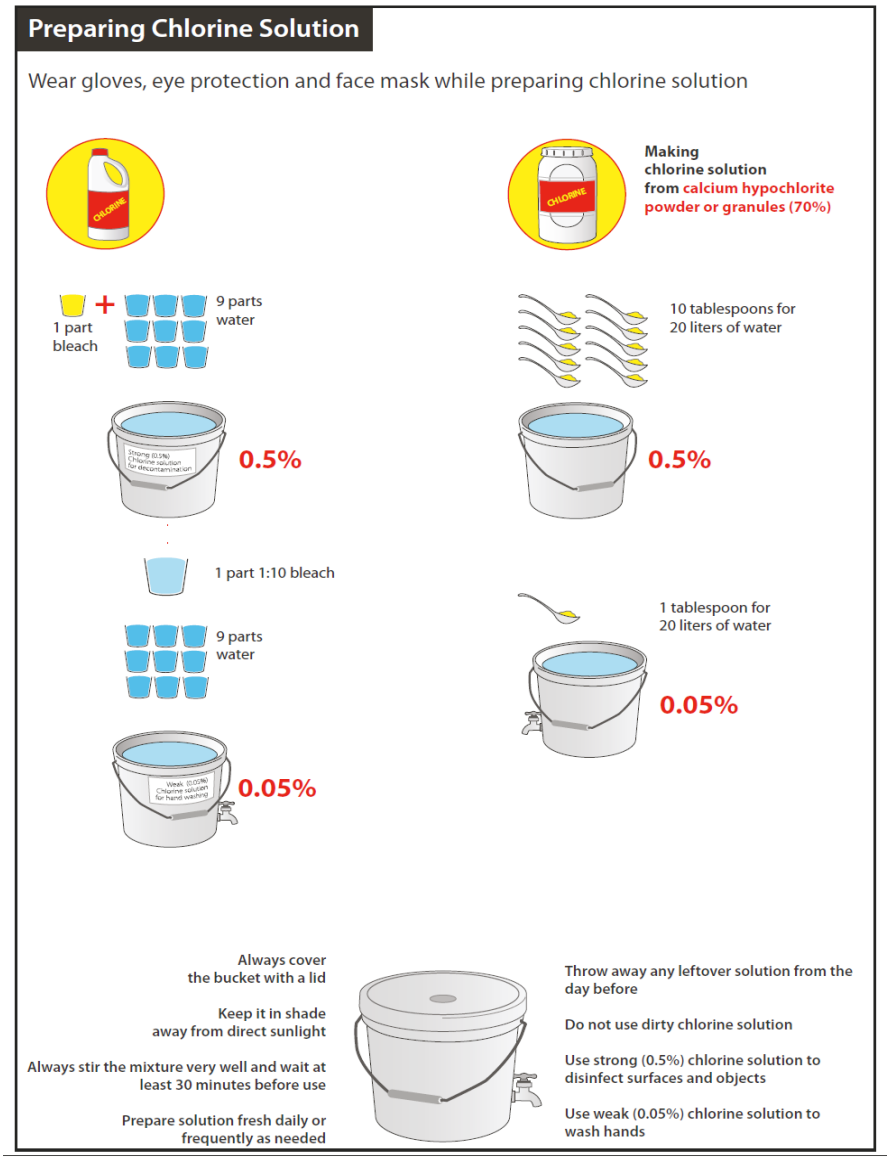


Fig 6.6: Preparing hypochlorite solution.[38]

Source: National Infection Prevention and Control Guidelines. Freetown: Ministry of Health and Sanitation, Government of the Republic of Sierra Leone.

Table 6.1 Uses of chlorine and recommended solution strengths.

Use	Available chlorine ppm1
Blood spills	10,000
Laboratory discards jars	2,500
General environmental disinfection	1000
Disinfection of clean instruments	500
Infant feeding bottles and teats	125
Food preparation areas and catering equipment	125

Adapted with modification from Fraise AP, Bradley C, eds. *Ayliffe's Control of Healthcare-associated Infection. A practical handbook*. 5th ed. London, Hodder Arnold, 2009.

[1]Undiluted commercial bleach products are usually available between 5.25% or 6.00%–6.15% sodium hypochlorite depending upon the manufacturer. There are test strips available for measuring the level of available chlorine in a diluted bleach solution, to ensure the desired concentration as outlined above.

Sodium dichloro-isocynaurate (NaDCC) tablets are also available and may be used for the preparation of chlorine solutions.

Fig 6.7: Extra high level strips (test concentration from 0 to 10,000) to check the ***original concentration*** of hypochlorite solution and high level strips (test concentration from 0 to 1000 ppm) to check the concentration of hypochlorite solution from ***after dilution*** has been made before use.

Detergent and chemical disinfectants

Various types of products are used for the cleaning and disinfection of environmental surfaces. For effective disinfection of surfaces, after thorough cleaning, apply disinfectants using the manufacturer's recommendations for ***dilution*** and ***contact time.*** Over-dilution of disinfectant solutions will make the disinfection process ***ineffective***, while a high concentration may not provide added advantage and, may ***damage*** the surface, items, and equipment. Table 6.2 lists the products used in Environmental Cleaning and their advantages and disadvantages**.**

Quaternary ammonium compounds (QACs) are widely used in healthcare surfaces as disinfectants. They have good cleaning ability and are considered to be gentle (non-corrosive and non-staining) on surfaces. They are ***less*** effective against Gram-negative bacteria than against Gram-positive bacteria and their overall antimicrobial activity is relatively limited. Some formulations can be aggressive on certain material surfaces such as copper and brass. The higher concentrations of QACs and other surfactants can cause severe irritation to the skin and mucous membranes. In diluted form, its antimicrobial efficacy is affected in the presence of hard water, fatty materials, and anionic surfactants (including soaps). ***Pseudomonas*** spp. may adapt to survive in QACs. If used incorrectly, Gram-negative bacteria can survive or grow in them. There have been reports of healthcare- associated infections associated with the use of various contaminated antiseptics and disinfectants, including QACs in healthcare settings.

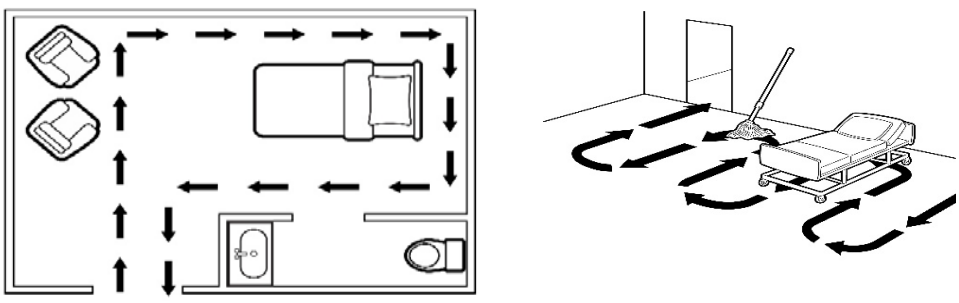


Fig 6.8: Example of a cleaning strategy for environmental surfaces, moving in a systematic manner around the patient care and in the general ward**.**

Source: Source: CDC and ICAN ***Best Practices for Environmental Cleaning in Healthcare Facilities in Resource-Limited Settings,*** 2019.[13]

Table 6.2 The Products Used in Environmental Cleaning.

Product Use	Advantage
Neutral detergent	• Good material • compatibility • Good/essential for soil removal
Alcohol 60–70% (ethanol or isopropanol)	• Rapidly bactericidal • Non-toxic • Stable in closed containers • Low cost • Rapid action • Non-staining • No residue • Effective on clean equipment/surfaces • Non-irritant
Chlorine releasing agents (for example, sodium hypochlorite, bleach 0.5%-1% available chlorine or 5000-10,000ppm)	• Low cost • Rapid action • Broad spectrum, including spores • Relatively safe • Readily available in most countries.
Hydrogen peroxide	• Stable under normal conditions, (for example, when stored in dark containers). • Non-toxic • Rapid action • Active in the presence of organic material.

	Disadvantage	Antimicrobial efficacy	Use
	• Some data demonstrate that enzymatic cleaning products are more effective than neutral detergents in removing microorganisms from surfaces.	• Not a disinfectant. • Cleaning reduces the microbial load through chemical and mechanical action.	• Critical role in the removal of soil and spillages including prior to disinfection.
	• Inactivated by organic matter. • Evaporates quickly. • Flammable – store in a cool, well- ventilated area. • Can damage /corrode some surfaces, for example, rubber/ plastic.	• A good activity against bacteria, mycobacteria. • Moderate activity against enveloped and non-enveloped viruses. • No activity or insufficient against spores.	• Can be used on external surfaces of some equipment. • Disinfection achieved after 10 minutes of contact.
	• Corrosive to metals. • Inactivated by organic materials – for blood spills, blood must be removed prior to disinfection. • Irritant/sensitizing agent - reported to cause respiratory and skin irritation and allergic reactions and one of the leading allergens affecting healthcare providers. • Stains clothing and carpets. • Corrosive/damaging • Not stable once made.	• A good activity against bacteria, mycobacteria, spores, enveloped and non-enveloped viruses.	• Spill management; disinfection of countertops and floors. • Use immediately once diluted. • Use in well-ventilated areas. • Store in closed containers away from heat and light to prevent deterioration.
	• Corrosive/damaging to a number of surfaces (for example, copper, brass, carbon-tipped devices, anodized aluminium). • Expensive • Irritant/sensitizing agent - reported to cause respiratory and skin irritation and allergic reactions and one of the leading allergens affecting healthcare providers.	• Active against a wide range of microorganisms, including bacteria, yeasts, fungi, viruses, and spores.	• Can be used for environmental cleaning under controlled conditions due to harmful effects on humans.

Clear soluble phenolics (1-2%)	• Stable • Not inactivated by organic material.
Quaternary ammonium (also known as QATs)	• Good cleaning ability and considered to be gentle (non- corrosive and non- staining) on surfaces.

From: *Implementation manual to prevent and control the spread of Carbapenem-resistant organisms at the national and healthcare facility level*. Geneva: World Health Organization; 2019.

	• Slightly corrosive/damaging. • Irritant/sensitizing agent - reported to cause respiratory and skin irritation and allergic reactions and one of the leading allergens. affecting healthcare providers.	• Good activity against bacteria. • Moderate activity against mycobacteria and enveloped viruses. • No activity or insufficient against spores. • Variable activity against non-enveloped viruses.	• Not recommended.
	• Variable stability. • Inactivated by organic material. • Slightly corrosive/ damaging to materials. • Irritant/sensitizing agent - reported to cause respiratory and skin irritation and allergic reactions and one of the leading allergens affecting healthcare providers.	• Variable to moderate activity against bacteria – overall antimicrobial. • Activity relatively limited. Less effective against Gram-negative bacteria. No activity or insufficient activity against mycobacteria and spores. • Variable activity against enveloped and non-enveloped viruses	• Not recommended.

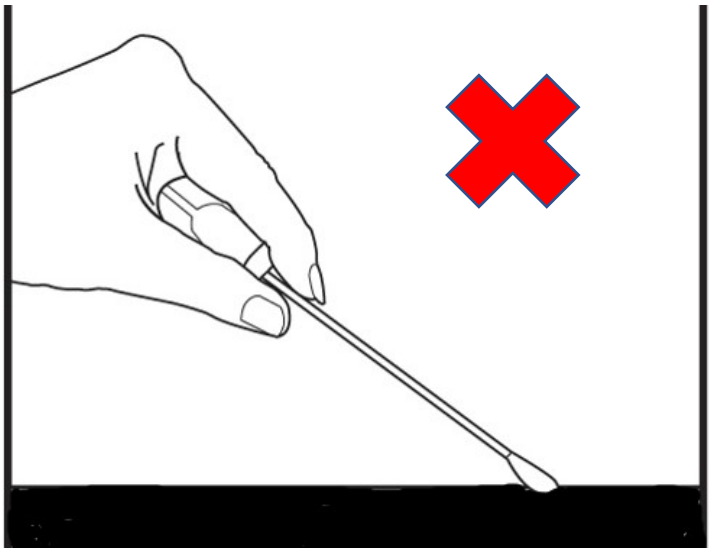


Fig 6.9 *Do not* take routine swabs from the environment to assess the effectiveness of environmental cleaning (see Table 6.3 for details).

Do not take routine swabs form the environment to assess the effectiveness of environmental cleaning.
Do not routinely use settle plates to evaluate airborne contaminants in the operating theatre

Measurements of cleanliness

The definition of 'clean' requires a validated and risk- assessed strategy to establish an accurate assessment of 'cleanliness' rather than the subjective assessment provided by visual inspection as they do ***not*** provide reliable assessments of cleanliness because assessment of cleanliness is subjective as ***what is clean is 'what an individual thinks it is'***! A summary of monitoring methods for environmental cleaning are outlined in Table 6.3**.** It is important to emphasize that LMI countries rely very heavily on environmental cultures and this practice should be abandoned to monitor the effectiveness of cleaning because this method is expensive, resource intensive, and the results of microbiological cultures are not available for 48 h. In addition, there are ***no*** agreed and accepted international standards of microbial counts for 'microbially clean'. As a result, performing ***routine*** environmental swabbing is ***not*** recommended. Microbiological cultures are useful ***only*** to establish epidemiological links during an outbreak and can be used for teaching purposes. The CDC check-list for monitoring environmental cleaning is available at: https://www.cdc.gov/hai/pdfs/toolkits/Environmental-Cleaning-Checklist-10-6-2010.pdf
For microorganisms like HBV, HCV, HIV and CCHF, terminal cleaning are done with a detergent followed by hypochlorite.

Table 6.3 The Summary of Monitoring Methods for Environmental Cleaning.

Method	Ease of use	Cost	Identifies pathogens	Useful for Teaching	Additional comments
Visual inspection	Simple	Minimal	No	Yes	• Easy to implement. However, visible checks alone are not enough and do not provide a reliable assessment of cleanliness. • Emphasis on visible dirt/soil only. • Assessment is subjective and results may vary across different inspectors.
Fluorescent marker systems	Relatively simple	Relatively less expensive than other methods.	No	Yes	• Apply clear marker/ gel to high-touch surfaces in patient/ resident rooms prior to cleaning, then evaluate to see if the marker/ gel was removed by cleaning. • Provides immediate and objective feedback to cleaning staff. • The marker may not be available in some countries.
ATP system (Adenosine triphosphate)	Relatively simple	Expensive (Requires special equipment and swabs)	No	Yes	• ATP is a chemical substance that is present in all living cells, including bacteria and viruses, but can also be confounded by the presence of bleach, microfiber products and manufactured plastics used in cleaning. • Provides a quantitative measure of the amount of bio-burden present. • Relatively light unit measurements do not correlate precisely with microbial counts as readings occur with residual organic soil and dead bacteria. • Quick results.

Culture methods (swab or agar plate)	Relatively complex	Expensive and requires provision of laboratory support	Yes (bacteria only)	Yes	• Results not available for 48 hours. • There is no clear evidence on what the accepted international standards for 'microbial cleanliness' are. • Useful to establish an epidemiological link during an outbreak. • Routine environmental swabbing is ***not*** recommended (no correlation with cleanliness).

From: Implementation manual to prevent and control the spread of Carbapenem-resistant organisms at the national and

healthcare facility level. Geneva: World Health Organization; 2019.

Based on: Damani N. Manual of infection prevention and control. 4th ed. Oxford, UK: Oxford University Press; 2019.

Management of potentially infectious spills

All spills of blood and high-risk body fluids should be carefully removed as soon as possible, and the area washed with detergent/disinfectant and dried as a part of good IPC practice. HCFs should have written protocols in place for dealing with blood and body fluid spills. It is not necessary to use hypochlorite solution for managing 'low-risk' body fluids, but it may be used if the circumstances indicate that it is necessary.

- As part of good IPC practice, it is essential that all spots and spills of blood and body materials be removed promptly, and this should be followed by cleaning and disinfection of the contaminated area.
- For spills containing large amounts of blood or other body substances, workers should contain and confine the spill by: (i) removing visible organic matter with absorbent material (e.g. disposable paper towels), (ii) removing any broken glass or sharp material with forceps, and (iii) soaking up excess liquid, using an absorbent clumping agent (e.g. absorbent granules). Alcohol solutions should not be used to clean spillages and hypochlorite (bleach) solution must not be used to clean up spills of urine due to release of toxic gas.

Methods of Cleaning Blood Spills

Splashes and drips

- Wear non-sterile gloves for this procedure.
- Wipe the area immediately with a paper towel/absorbent cloth.
- Discard immediately as clinical waste.
- Disinfect area with 10,000 ppm of hypochlorite (bleach) solution.
- Dry surface with disposable paper towels.
- Discard gloves and paper towels as clinical waste, in accordance with local policy.
- Wash hands with soap and water and dry hands immediately afterwards.

Small spills (up to 10 cm diameter or < 30 ml)

- Select appropriate PPE.
- Wipe spills immediately with absorbent material.
- Place contaminated absorbent material into impervious containers or plastic bag for disposal.
- Clean the area with a warm detergent solution, using disposable cloth or sponge.
- Wipe the area with sodium hypochlorite and allow to dry.
- Perform hand hygiene.

Larger spills

- All spills must be removed gently and carefully. Always wear the appropriate PPE (especially heavy-duty gloves); wear a single-use plastic apron if contamination of the body is likely. Use of gown, face shield, mask, and goggle are not necessary.
- Cover the area of spill with NaDCC granule (if available) or cover the spill using disposable paper towels or cloth soaked in 10,000 ppm of hypochlorite solution and leave it for 3–5 minutes. Do not pour the solution directly onto the spillage, it may cause splashing and widen the area of contamination.
- (Note: Blood has a very high level viscous organic matter, is poorly

penetrated by any disinfectant, and as such will need to be treated as infectious even if disinfection is attempted).

- Depending on the method used, either lift the soiled paper towels/ cloths or scoop up the absorbed granules and discard into a clinical waste bag in accordance with local policy.
- Clean the area with water and detergent solution.
- Wipe the surface area with fresh 1000 ppm of hypochlorite solution and rinse with water as the hypochlorite solution may be corrosive.
- Dry the surface with disposable paper towels.
- Remove gloves and plastic apron and discard as clinical waste in accordance with the local policy.
- Wash hands with soap and water immediately, and dry hands.

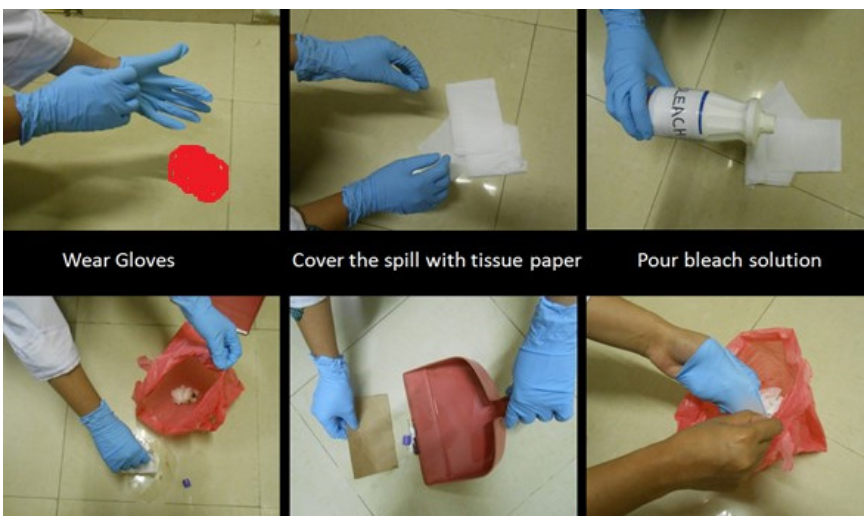


Fig. 6.10 Management of Blood Spills – never use hypochloriwte solution on urine!

Fig 6.11 Spill kit and its contents.

SECTION 7

Management of Healthcare Waste

The waste generated by any healthcare facility (esp. hospital) is a specialized type of waste. This may pose a threat not only to healthcare workers, patients and visitors, but also to the general public and the environment. Healthcare waste not only contains pathogenic microorganisms, but also sharp items and appropriate treatment of these items must be made mandatory. Therefore, it is essential that the management of clinical and related wastes must conform to the appropriate national[28,40], and international guidelines.[63] The waste generated by a healthcare facility should be dealt with by a waste management team. The team should develop a written waste management plan or if it is a small setup, a person or persons should be appointed to manage the health facility's waste. Team members should be appraised in writing of their roles and responsibilities and should meet at least twice a month. Waste management should be conducted in coordination with the Infection Prevention and Control Team. The overall responsibility rests with the medical superintendent/chief of the hospital who has to manage the subsequent team composition, its responsibilities and arranging for the resources and finances for the plan.

Education and Training

It is essential that all employees who are required to handle and move clinical waste should be adequately trained in safe procedures. They must be provided with appropriate personal protective equipment (PPE), i.e. water-repellent clothing, heavy-duty gloves, and protective footwear), and be trained in how to use the PPE. Spillages and other incidents must be dealt with according to written protocols. All accidents and incidents involving clinical waste, particularly those resulting in injury to, or contamination of handlers, must be dealt with according to the local policy.

Categories of Waste

The majority of healthcare waste (i.e. between 75 to 90%) poses no risk and can be disposed of like domestic waste- this is non-hazardous/non-infectious waste. This document pertains to hazardous waste in the following categories – infectious waste/ pathological waste and sharps only. The remaining 10 to 25% of healthcare waste is regarded as hazardous/infectious waste. Of all the categories comprising clinical

medical waste, microbiological waste and sharps waste pose the *greatest risk* for infections. The categories of healthcare waste are summarized in Table 7.1.

Table 7.1 Category of healthcare waste.

WASTE CATEGORY	EXAMPLE
Infectious waste	Waste suspected to contain pathogens e.g. laboratory cultures, waste from surgeries, autopsies and originating from patient care units etc.
Pathological waste	Human tissues, body parts, foetuses, blood and body fluids, etc.
Sharps	Sharp waste e.g. needles, scalpels, knives, blades, broken glass, etc.
Pharmaceutical Waste	Waste containing pharmaceuticals, e.g. pharmaceuticals that are expired or no longer needed, items contaminated by or containing pharmaceuticals (bottles, boxes, tubes, vials).
Genotoxic waste	Waste containing substances with genotoxic properties e.g. waste containing cytotoxic drugs (often used in cancer therapy) including syringes/vials used in preparation. Urine, faeces and vomit from patients treated with cytotoxic drugs/chemicals.
Chemical waste	Contains chemical substances, e.g. laboratory reagents, film developer, and chemical disinfectants that are expired or no longer needed etc.
Wastes with high content of heavy metals	Batteries; broken thermometers, blood-pressure gauges, etc.
Pressurized containers	Gas cylinders; gas cartridges; aerosol cans.
Radioactive	Contaminated with radionucleotides e.g. unused liquids from radiotherapy or laboratory research, contaminated glassware, packages, or absorbent paper, urine and excreta from patients treated or tested with unsealed radionuclide, sealed sources etc.

Steps in the management of healthcare waste

It is essential that all healthcare waste should include a well-defined waste stream from the point of generation till its disposal. Therefore, the steps in the management of healthcare include waste minimization and appropriate segregation/separation at the point of generation, safe collection, on-site storage, off–site transport and final disposal of waste as per local guidelines.

Structure Of The Organisation Overlooking Healthcare Waste In The Facility

Waste management committee

The overall responsibility for the safe disposal of infectious and other types of wastes rests with the head of the organization- be it small or large. The waste management team should comprise of the following members.

Medical superintendent	Chairman/Head
Heads of all the departments	Member(s)
Infection control officer	Member
Administrative head	Member
Hospital engineer	Member
Senior matron	Member
Head of sanitation staff	Member
A public representative of district administration nominated by the district coordination officer or its delegate.	Member
A representative of the Provincial Agency concerned or in the case of a hospital located in Islamabad capital territory, the Federal Agency.	Member
Any other hospital staff the MS may designate.	Member

The devolution of the waste management plan, the waste management team, the frequency of meeting, and the responsibilities of each member should be guided by relevant laws.

Waste minimization

This can be achieved by selecting items generating less waste, especially hazardous ones, maintaining good stock management, reducing the tendency to recycle, and appropriate waste segregation training at the point of generation. Minimization of healthcare waste is essential as the cost of disposal is very high.

Waste segregation

To make separate collection possible, hospital personnel at all levels, especially the nurses, support staff, and cleaners, should be trained to sort the waste they produce. The waste disposal points should be clearly marked for each ward/unit. Segregation should:

- Always be the responsibility of the waste producer.
- Take place on the site of generation or as close as possible to where the waste is generated.
- Be maintained in safe storage areas after transportation.
- Guided by behavioural clues posters at the waste disposal point.
- Be sorted into colour-coded plastic bags or containers as outlined in local guidelines.
- Ensure that general healthcare waste join the stream of community waste.
- Ensure that highly infectious waste should, whenever possible, be sterilized immediately by autoclaving. Be packaged in bags that are compatible with the proposed treatment process: red bags, suitable for autoclaving, are recommended.
- Collect low-level radioactive infectious waste (e.g. swabs, syringes for diagnostic or therapeutic use) in yellow bags or containers for infectious waste, if these are destined for incineration.
- Collect Cytotoxic waste, most of which are produced in a major hospital or research facilities, in strong, leak-proof containers clearly labelled as 'cytotoxic waste'.
- Collect small amounts of chemical or pharmaceutical waste together with infectious waste.
- Return large quantities of obsolete or expired pharmaceuticals stored in hospital wards or departments to the pharmacy for disposal. Other pharmaceutical wastes generated at this level, such as spilled or contaminated drugs or packaging containing drug residues should not be returned because of the risk of contaminating the pharmacy. Such wastes should be deposited in the correct container at the point of production.
- Pack large quantities of chemical waste in chemical resistant containers and send to specialized treatment facilities (if available). The identity of the chemicals, the name should be clearly marked on the containers. Hazardous chemical wastes of different types should never be mixed.
- Collect waste with a high content of heavy metals (e.g. cadmium or mercury) separately.

Clinical waste bag

- Clinical waste bags should be marked with a Biohazard symbol; these should be robust plastic bags marked according to the colour code.
- They should be suitably identified with the name of the healthcare facility, department that generated the waste, and the date so as to clearly identify their point of origin in case of improper disposal.
- Staples must not be used as they do not provide secure closure, may puncture the bag, and cause a sharps injury to the handler.
- Bags should be handled by the neck only and kept upright. To avoid injuries by improperly disposed sharps, the hand should not be put underneath the waste bag while lifting.
- Bags should not be more than three-quarters full.

Table 7.2 Types of healthcare waste and colour coding.

Types of Waste	Colour Coding
Infectious	Yellow/Red/Orange
Non-infectious	Blue/green/white/black
Sharps	Sharp box yellow/red and then secured in an infectious waste bag if being outsourced

Table 7.3 Types and categories of healthcare waste.

Type of waste	Category	Bag colour coding	Container	Final disposal
Infectious (Hazardous)	Infectious Pathological Sharps	Yellow/red/orange	Yellow for sharps box	Incineration Landfill
Non-infectious Non-hazardous)	General waste	Blue/green/white	-	Community/ solid waste

Sharp container

- All sharp containers should be puncture-proof (usually made of metal or high-density plastic) and fitted with covers.

- They must be correctly assembled and used according to the manufacturer's instructions. They must be puncture resistant and should comply with appropriate standards (e.g. UN 3291), if possible.
- Sharps boxes or procedure tray should ideally be within arm's reach, particularly during an injection procedure.
- They should be readily available wherever blood samples are taken, and must be kept in a location that excludes injury to patients, visitors, and staff.
- Used sharps boxes must be suitably marked for identification from wards or departments of the hospital or the healthcare facility.
- Ensure that sharps are collected together in a sharp container, regardless of whether or not they are contaminated.
- Sharps containers must be properly closed when three- quarters full and stored in a designated secure point whilst awaiting collection. The sharps container must never be overfilled, since used sharps protruding from overloaded containers constitute a very significant hazard to those who handle them.
- The staff responsible for the transport of sharp's boxes must take special care and should wear heavy-duty gloves when collecting sharps containers.
- They should be rigid and impermeable so that they safely retain not only the sharps but also any residual liquids from syringes. To discourage abuse, containers should be tamper-proof (difficult to open or break) and needles and syringes should be rendered unusable.
- Where plastic or metal containers are unavailable or too costly, containers made of dense cardboard are recommended -these folds for ease of transport and may be supplied with a plastic lining. Label 'DANGEROUS CONTAMINATED SHARPS'.

Waste Collection

Certain recommendations should be followed by the workers in charge of waste collection:

- Waste should be collected daily (or as frequently as required) and transported to the designated central storage site. A timetable should be provided to the waste originator.
- Nursing and other clinical staff should ensure that waste bags are tightly closed or sealed and in no case more than ¾ full.
- No bags should be removed unless labelled with their point of production, date, weight and contents-this information should be written on the bag or

on the printed label securely attached.

- The bags or containers should be replaced immediately in separate bins/ drums with new ones of the same type.
- Ensure cleaning of the bin/container before a new bag is fitted.
- Staff who regularly have to handle, transfer, transport, or incinerate clinical waste containers must be provided with appropriate PPE, i.e. heavy-duty gloves, appropriate footwear, industrial apron or leg shields, waterproof clothing, face visors and respiratory equipment as required.
- Spillages of waste should be treated according to the local policy.
- All accidents and incidents involving clinical waste, particularly those resulting in an injury or of contamination of handlers, must be reported without delay to the line manager.

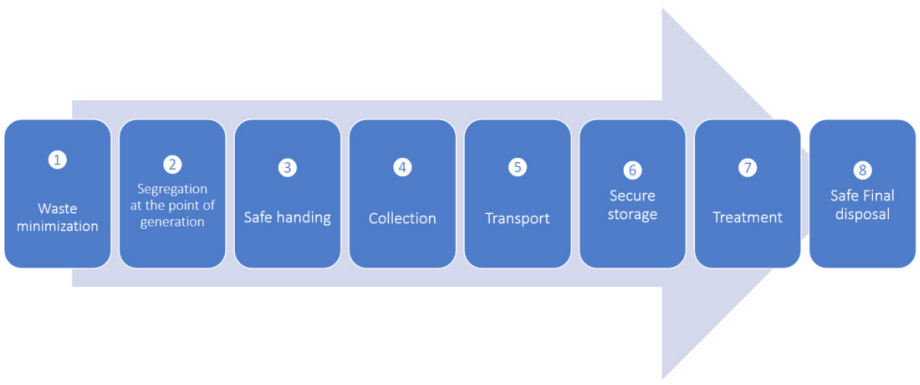


Fig 7. 1 The waste management cycle.

Storage of the waste

Recommendations of storage facilities for healthcare waste:

- A storage location should be designated inside the facility and sized according to the need.
- Should have an impermeable, hard-standing floor with good drainage and be easy to clean and disinfect.
- Should have a water supply for cleaning purposes.
- Should afford easy access for the staff in charge of handling the waste.
- Should be possible to lock the store to prevent access by unauthorized persons.
- Easy access for waste-collection vehicles is essential.
- They should be protected from the sun.

- The storage area should be inaccessible to animals, insects, and birds.
- There should be good lighting and at least passive ventilation.
- Should not be situated in proximity of fresh food stores or food preparation areas.
- Storage time should not exceed 24-48 hours.

A supply of cleaning equipment, hand washing facilities with soap and drying material, availability of personal protective equipment (heavy-duty gloves, boots, gown, etc.) and waste bags or containers should be located conveniently close to the storage area.

Waste transport

On-site transport of healthcare waste should be by means of wheeled trolleys, containers, or carts that are not used for any other purpose and meet the following specifications:

- Must follow specific routes to the central storage area.
- Easy to load and unload.
- No sharp edges that could damage waste bags or containers during loading and unloading.
- Easy to clean and wash.
- Marked with corresponding colour coding.

The collection route should be direct; waste should not be left unattended even temporarily. The staff should be properly trained for documentation, collection, handling and disposal, and must wear proper personal protective equipment. There should be a contingency plan for the resources for emergency spill management.

Treatment and disposal of the waste

Each healthcare facility should identify a method for the treatment and disposal of hazardous waste, according to the national and local guidelines.

Infectious waste

Incineration in double-chamber incinerators should be the method of choice in establishments that apply minimal waste management programmes. Highly infectious waste (esp. Hazard Group 3 and 4 pathogens), microbiological cultures and stocks

of infectious agents from laboratory work, ***must be sterilized by autoclaving*** in the laboratory at the earliest stage not allowing accumulation for more than 24 hours. Clinical waste harbouring or suspicious of harbouring Hazard group 3 and 4 pathogens should be ***sterilized by autoclaving before*** transportation from the laboratory and healthcare facility to the incinerator. In the case of an autoclave malfunction, it should be packaged in accordance with the approved requirements for carriage, and transferred to an incinerator as soon as possible. For other infectious healthcare wastes, disinfection to reduce the microbial concentration is sufficient as per the local policy.

Wastes requiring incineration include:

- Anatomical parts and animal carcasses.
- Cytotoxic drugs (residues or outdated).
- Toxic laboratory chemicals other than mercury.

Wastes that may be incinerated include:

- Patient-contaminated non-plastics.
- Non-chlorinated plastics.

Wastes that should not be incinerated include:

- Chlorinated plastics.
- Volatile toxic wastes such as mercury.
- Plastics, non-plastics contaminated with blood and body fluids, secretions and excretions, and infectious laboratory wastes. (Such wastes should be treated by steam sterilization in an autoclavable container/bags or by microwave treatment. Shredding may follow both of these methods. If neither method is available, a chemical disinfectant can be used as per the local policy based on international recommendations. 63 However, excessive use of chemical disinfectants should be avoided, as it may be a health and environmental hazard.

Sharps disposal

- Sharps are collected in puncture-proof and leak-proof containers, such as high-density polyethylene boxes, metallic drums, or barrels.
- Sharps should undergo incineration whenever possible.
- When a container is three-quarters full, a material such as cement mortar, bituminous sand, plastic foam, or clay is poured until the container is filled.

After the medium has dried, the containers are sealed and disposed of in landfill sites.

- After incineration or other disinfection, the residues can be disposed of in a pit. Such a pit can be dug and lined with brick, masonry or concrete rings. The pit should be covered with a heavy concrete slab, which is penetrated by a galvanized steel pipe.
- Burial should be 2 to 3 meters deep and at least 1.5 meters above the groundwater level. When the pit is full, it can be sealed completely but before that another pit must have been prepared.
- Another easy method for safe disposal of sharps is encapsulation.

Monitoring

These aspects should include an audit of the waste disposal procedures. It should include input on the waste generated from the hospital in terms of category and disposal methods, financial implications, training and cost of operations. The survey should include injuries and related occupational issues as well.

SECTION 8

Protection of Healthcare Workers

Protection of staff is an integral part of health and safety. It is the responsibility of all healthcare facilities (HCFs) to ensure that all their employees are appropriately trained and proficient in the procedures necessary for working safely. All healthcare workers (HCWs) must be given adequate education and ***practical*** training on all issues relating to Infection Prevention and Control (IPC) as part of their induction/orientation programme and this training should be made mandatory.

Responsibility of Healthcare Facility

All HCWs should have access to an employee healthcare programme, charged with the following duties:

- Perform pre-employment health assessment by screening the health of all staff via questionnaire and/or medical examination.
- The screening process includes assessment of health covering questions related to general health, history of infectious diseases, and immunization status.
- Keeping accurate and up- to- date records of all members of staff.
- Immunization of all existing staff at the required time interval.
- Arrange training of all grades of staff in IPC, personal hygiene, and management of sharps injuries and exposure to blood and body fluids.
- Examine staff returning to work after an absence due to diarrhoea or other infectious conditions, to ensure that the infection has cleared and to give advice to the chronic carrier of microorganisms.
- Keeping records of all sharps/ inoculation injuries, and arrange post-exposure prophylaxis and counselling of staff if necessary.
- Survey potential infective/microbiological and chemical (e.g. chemical disinfectant) hazards to staff in HCFs.

It is also important to ascertain the immune status if the HCW has either had or been vaccinated against tuberculosis, rubella, measles, mumps, chickenpox, and hepatitis B virus. In addition, the presence of skin disorders, such as eczema and infectious condition, or a history of an underlying immunosuppressive disorder might require

reassessment of the staff member's work practices. It is important for employees to be given assurance of the ***complete confidentiality*** of any health questioning and their health record.

Responsibility of healthcare workers

In addition, it is the responsibility of every employee to play their role in IPC and incorporate good practices into their daily activity to ensure their health and safety and that of others. It is important to note that certain medical conditions of HCWs (e.g. pregnancy, immune status, and certain skin conditions) increase their predisposition to infection.

The staff should not work if they suffer from acute or chronic diarrhoeal disease or febrile respiratory illness. Catering staff need to be carefully questioned about gastrointestinal infection, history of enteric fever, skin conditions (e.g. infection, allergic eczema, psoriasis, and exfoliative dermatitis), recurrent sepsis, and tuberculosis. Staff with either shedding or weeping skin conditions or damaged skin may readily be colonized by multidrug- resistant organisms (MDROs) present in the healthcare environment.

It is the responsibility of HCWs that if they have any reason to believe that they have been exposed to a serious transmissible infection, they ***must seek*** and follow professional advice without delay on whether they should undergo any testing and whether, they should modify their professional practice or current duties. It is essential that HCWs ***must not rely on their own assessment*** of the risks. Staff who are or have reason to believe that they may have been exposed to bloodborne viruses (hepatitis B, C or HIV) must declare this and discuss it in complete confidence to the senior medical personnel of the HCF as per the local policy.

Immunization

All HCWs should be immunized against vaccine- preventable diseases (tetanus, diphtheria, polio, measles, mumps, and rubella etc.) and should have up to date record of their routine immunizations. This is important in the context of the ability of staff to transmit infections to vulnerable groups but also for their ***own*** protection (see Table 8.1).

Table 8.1 Suggested schedule for immunization.

VACCINATION	DOSE	COMMENTS
MMR* (Mumps, Measles & Rubella)	Two doses a month apart	
Varicella	Two doses: now; at 1-3 months	HCW without a history of chickenpox.
Tdap* (DPT) (Tetanus, Diphtheria & Pertussis)	One dose (in lifetime) One dose for each pregnancy in female HCW	Tetanus booster (TT) Booster in 10 years
Hepatitis B*	Three doses: 1st dose, 2nd dose after one month and 3rd dose after 6 months.	Check antibody levels1– 2 months after the completion of course In case of immunity, a booster dose is not required
Typhoid	Single dose	To be repeated as per recommendation in high risk groups (food handlers and microbiology workers)
Influenza	Yearly	
Meningococcal vaccine (Groups A, C, Y &W 135 strains)	One dose	Outbreak situations or to exposed HCW

* Vaccinate if not immune

Management of sharps injuries & blood and body fluid exposure

The occupational exposure to blood and body fluids from bloodborne pathogens remains a serious concern and the risk of acquiring infections depends on the sero-prevalence in the general population. It is important to note that more than 30 different pathogens have been documented to cause infection after exposure to blood or body fluids in HCW and laboratory personnel.

This chapter mainly deals with the action to be taken against exposure to blood or body fluids in relation to HBV, HCV, and HIV infections. It has been estimated that the risks of transmission of infections are 0.3% (~1:3000) for percutaneous exposure and 0.1% (~1:1000) for mucocutaneous exposure to HIV-infected blood, 3% (1:30) for percutaneous exposure to Hepatitis C infected blood with detectable viral RNA and up to 30% (1:3) for percutaneous exposure of a non-immune individual to an HBeAg positive source. It is important that all HCWs should adopt a safe system of work when using or disposing of sharp objects. When undertaking any task or activity which has

the potential to result in exposure to blood, body fluids, or tissues, HCWs must use standard IPC precautions, including hand hygiene and appropriate use of PPE.

Sharps injury may be defined as an incident where the skin is punctured by an instrument or object that is ***contaminated*** with human blood, high-risk body fluids, or tissue (see Box). For practical purposes, the staff that experience contamination of the eyes, mouth, skin, cuts or abrasions, by splashes or spills will be managed in line with the sharps management policy.

First aid

- Allow the wound to bleed and then rinse under running water and wash with soap.
- Don't scrub or suck the wound.
- Cover with waterproof dressing.
- Exposed mucous membranes, including conjunctivae should be irrigated copiously with running water or saline, after removing contact lenses.
- After a splash into the mouth, do not swallow but rinse out the mouth several times with cold water.

Report the incident to the line manager in the department ***without delay*** and complete an incident form and contact an IPC health expert, as per the local guidelines that will carry out risk assessment about the injury and take appropriate action. It is essential that HCWs must not rely on their own assessment of risks.

HIGH-RISK BODY FLUIDS

High- risk body fluids include blood, amniotic fluid, semen, vaginal secretions, human breast milk, cerebrospinal fluid, peritoneal fluid, pleural fluid, pericardial fluid, synovial fluid, saliva in association with dentistry (likely to be contaminated with blood, even when not visibly so), exudative or other tissue fluid from burns or skin lesions, and unfixed tissues and organs. *Low-risk body fluids* (unless they are visibly stained) include urine, vomit, saliva (non- dentistry associated) and faeces.

Risk assessment

The risk assessment is an essential part of the management and necessitates the collection of the following information for assessment:

- Type of fluids: blood, type of body fluids, and other potentially infectious tissue.
- Inoculum size: Assess inoculum size by
- Type of injury, extent and depth, i.e. superficial or deep.

- Size and type of contaminated needle, i.e. was the instrument/ needle hollow bore or solid and was visible contamination with blood seen?
- Degree and duration of contamination, i.e. massive or small and the duration of contact with blood and body fluids with the skin or mucous membrane.
- If the injury was caused by a needle, had it been used to inject drugs or to withdraw blood and it was attached to a syringe containing blood?

Evaluate the source patient and HCW

Following informed consent, request source sample for urgent testing for HBV, HCV, and HIV— consider using rapid testing. For unknown sources, assess the risk of exposure to infection. The discarded needles or syringes cannot be tested for blood-borne viruses. Evaluate the exposed HCW and the assessment is based on the risk analysis. Give appropriate PEP, if the risk is significant of HIV, or HBV and HCV. If the source is unknown, then gather as much information as possible to make a risk assessment.

Post-exposure prophylaxis

If post-exposure prophylaxis (PEP) is being considered, the injured person must be risk assessed and counselled. Following counselling and advice, the injured worker may, in the absence of any contraindication decide to start PEP as outlined below:

Hepatitis B: As per local guidelines, discuss with the local expert who will assess the immune status for HBV infection and will take appropriate action. Based on the assessment, Hepatitis B vaccine ± Hepatitis B immunoglobulin can be given (Table 8. 2).

Hepatitis C virus: Currently no vaccine is effective in the prevention of HCV transmission. However, treatment of acute hepatitis C infection is known to be highly effective. Please refer to the local expert for assessment, testing and treatment as per the local guidelines.

Human immunodeficiency virus (HIV): Urgent action is required. HIV PEP consists of a 28-day course of anti-retroviral. If indicated, the PEP should be started as soon as possible, ideally within one hour of the injury or within 72 hours' post-exposure. The HCF should keep starter packs usually in the pharmacy and this consists of a 3 to 5-day starter pack of anti-retroviral therapy. If PEP is started, risk assessment, counselling, review of the test result and monitoring of treatment is essential by local infection disease. Please refer to the WHO for details. 23https://www.who.int/hiv/pub/prophylaxis/02.pdf

Table 8. 2 Hepatitis B virus prophylaxis for reported exposure incidents.

Hepatitis B virus status of person prior to exposure	**Significant exposure**	
	HBeAg-positive source	Unknown source
Unvaccinated	Accelerated course of Hep B vaccine plus HBIG with first dose.	Accelerated course of Hep B vaccine.
Partially vaccinated	One dose of Hep B vaccine and finish course.	One dose of Hep B vaccine and finish course
Fully vaccinated with primary course	Booster dose of Hep B vaccine if last dose ≥1year ago	Consider booster dose of Hep B vaccine if last dose ≥ 1year ago
Known non-responder to Hep B vaccine (anti-HBs < 10m IU/ml 1–2 months post-immunisation)	HBIG Booster dose of Hep B vaccine. A second dose of HBIG should be given at 1 month.	HBIG Consider booster dose of Hep B vaccine. A second dose of HBIG should be given at one month.

HBs: Hepatitis B surface antigen; HBIG = Hepatitis B Immunoglobulin

Adapted from, PHLS Hepatitis Subcommittee. Exposure to hepatitis B virus: guidance on post-exposure prophylaxis.CDR 1992; 2: R 97–101.

Table 8.3 Characteristics of transmissible infections and recommended work restrictions for healthcare workers who are colonized or exposed to most common infectious agents.

Disease	**Mode of transmission (IP: Incubation period)**
Conjunctivitis (viral, e.g. adenovirus)	Physical contact of contaminated hand at mucosal surfaces.
Cytomegalovirus infection	Physical contact with virus at mucosal surfaces.
Diarrhoeal diseases	Faecal–oral and fomites.

Significant exposure	Non-significant exposure	
HBeAg-negative source	Continued risk	No further risk.
Consider course of Hep B vaccine.	Initiate course of Hep B vaccine.	No HBV prophylaxis. Reassure.
Complete course of Hep B vaccine.	Complete course of Hep B vaccine.	Complete course of Hep B vaccine.
No HBV prophylaxis. Reassure.	No HBV prophylaxis. Reassure.	No HBV prophylaxis. Reassure.
No HBIG Consider booster dose of Hep B vaccine.	No HBIG Consider booster dose of Hep B vaccine.	No HBV prophylaxis. Reassure.

Communicability (Duration of shedding and infectivity) 1	Work restrictions
Low	• Restrict from patient's contact and contact with the patient's environment until discharge ceases from eyes.
Low (weeks)	• No restriction. Apply standard IPC precautions, especially hand hygiene.
Medium to high depending on the microorganisms	• Risk assess. Acute disease: Exclude from duty until symptoms resolve (i.e. after > 48–72 h) • Food handlers and carriers for high-risk patients: refer to local guidelines regarding the need for negative stool culture before return to work esp. with Salmonella spp.).

Disease	Mode of transmission (IP: Incubation period)
Diphtheria	Droplet and contact IP: 2–5 days (range 2–7 days)
Enteroviral infections	Faecal–oral and fomites
Hepatitis A	Faecal-oral IP: 28–30 days (range 15–50 days)
Hepatitis E	Faecal–oral IP: 15–64 days (range 3–6 weeks)
Hepatitis B	Bloodborne IP: HBV 75 days (range 45–180 days)
Hepatitis C	IP: HCV 20 days to 13 weeks (range: 2 weeks to 6 months)
Herpes simplex (herpetic whitlow)	Herpes simplex (IP: 2–12 days)
HIV infection	Bloodborne (IP: usually 2 weeks to 3 months from exposure)
Influenza	Droplet, airborne, and contact (IP: 2–3 days)
Measles (Rubeola virus)	Respiratory droplet (IP: 7–18 days)

Communicability (Duration of shedding and infectivity) 1	Work restrictions
High	• Exclude from duty until antimicrobial therapy completed and two cultures obtained 24 h apart are negative.
Low to medium (1–8 weeks)	• Restrict from the care of infants, neonates, or immunocompromised patients and their environments until symptoms resolve.
Medium (about 2 weeks after the onset of jaundice)	• Not known, but the restriction from work until 14 days after onset of jaundice is advisable. • Women in the 3rd trimester of pregnancy are susceptible to fulminant disease.
Medium	• Restrictions based on review of HCW to perform exposure prone procedures by the IPC health physician.
Medium	• Restrictions based on review of HCW to perform exposure prone procedures by the IPC health physician.
High if breakdown in hand and personal hygiene. (1–8 weeks)	• Restrict from patient contact with the patient's environment until the lesion is fully healed, dry, and crusted over. • Evaluate for need to restrict from care of high-risk patients.
Low	• Restrictions based on review of HCW to perform exposure prone procedures by the health physician.
High. (-1 to 7 days) Viral shedding usually ceases within 5–7 days but can persist longer in children or immunocompromised individuals	• Exposed HCW: None but educate staff and monitor symptoms. • Infected HCW: Exclude from duty until they are asymptomatic. • Consider chemoprophylaxis with anti-viral agent for nonimmune HCW based on the risk of complications and exposure characteristics. • Encourage to take seasonal flu vaccination.
Very high (-2 to + 5 days)	• Exposed HCW: Day 1–4 no restrictions. Day 5–21 for a single exposure and/or after the rash appears). Exclude HCW from work. • Give MMR vaccine to non-immune HCW within 72 hours of exposure to modify infection.

Disease	Mode of transmission (IP: Incubation period)
Mumps Active	Respiratory droplet. (IP: 14–19 days) Contact with saliva or items contaminated with saliva from an infected person without wearing gloves.
Methicillin-resistant Staph. aureus (MRSA)	
Norovirus	Faecal-oral and fomites (IP: 1–3 days)
Bordetella pertussis (Whooping cough)	(IP: 7–10 days) (Range: 6–20 days)

Communicability (Duration of shedding and infectivity) 1	Work restrictions
High in certain cohorts (- 6 to + 4 days) Most communicable 48 hours before onset of illness, but may begin as early as 7 days before onset of overt parotitis and/or orchitis and continue 5–9 days thereafter (average 5 days).	• Assess immunity and HCW is susceptible unless they have documented serologic evidence of immunity or receive 2 doses of live mumps virus containing vaccine. • Exposed Nonimmune HCW: Day 1–11 no restrictions. Day 12–25 for a single exposure or day 12 after first exposure through day 25 after last exposure or after onset of parotitis. Exclude HCW from work. • Infected HCW: May return to work 5 days after onset of parotid gland swelling and they are asymptomatic. • Mumps vaccine not proven to prevent infection after exposure.
	• Colonized: No restrictions unless ill or epidemiologically/molecular test linked to cross-infection to patients. • Allow to work provided lesions can be contained under some bandage and clothes. If lesions on exposed area (e.g. hand/wrists and/or face/neck), exclude from duty until lesions healed.
Very high. (up to 2 weeks)	• Allow back to work 72 h after symptoms are resolved.
Low to medium. Clinical diagnosis can be confirmed by paroxysmal cough, inspiratory whoop, or other respiratory symptoms. Lab evidence can be confirmed by positive DFA, culture, PCR, or serology for Bordetella pertussis.	Most contagious during the catarrhal state and communicability diminishes rapidly after onset of cough, but can persist as long as 3 weeks. Exposed HCW: Exclude from duty from beginning of the catarrhal stage through 3rd week after onset of paroxysms, or until 5 days after start of effective antibiotic therapy (Azithromycin 500 mg per day for 5 days or Erythromycin QID for 14 days). If HCW has no symptoms, consider prophylaxis within 21 days of exposure for high risk HCW caring for high risk patients, e.g. infants, pregnant women in the 3rd trimester, immunocompromised patient, patients with asthma or lung disease.

Disease	Mode of transmission (IP: Incubation period)
Scabies	IP: 1–4 days if previous infestation; 4-8 weeks if no previous infestation
Rubella virus	Droplet and airborne IP: 14 days (range: 12-23 days Also contact with nasopharyngeal secretions or urine from infant with congenital rubella without wearing gloves.
Mycobacterium tuberculosis	Airborne form pulmonary infection or wound drainage from infected wound IP: 4–12 weeks (variable)
Viral respiratory tract infections (Acute)	

Communicability (Duration of shedding and infectivity) 1	Work restrictions
Low to medium Direct prolonged, close, skin-to-skin contact. Minimal direct contact with crusted scabies (Norwegian) can result in transmission and can offer before the onset of symptom.	Exposed HCW: No restriction, educate and monitor symptom. Infested: Immediate restriction to patient contact until 24 hours after treatment after medical evaluation.
Low 7 days before rash to 7 days after rash appears. Most contagious when the rash first appears and up to 1 year for infants with congenital rubella.	Exposed Nonimmune HCW: Day 1–6 no restrictions. Day 7–21 for a single exposure or day 7 after first exposure through day 23 after last exposure. HCW must not work or have direct patient contact and work only with immune persons in non–patient care areas Exposed Immune: None but educate and monitor symptom for infection Infected HCW may return to work 8 days after developing a rash Rubella vaccine does not prevent infection after exposure and presence IG does not prevent infection.
Low to medium	Obtain baseline TST within 2 weeks of exposure if HCW previously negative or unknown status. Perform post exposure TST at 12 weeks and prescribe treatment if post exposure TST is positive. Exposed HCW: Refer to IPC OHD. None for persons whose TST become positive. TB until they are on effective anti-TB and have 3 consecutive negative sputum smears.
	No restrictions unless illness develops. Consider restrictions, if HCW exposed to highly contagious disease transmitted by the respiratory route or close contact MERS-CoV or other infectious disease which may present with respiratory symptoms (Ebola virus, etc.) Febrile. Exclude from duty until afebrile and asymptomatic for >24 h. Afebrile: Exclude from care of immunocompromised patients, i.e. patients cared for in a protected environment until afebrile for >24 h or 7 days from onset of symptoms, whichever is longer. HCW should wear a surgical mask providing care until symptom-free.

Disease	Mode of transmission (IP: Incubation period)
Varicella zoster virus (Chickenpox and herpes zoster)	Airborne, droplet, and contact IP: 10–21 days (Average: 14 days).

IP = Incubation period. [1] Degree of communicability and infectivity: High = ≥ 50%;

Medium =10–50%; Low = <10%

From: Damani N. Manual of Infection Prevention and Control.

Oxford: Oxford University Press, 2019.

Communicability (Duration of shedding and infectivity) 1	Work restrictions
High: Infectious 2 before to 7 days after or until scabbed). > 5 minutes' face-to face contact with an infected person without wearing a respirator. Direct contact with vesicle fluid without wearing gloves. Immunocompromised persons may be contagious as long as new lesions are appearing.	• Exposed Immune HCW: Definite history of chickenpox or obtain serologic evidence of immunity or has 2 documented doses of varicella vaccine. • Exposed non-immune: Day 1–7; no restrictions. Day 8–21 for a single exposure or day 8 after 1st exposure through day 21 after last exposure. They should be instructed to take twice daily temperatures and to remain at home if they are febrile, as this could be the first sign of a prodromal illness. • Administer varicella virus vaccine to susceptible HCW within 3 days of exposure to prevent or modify infection, remember that giving the vaccine does not change the work restrictions. • Chickenpox is infectious 2 days prior to onset of rash through to the 21st to 27th day if VZIG is given after last exposure. • If infected, exclude from duty until all lesions are dry and crusted.

ANNEX 1

Food Safety

Access to an adequate amount of safe and nutritious food is vital in order to promote good health. Unsafe food containing harmful bacteria, viruses, parasites or chemical substances, causes more than 200 diseases – ranging from diarrhoea to cancers.

Diarrhoeal diseases are extremely common illnesses resulting from the consumption of contaminated food. Approximately, 550 million people succumb to them each year and 230,000 deaths are reported annually. Food safety, nutrition and food security are inextricably linked.

Food industry workers and individuals working in healthcare facilities who are preparing and handling food need to notify their employers of the following:

- Diarrhoea and/or vomiting.
- Skin Rash/ Skin Lesion (e.g. boils, cuts, etc.).
- Respiratory infections and sore throat.
- Pus containing discharges from the eyes, ears, nose or mouth/gums.
- Jaundice.
- Fever.

Key Points in Food Preparation

1. Keep Clean

- Wash your hands before handling food and often during food preparation.
- Wash your hands after going to the toilet.
- Wash and clean and disinfect surfaces and equipment used for food preparation.
- Protect kitchen areas and food from insects, pests and other animals.

2. Separate raw and cooked food to prevent cross contamination and transfer of micro-organisms

- Separate raw meat, poultry and other seafood from other food.

- Use separate (preferably different colour) equipment like knives and chopping boards for raw food.
- Store food in containers to avoid contact between raw and cooked food.

3. Cook thoroughly

- Cook food thoroughly, especially eggs, poultry, seafood and meat.
- Reheat cooked food thoroughly.

4. Keep food at safe temperatures

- Do not leave cooked food for more than 2 hours at room temperature.
- Refrigerate promptly all cooked and perishable food.
- Keep cooked food piping hot (more than 63°C) prior to serving.
- Do not thaw frozen food at room temperature.

5. Use safe water and raw materials

- Use safe water and meat.
- Select fresh and wholesome foods.
- Choose safe foods like pasteurized milk over raw milk.
- Do not use food beyond the expiry date.

Food handlers and consumers should

- Know the food they use. Read labels on food packaging, make an informed choice, and be familiar with common food hazards.
- Handle and prepare food safely.
- Face masks are recommended for people who may cough or sneeze while handling food.
- Wear gloves that can be used to cover any cuts or lesions and should be changed frequently.

Other Precautions:

- Seek medical advice when bowel movements are very frequent, very watery or contain blood.
- Try not to handle or prepare food during gastrointestinal symptoms and

for 48 hours after symptoms stop. However, if this cannot be avoided, wash hands with soap and water first and frequently during food preparation.

- Food handlers should wear suitable, clean and appropriate outer clothing. Personal hygiene is also of great importance. Hairs should be kept neat and tidy. Hair restraints and beard restraints should be worn where appropriate. The use of jewelry should be avoided.
- Where vomiting occurs in a food handling area, exposed food should be disposed of. The area should be cleaned and subsequently disinfected with a freshly prepared hypochlorite solution (1,000 ppm) as per manufacturer's recommendation.
- The importance of reporting needs to be repeatedly emphasized at pre-employment (with written instruction), at refresher training and annually.

Laboratory investigation of Food Handlers

- Routine stool screening is not necessary for all sporadic cases.
- Microbiological stool clearance before return to work is always applicable to high-risk* food handlers in relation to confirmed or suspected infection with Typhoid, Paratyphoid, Verocytotoxin-producing E. coli (VTEC) Shigella dysenteriae and jaundice.
- The legal requirement for medical certification of food handlers should be used as an opportunity to promote personal and food handling hygiene, and to emphasize the importance of illness reporting.

Conditions in which Food Handlers should not be allowed to work Hepatitis A

- A food handler infected with Hepatitis A (HAV) should be excluded from food handling duties for seven days after the onset of jaundice and/or symptoms.
- A food handler in contact with a Hepatitis A case need not be excluded, provided good hygiene practices are observed.
- Routine Hepatitis A vaccination of food handlers is not indicated.
- When a food handler is a household contact of a confirmed case of HAV, the food handler should be considered for prophylaxis (HNIG or HAV vaccine).
- Food handling colleagues of a food handler case of Hepatitis A, should be included as close contacts.

Typhoid/Paratyphoid

- **Case:** Exclude until 6 consecutive negative stool samples are obtained, taken at 2-week intervals, starting 2 weeks after completion of antibiotic treatment.
- **Carrier:** Exclude until 6 consecutive negative stool samples are obtained, taken at 2-week intervals.
- **Suspected case:** (History suggestive of enteric fever): Consider need to obtain 6 consecutive negative stool samples at 2-week intervals.
- **Contact of case/outbreak:** Exclude until 3 consecutive negative stool samples are obtained, taken at weekly intervals, starting 3 weeks after last contact with an untreated case.
- **Household contact of the carrier:** Consider excluding until 3 consecutive negative stool samples are obtained, taken at weekly intervals, starting from the date of carrier identification.

Staphylococcus aureus

- Nasal carriers of S. aureus need not be excluded from food handling, but need to avoid unhygienic practices.

Skin Lesions

- Exclude high-risk food handlers with infected skin lesions on exposed body parts that cannot be adequately covered (with waterproof dressing) until healed.

Group A Streptococci

- Treatment of nasal carriage is generally not indicated; it may be considered where the food handler is implicated in an outbreak Group A (ß-haemolytic) streptococci.
- Exclude high-risk food handlers with streptococcal sore throat until symptom resolution.
- Exclude high-risk food handlers with infected skin lesions on exposed body parts that cannot be adequately covered (with waterproof dressing) until healed.

Vibrio cholerae

- High-risk food handlers infected with V. cholerae 01 or 0139 should be excluded for 48 hours after the first normal stool. When microbiological clearance is indicated (e.g. sanitary facilities/ personal hygiene suspect), two consecutive negative stools at intervals of at least 24 hours are required.
- Prolonged carriage is rare. If treatment of carriage is considered, sensitivities should guide the choice of antimicrobial used in view of the possibility of resistant strains.

Amoebic Dysentery

- High-risk food handlers should be excluded for 48 hours, after the first normal stool. While microbiological clearance is not required to return to work, treatment of the carriers of pathogenic strains is recommended

ANNEX 2.

Minimum requirements for Infection Preventionand Control

At primary, secondary and tertiary healthcare facility levels [86] based on the WHO Eight Core components [74]

1. IPC PROGRAMMES		
Primary Care	**Secondary Care**	**Tertiary Care**
IPC trained healthcare officer • Trained IPC link person, with dedicated (part-time) in each primary healthcare facility. • One IPC trained healthcare officer at the next administrative level (for example, district) to supervise the IPC link professionals in primary healthcare facilities	Functional IPC programme • Trained IPC focal point (one full-time trained IPC Officer [nurse or doctor]) as per the recommended ratio of 1:250 beds with dedicated time to carry out IPC activities in all facilities (for example, if the facility has 120 beds, one 50% full-time equivalent dedicated officer) • Dedicated budget for IPC implementation.	Functional IPC programme • At least one full-time trained IPC focal point (nurse or doctor) with dedicated time per 250 beds. • IPC programme aligned with the national programme and with a dedicated budget. • Multidisciplinary committee/ team. • Access to microbiology laboratory.

2. IPC GUIDELINES	
Primary Care	**Secondary and Tertiary Care**
Facility-adapted standard operating procedures (SOPs) and their monitoring • Evidence-based facility-adapted SOPs based on the national IPC guidelines. • At a minimum, the facility SOPs should include: β Hand hygiene β Decontamination of medical devices and patient care equipment. β Environmental cleaning. β Healthcare waste management. β Injection safety. β HCW protection (for example, post exposure prophylaxis, vaccinations). β Aseptic techniques. β Triage of infectious patients. β Basic principles of standard and transmission-based precautions. • Routine monitoring of the implementation of at least some of the IPC guidelines/SOPs.	All requirements as for the primary healthcare facility level, with additional SOPs on: • Standard and transmission-based precautions (for example, detailed, specific SOPs for the prevention of airborne pathogen transmission). • Aseptic technique for invasive procedures, including surgery. • Specific SOPs to prevent the most prevalent HCAIs based on the local context/ epidemiology. • Occupational health (specific detailed SOP).

3. IPC EDUCATION AND TRAINING		
Primary Care	**Secondary Care**	**Tertiary Care**
IPC training for all front-line clinical staff and cleaners upon hiring • All front-line clinical staff and cleaners must receive education and training on the facility IPC guidelines/SOPs upon employment. • All IPC link persons in primary care facilities and IPC officers at the district level (or other administrative level) need to receive specific IPC training.	IPC training for all front-line clinical staff and cleaners upon hire • All front-line clinical staff and cleaners must receive education and training on the facility IPC guidelines/SOPs upon employment. • All IPC staff need to receive specific IPC training.	IPC training for all front-line clinical staff and cleaners upon hire and annually • All front-line clinical staff and cleaners must receive education and training on the facility IPC guidelines/ SOPs upon employment and annually. • All IPC staff need to receive specific IPC training.

4. HCAI SURVEILLANCE		
Primary Care	**Secondary Care**	**Tertiary Care**
• HCAI surveillance is not required as a minimum requirement at the primary facility level, but should follow national or sub-national plans, if available (for example, detection and reporting of outbreaks affecting the community is usually included in national plans).	• HCAI surveillance should follow national or sub-national plans.	Functional HCAI surveillance • Active HCAI surveillance should be conducted to include information on AMR: β Enabling structures and supporting resources need to be in place (for example, dependable laboratories, medical records, trained staff), directed by an appropriate method of surveillance. - The method of surveillance should be directed by the priorities/plans of the facility and/or country. • Timely and regular feedback needs to be provided to key stakeholders in order to lead to appropriate action, in particular to the hospital administration.
5. MULTIMODAL STRATEGIES		
Primary Care	**Secondary Care**	**Tertiary Care**
Multimodal strategies for priority IPC interventions • Use of multimodal strategies – at the very least to implement interventions to improve hand hygiene, safe injection practices, decontamination of medical instruments, devices and environmental cleaning.	Multimodal strategies for priority IPC interventions • Use of multimodal strategies – at the very least to implement interventions to improve each one of the standard and transmission-based precautions, and triage.	Multimodal strategies for all IPC interventions • Use of multimodal strategies to implement interventions to improve each one of the standard and transmission-based precautions, triage, and those targeted at the reduction of specific infections (for example, surgical site infections or catheter-associated infections) in high-risk areas/ patient groups, in line with local priorities.

6. MONITORING, AUDITING AND FEEDBACK	
Primary Care	**Secondary and Tertiary Care**
• Monitoring of IPC structural and process indicators should be put in place at the primary care level, based on IPC priorities identified in the other components. This requires decisions at the national level and implementation support at the sub-national level.	• A person responsible for the conduct of periodic or continuous monitoring of selected indicators for process and structure, informed by the priorities of the facility or the country. • Hand hygiene is an essential process indicator to be monitored. • Timely and regular feedback needs to be provided to the key stakeholders, in order to lead to appropriate action, particularly to the hospital administration.
7. WORKLOAD, STAFFING AND BED OCCUPANCY	
Primary Care	**Secondary and Tertiary Care**
• To reduce overcrowding A system for patient flow, a triage system (including referral system) and a system for the management of consultations should be established according to the existing guidelines, if available. • To optimize staffing levels Assessment of appropriate staffing levels, depending on the categories identified when using WHO/national tools (national norms on patient/staff ratio), and development of an appropriate plan.	• To standardize bed occupancy ◦ Establish a system to manage the use of space in the facility and to establish the standard bed capacity for the facility. ◦ Hospital administration enforcement of the system developed. ◦ No more than one patient per bed. ◦ Spacing of at least one metre between the edges of beds. ◦ Overall occupancy should not exceed the designed total bed capacity of the facility. • To reduce overcrowding and optimizing staffing levels Same minimum requirements as for primary healthcare.
8. BUILT ENVIRONMENT, MATERIALS AND EQUIPMENT FOR IPC	
Primary Care	**Secondary and Tertiary Care**
• Water should always be available from a source on the premises (such as a deep borehole or a treated, safely managed piped water supply) to perform basic IPC measures, including hand hygiene, environmental cleaning, laundry, decontamination of medical devices and healthcare waste management according to the national guidelines.	• Safe and sufficient quantity of water should be available for all required IPC measures and specific medical activities, including for drinking, and piped inside the facility at all times - at minimum to high-risk wards (for example, maternity ward, operating room/s, intensive care unit). • A minimum of two functional, improved sanitation facilities that safely contain waste available for outpatient wards should be available and one per 20 beds for inpatient wards; all should be equipped with menstrual hygiene facilities.

- A minimum of two functional, improved sanitation facilities should be available on-site, one for patients and the other for staff; both should be equipped with menstrual hygiene facilities.
- Functional hand hygiene facilities should always be available at points of care/ toilets and include soap, water and single-use towels (or if unavailable, clean reusable towels) or alcohol-based hand rub (ABHR) at points of care and soap, water and single-use towels (or if unavailable, clean reusable towels) within 5 metres of toilets.
- Sufficient and appropriately labelled bins to allow for healthcare waste segregation should be available and used (less than 5 metres from point of generation); waste should be treated and disposed of safely via autoclaving, high temperature incineration, and/or buried in a lined, protected pit.
- The facility layout should allow adequate natural ventilation, decontamination of reusable medical devices, triage and space for temporary cohorting/isolation/ physical separation, if necessary.
- Sufficient and appropriate IPC supplies and equipment (for example, mops, detergent, disinfectant, personal protective equipment (PPE) and sterilization) and power/energy (for example, fuel) should be available for performing all basic IPC measures according to minimum requirements/ SOPs, including all standard precautions, as applicable; lighting should be available during working hours for providing care.
- Functional hand hygiene facilities should always be available at points of care, toilets and service areas (for example, the decontamination unit), which include ABHR and soap, water and single-use towels (or if unavailable, clean reusable towels) at points of care and service areas, and soap, water and single-use towels (or if unavailable, clean reusable towels) within 5 metres of the toilets.
- Sufficient and appropriately labelled bins to allow for healthcare waste segregation should be available and used (less than 5 metres from point of generation) and waste should be treated and disposed of safely via autoclaving, incineration (850° to 1100°C), and/or buried in a lined, protected pit.
- The facility should be designed to allow adequate ventilation (natural or mechanical, as needed) to prevent transmission of pathogens.
- Sufficient and appropriate supplies of equipment and reliable power/energy should be available for performing all IPC practices, including standard and transmission-based precautions, according to minimum requirements/SOPs; reliable electricity should be available to provide lighting to clinical areas for providing continuous and safe care, at minimum to high-risk wards (for example, maternity ward, operating room/s, intensive care unit).
- The facility should have a dedicated space/area for performing the decontamination and reprocessing of medical devices (that is, a decontamination unit) according to minimum requirements/SOPs.
- The facility should have adequate single isolation rooms or at least one room for cohorting patients with similar pathogens or syndromes, if the number of isolation rooms is insufficient.

Reproduced from: Minimum requirements for Infection Prevention and Control. Geneva: World Health Organization, 2019.

Prevention of Catheter Related Infections (Peripheral I/V Cannula)	
Placement	**Maintenance**
Avoid unnecessary cannulation.	Daily review the need of IV lines and, remove if no longer required.
Prepare a tray of items required for catheter placement.	Keep the dressing clean and dry and change dressing if it becomes wet, soiled or loosened.
Perform hand hygiene before and after catheter placement and use aseptic non-touch technique during insertion.	Use aseptic non-touch technique for daily care (e.g. hand hygiene before accessing the device and disinfect catheter hubs with an alcohol swab).
Wear non-sterile gloves for insertion.	Replace cannula immediately after administration of blood/ blood products.
Clean site with an antiseptic* and let it dry before catheter insertion.	If needed, place a new peripheral catheter at an alternative site.
Use sterile transparent dressing, if not available then use sterile gauze dressing.	
Secure catheter to prevent any unnecessary movement or dislodgment of the catheter.	
Protect insertion site from outside contamination.	
Note the date of catheter insertion.	
Prevention of Central line associated Blood Stream Infections	
Placement	**Maintenance**
Prepare a tray of items required for catheter placement. Always use sterile items and equipment.	Daily review the need of IV line and, remove if no longer required or infection is suspected.
Use single lumen unless indicated otherwise.	Keep dressing clean and dry.
Use maximal sterile barrier precautions and use aseptic non-touch technique during insertion.	Change dressing if it becomes wet, soiled or loosened.
Clean site with an antiseptic* and let it dry before catheter insertion.	Use aseptic non-touch technique for daily care (e.g. hand hygiene before accessing the device and disinfect catheter hubs with an alcohol swab).

Secure catheter with suture or clips to prevent unnecessary movement or dislodgement of the catheter.	Wear sterile gloves for dressing change or exit site care.
Use sterile transparent dressing or sterile gauze, if transparent dressing is not available.	Avoid femoral site for insertion, if possible.
Protect insertion site from outside contamination.	If needed, place a new peripheral catheter at an alternative site.
Note the date of catheter insertion.	

* Based on the current evidence, the best antiseptic solution to disinfect the insertion site is the use of 2% chlorhexidine with 70% Isopropyl alcohol; if the patient has a history of chlorhexidine allergy, use Povidone Iodine with 70% Isopropyl alcohol.

Prevention of Catheter Associated Urinary Tract Infections	
Insertion	**Maintenance**
Avoid unnecessary catheterization.	Review the need for the catheter on a daily basis, and remove promptly if no longer needed.
Use sterile items and equipment.	Use aseptic non-touch technique for daily catheter care e.g. hand hygiene, sterile items and equipment.
Insert catheter using strict aseptic non-touch technique.	Do not break the closed drainage system. If a urine specimen is required, take specimen aseptically via the sampling port.
Choose catheters of appropriate size.	Keep the drainage bag above the floor– never place the catheter bag on the floor but below the level of the bladder to prevent reflux and contamination. In case of need e.g. during transportation, clamp the urinary bag tube to prevent backflow.
Use a closed drainage system.	Perform daily meatal hygiene with soap and water only.
	Maintain closed drainage system and unobstructed urinary flow.
	Empty drainage bag using a clean container separately for each patient.

Prevention of Ventilator Associated Pneumonia	
Placement	**Maintenance**
Insert endotracheal tube (ET) only for appropriate indication. Consider use of non-invasive ventilation when possible.	Daily assessment of sedation with readiness to extubate.
Ensure appropriate size of ET is used.	Unless contraindicated, keep the head of the patient's bed elevated at 30^0-45^0 – avoid laying the patient completely flat.
Ensure only properly trained persons insert the ET tube.	Oral hygiene: Brush 12 hourly with standard toothpaste, and clean mouth With chlorhexidine gluconate (≥ 1– 2% gel or liquid) 6 hourly.
Use aseptic non-touch technique and sterile items and equipment for insertion.	Education and training of staff in appropriate airway management.
Set (and maintain) appropriate ET cuff pressure between 20-30 cm H_2O (or 2 cm H_2O above peak aspiratory pressure).	Adherence to strict hand hygiene and aseptic non-touch technique.
	Cuff pressure control and monitoring 6 hourly.
	Avoid routine change of ventilator circuit, humidifiers and endotracheal.
	Use sterile water in humidifier and maintain appropriate humidification of inspired gas.
	Perform subglottic suctioning of respiratory secretions.

Prevention of Surgical Site Infections	
Before surgery	**During and after surgery**
It is good clinical practice for patients to bathe or shower before surgery. Either a plain soap or an antiseptic soap could be used for this purpose.	Limit the number of people in the operating room (OR) during surgery and they should be kept closed.
In patients undergoing any surgical procedure, hair should either not be removed or, if absolutely necessary, should only be removed with a clipper. Shaving is strongly discouraged at all times, whether preoperatively or in the operating room.	Check surgical wounds if infection is suspected.
Ensure all surgical items and equipment is sterile and maintains asepsis throughout surgery.	SAP administration should not be prolonged after completion of the operation, even in the presence of drain.
Alcohol- based antiseptic solutions based on chlorhexidine gluconate for surgical site skin preparation should be used in patients undergoing surgical procedures. *	
Surgical hand preparation should be performed either by scrubbing with a suitable antimicrobial soap and water or using a suitable alcohol-based hand rub before donning sterile gloves.	
Use surgical antibiotic prophylaxis (SAP), if recommended. SAP should be administered before surgical incision. It should be administered within 120 min before incision, while considering the half- life of the antibiotic. Check dosage and time of administration before surgery.	

From: Global Guidelines for the Prevention of Surgical Site Infection. Geneva: World Health Organization, 2016.

* The based on the current evidence, the best antiseptic solution to disinfect the insertion site is the use of 2% chlorhexidine with 70% Isopropyl alcohol; if the patient has a history of chlorhexidine allergy, use Povidone Iodine with 70% Isopropyl alcohol. 76

ANNEX 4.

Wasteful, Ritual and/or Unsafe Practices

Do's and Don'ts for Sharps

- ***Don't*** reuse needles and syringes.
- ***Don't*** administer unnecessary IM/ IV injections when the oral route is appropriate.
- Replace sharps container when 3/4 full.
- Keep sharps container out of reach of children.
- ***Don't*** re-sheath needles as it is the most common method of needle injuries.

Do's and Don'ts for Cleaning and Disinfection

- Dispose faeces from infected patients as soon as possible —prior soaking of bedpans in disinfectant solution is not required.
- Marked crockery and separate washing up facilities are not necessary.
- ***Don't*** use antiseptic solutions (chlorhexidine gluconate, povidone iodine, etc.) for hand disinfection in any ward, including intensive care and neonatal unit. Their use should be restricted for surgical scrub in the operating theatre.
- ***Don't*** use formaldehyde fumigation.
- **Don't** use 'no touch' methods of room decontamination (e.g. ultraviolet devices and hydrogen peroxide systems) for routine purposes. If considered necessary, use only a validated system for terminal disinfection of a room following discharge of patients on IPC precautions.
- ***Don't*** perform aerosol-generating procedures in an open ward.

Do's and Don'ts for PPEs

- ***Don't*** reuse gloves, surgical face masks, gown and aprons— they are single-use disposable items.
- ***Don't*** spray any disinfectants (e.g. hypochlorite solution) to 'disinfect' PPE nor use hypochlorite solution to disinfect your hands.
- ***Don't*** routinely use PPE for visitors in the augmented care areas (Intensive care, neonatal unit etc).

Do's and Don'ts for Devices

- ***Don't*** use systemic antibiotic prophylaxis prior to insertion or when invasive devices are in situ.
- ***Don't*** use systemic antibiotic prophylaxis prior to insertion of CVC or when CVC is in situ.
- ***Don't*** routinely use antimicrobial impregnated CVCs.
- ***Don't*** routinely use systemic antibiotic prophylaxis prior to insertion of Foley's catheter or when urinary catheter is in situ.
- ***Don't*** routinely insert urinary catheter in all patients admitted to ICU.
- ***Don't*** routinely use antimicrobial impregnated urinary catheters.
- ***Don't*** put antiseptic in the urine bag to prevent infection.
- ***Don't*** do bladder washout or put any antiseptic solution in the urinary catheter bag.
- ***Don't*** routinely send IV catheter tips for bacteriological culture, as it a poor predictor for diagnosis of IV-line infections.
- ***Don't*** send urinary catheter tips for bacteriological culture, even when infection is suspected— send properly collected urine sample and/or blood culture.

Do's and Don'ts for Operation Theatres (OT)

- ***Don't*** soak any respiratory therapy items and equipment in glutaraldehyde, as it is a respiratory irritant—Send it to the sterile service department for decontamination.
- ***Don't*** use a nail brush during surgical scrub—Use a nail file to clean under the fingernails and subungual areas. If essential, utilize a single-use sterile sponge.
- ***Don't*** use fumigation in the theatre after a 'dirty/ infected' case—thoroughly clean with detergent, and clean and disinfect high frequency hand touch surfaces as per the local protocol.
- ***Don't*** use overshoes in the operating theatre— change footwear to clogs before entering the OT.
- Surgical masks must be used only by the operating/ scrub team. Wearing of surgical masks by other staff is not necessary.
- ***Don't*** routinely perform microbiological monitoring of OT by using

environmental swabs, air sampler or settle plates.

- Routine screening of OT staff for Staph. aureus is not necessary unless the cross- infection and/or outbreak is suspected to be linked with the personnel working in the OT.
- Use of UV light in OT to prevent surgical site infections is not recommended.

Do's and Don'ts for Cleaning Instruments

- **Don't** soak any surgical instruments in hypochlorite solution during transport, as it destroys the instruments.
- Don't use skin antiseptics for cleaning instruments.
- **Don't** disinfect any single-use invasive devices e.g. CVC, urinary catheters and nasogastric tube.
- **Don't** soak respiratory therapy items, e.g. endotracheal tube, ventilator tubing in disinfectant solution (esp. glutaraldehyde as it is a respiratory irritant) —Send it to the sterile service department for decontamination.
- Limit the utilization of 'Immediate use' (flash) sterilization system to disinfect instruments.

Do's and Don'ts for HCWs

- **Don't** use overshoes and dust attracting mats at the entrance of an operating theatre, intensive care and neonatal unit.
- **Don't** routinely use single-use disposable tourniquets.
- **Don't** locate wash hand basin so close that patients get splashed with contaminated water, when it is used especially in the augmented care areas (Adult and neonatal critical care, renal, transplant, hematology/oncology, burns and high dependency units).
- **Don't** routinely screen any staff for Staph. aureus, or MRSA, in any area unless cross-infection and/or outbreak is suspected to be linked with the personnel working.

From: Damani N. Manual of Infection Prevention and Control. Oxford: Oxford University Press, 2019.

Glossary of Infection Control Terms

Additional (transmission based) precautions: Infection control precautions required when the standard precautions may not be sufficient to prevent transmission of infection. These are used for patients known, or suspected, to be infected or colonized with pathogens that can be transmitted by airborne, droplet, or contact routes. Additional precautions are transmission- based precautions and should be used in addition to standard precautions.

Air purifier or air cleaner: A portable indoor electrical device intended to remove or deactivate potentially harmful contaminants, pollutants, allergens, and odours from the circulating air.

Airborne transmission: Transmission of infectious agents by either airborne nuclei or particles of <5 mm in size.

Antimicrobial: A chemical agent that, on application to living tissue or by systemic administration, will selectively kill or prevent the growth of susceptible organisms. This definition includes antibacterials, antivirals, antiprotozoals, antifungals, antiseptics, and disinfectants.

Antiseptic: A chemical agent which, when applied to living tissue, will destroy or inhibit the reproduction of microorganisms.

Asepsis: The prevention of microbial contamination of living tissues or sterile materials by removal, exclusion, or destruction of microorganisms.

Aseptic technique: A technique in which the instruments, drapes, and the gloved hands of the healthcare worker are sterile when performing surgery or invasive procedures.

Carrier: A person (host) who harbours a microorganism (agent) but does not necessarily display clinical signs/ symptoms of disease. Depending on the type of pathogens, a carrier may shed organisms into the environment intermittently or continuously and therefore act as a potential reservoir or source of infection.

Case: A person with symptoms.

Chemoprophylaxis: The administration of antimicrobial agents to prevent the development of an infection or the progression of an infection to active manifest disease.

Cleaning: The removal, usually with detergent and water, of adherent visible-soil, blood, protein substances, microorganisms and other debris from surfaces, crevices, serrations, joints, and lumens of instruments, devices, and equipment by a manual or mechanical process. This prepares the items for safe handling and/ or further decontamination. Cleaning is essential prior to the use of heat or chemicals disinfection or sterilization.

Cohort: A group of patients infected or colonized with the same microorganism, grouped together in a designated area of a unit or ward within an area of a hospital ward.

Cohort staffing: The practice of assigning specific personnel to care only for patients known to be exposed to, or infected with, the same microorganism. Such personnel would not participate in the care of patients who had not been exposed to, or infected with, that microorganism.

Colonization: The presence of microorganisms at a body site(s) without the presence of symptoms or clinical manifestations of illness or infection. The colonization may be a form of carriage and is a potential source of transmission.

Contact: An exposed individual who might have been infected through transmission from another host or the environment.

Contamination: The presence of microorganisms on a surface or in a fluid or material.

Cross- infection: An infection transmitted from one patient to another, or from a member of staff, or from the environment, to another patient.

Cough etiquette: The practice of covering the mouth and nose during breathing, coughing, or sneezing (such as wearing a surgical mask, cloth mask, covering mouth with tissues, a sleeve, flexed elbow or hand, followed by hand hygiene), to reduce the dispersal of respiratory secretions that may contain infectious particles.

Decontamination: The use of physical or chemical means to remove, inactivate, or destroy pathogenic microorganisms from a surface or item to the point where they are no longer capable of transmitting infectious particles and the surface or item is rendered safe for handling, use, or disposal. This term is used to encompass cleaning, disinfection, and sterilization.

Disinfectant: A chemical agent which, under defined conditions, is capable of disinfection. A substance recommended by its manufacturer for application to an inanimate object, for killing a range of microorganisms.

Disinfection: Either thermal or chemical destruction of pathogenic and other types of microorganisms. Disinfection is less lethal than sterilization because it destroys most recognized pathogenic microorganisms but not necessarily all microbial forms (e.g. bacterial spores). It reduces the number of microorganisms to a level that is not harmful to health or is safe to handle.

Droplet nuclei: The particles produced when aqueous droplets of a suitably small size are dispersed in air. The larger droplets expelled from the nasopharynx can only travel about 1 metre (~ 3 feet) at the most before impaction by gravity. The small droplets or nuclei (after surface evaporation) can travel quite a large distance.

Emollients: They are used to soften and smooth the scales of the skin and prevent flakiness of skin. In addition, they also act as an occlusive agent; the substances that provide a layer of protection that helps prevent loss of water/ moisture from the skin.

Endemic: The usual level or presence of an agent or disease in a defined population during a given period.

Endogenous infection: Microorganisms originating from the patient's own body which may cause infection in another body site.

Epidemic: An unusual, higher than expected level of infection or disease by a common agent in a defined population in a given period.

Exogenous infection: Microorganisms originating from a source or reservoir that are transmitted to a person, i.e. contact, airborne, droplet, ingestion, inoculation, vertical, sexual, or vector- borne.

Exposure-prone procedures (EPPs): They are defined where the worker's gloved hands may be in contact with sharp instruments, needle tips, or sharp tissues inside a patient's open body cavity, wound, or confined anatomical space, where the hands or fingertips may not be completely visible at all times. However, other situations, such as pre-hospital trauma care, should be avoided by HCWs restricted from performing EPPs, as they could also result in the exposure of the patient's open tissues to the blood of the worker. The definition of EPPs given above embraces a wide range of procedures, in which there may be very different levels of risk of 'bleed- back' i.e. where injury to the HCW could result in the worker's blood contaminating the patient's open tissues. For further information, please refer to the Public Health England document which outlines three categories of EPPs with increasing risk of bleed-back (Public Health England, 2017).

Fit tests: The use of a qualitative or a quantitative method to evaluate the fit of a specific manufacturer, model, and size of respirator on an individual.

Fomite: An inanimate object which can act as an intermediate source of infecting organisms, e.g. equipment that is used for more than one patient and is not decontaminated between uses.

Healthcare-associated infections: They refer to infections associated with healthcare delivery in any setting (e.g. hospitals, long- term care, and ambulatory settings). This term reflects that some patients are going through various healthcare facilities and it is not always possible to establish, with certainty, when the primary source of infection was acquired by these patients. This term replaces both hospital-acquired infections and nosocomial infections.

Healthcare workers: The staff involved in direct patient care, i.e. who have regular clinical contact with patients. This includes doctors, dentists, midwives and nurses, paramedics and ambulance drivers,

occupational therapists, physiotherapists, and radiographers. The students and trainees in these disciplines and volunteers who are working with patients must as well be included. (Refer to The World Health Report 2006 - http:// www.who.int/ whr/ 2006/ 06_ chap1_ en.pdf).

High-risk body fluids: This includes blood, amniotic fluid, semen, vaginal secretions, human breast milk, cerebrospinal fluid, peritoneal fluid, pleural fluid, pericardial fluid, synovial fluid, saliva in association with dentistry (likely to be contaminated with blood, even when not visibly so), exudative or other tissue fluid from burns or skin lesions, and unfixed tissues and organs. Low-risk body fluids (unless they are visibly stained) include urine, vomit, saliva (non- dentistry associated), and faeces.

High-risk/ critical items: The items in close contact with a break in the skin or mucous membrane or which have been introduced into a sterile body area (e.g. surgical instruments, dressings, catheters, and prosthetic devices). The items in this category must be sterile before they are used on a patient. The recommended decontamination method is sterilization.

Immunity: The resistance of a host to a specific infectious agent.

Immunocompromised: A patient who does not have the ability to respond normally to an infection due to an impaired or weakened immune system. A patient whose immune system is compromised due to various conditions, e.g. immunodeficiency due to HIV/ AIDS infection, congenital deficiency and the nutrition deprived states, etc.

Immunosuppressed: A patient becomes or is made to suppress its immune system by the use of chemotherapy and/ or radiotherapy for treatment of cancer or use of immunosuppressive drugs after organ transplant to prevent graft rejection.

Incidence: The number of new cases of a disease (or event) occurring in a specified time.

Incidence rate: The ratio of the number of new cases of infection or disease in a defined population, in a given period, to the number of individuals at risk in the population.

Incubation period: The time interval between initial exposure to the infectious agent and the appearance of the first signs or symptoms of the disease in a susceptible host.

Infection: The host reaction to invasion by microorganisms. It refers to the damaging of body tissue by microorganisms or by poisonous substances released by the microorganisms.

Intermediate-risk/ semi-critical items: Items that make direct contact with intact mucous membranes. Semi-critical items need not be sterile when used, although this is desirable; but they do need to be free of the common vegetative microorganisms. The recommended decontamination method is disinfection, preferably by moist heat.

Invasive procedure: Any procedure that pierces the skin or mucous membranes or enters a body cavity or organ. This includes surgical entry into tissues, cavities, or organs, or repair of traumatic injuries. See also exposure-prone procedures.

Lookback investigation: The process of identifying, tracing, recalling, counselling, and testing patients or healthcare workers who may have been exposed to an infection.

Low-risk/ non-critical items: Objects that make contact with intact skin (e.g. chairs, baths, washing bowls, toilets, and bedding). The recommended decontamination method is cleaning and drying. The disinfection is necessary if there is a known infection risk.

Medical device: According to the WHO a medical device means any instrument, apparatus, implement, machine, appliance, implant, reagent for in vitro use, software, material, or other similar or related article, intended by the manufacturer to be used, alone or in combination, for human beings, for one or more specific medical purpose(s).

Microbiological clearance: The reduction of the number of pathogenic micro-organisms in a specimen below that detectable by conventional means.

Microbial flora: The normal human microbial flora (also called microbiota) comprises microbes which are found commonly on, or in, humans. In general, the normal flora lives, multiplies, and dies without any adverse effects on the host. Transient organisms are normally picked up on the hands of healthcare workers from contaminated environments, items, equipment, or patients with infection. Hand washing is the most effective method of removing transient flora picked up from the contaminated environment.

Microorganism (microbe): A microscopic entity capable of replication. These include bacteria, viruses, fungi, and protozoa.

Negative pressure ventilation: Used to denote airflow, which is negative in relation to the surrounding air pressure. It is usually created by mechanical airflow devices (e.g. exhaust fans).

Outbreak: There are various definitions of an outbreak, but essentially an outbreak is defined as an increased occurrence of an incident and/or infection above the usual or expected frequency within a specific geographical area and over a defined period of time. In some cases, even an emergence of a novel or an unusual pathogen with a single case may constitute an outbreak (e.g. viral haemorrhagic fever).

Pathogen: A microorganism capable of producing disease in a susceptible host.

Pathogenicity: The power of an infectious agent or microorganism to produce disease in a susceptible host.

Prevalence rate: The ratio of the total number of individuals who have a disease at a particular time to the population at risk of having the disease.

Prion: A small proteinaceous infectious unit that appears to cause transmissible spongiform encephalopathies.

Protective isolation: The physical separation of immunocompromised patients in an attempt to prevent the transmission of infectious agents.

Reservoir: Any animate or inanimate focus in the environment in which an infectious agent may survive and multiply and which may act as a potential source of infection.

Respirator: Special type of closely fitted face covers with the capacity to filter particles to protect the wearer against inhaling infectious droplet nuclei, e.g. tuberculosis. The N95 respirator has a filter efficiency level of 95% or more against particulate aerosols free of oil when tested against 0.3 μm particles. The 'N' denotes that the mask is not resistant to oil; the '95' refers to a 95% filter efficiency. The FFP2 respirator has a filter efficiency level of 94% or more against 0.4 μm particles and is tested against both an oil and a non-oil aerosol.

Seroconversion: The development of antibodies not previously present, resulting from a primary infection.

Sharps: Any objects capable of inflicting penetrating injury, including needles, scalpel blades, wires, trochors, auto lancets, stitch cutters, etc.

Single-use items: Items designated by the manufacturer for single-use only.

Skin antiseptic: An antiseptic that is intended for application to intact, healthy skin to prevent the transmission of transient or resident skin bacteria from person to person or from a surgical operation site to underlying tissue. Skin disinfectants include antiseptic preparations, antiseptic soaps and hand washes, and antiseptic hand rubs.

Source isolation: The physical separation of an infected or colonized host from the remainder of the 'at- risk' population in an attempt to prevent transmission of the specific agent to other individuals and patients.

Standard precautions: Work practices required to achieve a basic level of infection control. Standard precautions are recommended for the treatment and care of all patients.

Sterile: Free from all living microorganisms and spores.

Sterilization: The complete destruction of all microorganisms including bacterial spores. For practical

reasons, a process can be said to sterilize if it can kill or remove 10^6 spores of a type specified to test the process within the time specified.

Surveillance: Systematic collection, analysis, and interpretation of data on specific events (infections) and disease, followed by dissemination of that information to those who can improve the outcomes.

Susceptible: A person not possessing sufficient resistance (or immunity) to an infectious agent to prevent them from contracting infection when exposed to the agent.

Transmission: The method by which any potentially infecting agent is spread to another host, i.e. contact, airborne, droplet, ingestion, inoculation, vertical, sexual, and vector-borne.

Transmission-based precautions: These are additional precautions, used for patients infected or colonized with pathogens that can be transmitted by contact, droplet, or airborne routes.

Virulence: The intrinsic ability of a microorganism to infect a host and produce disease.

Window period: The period immediately after a person is exposed to an agent, during which the infection is not detected by laboratory tests, although the person may be infectious.

Zoonosis: An infection or infectious disease transmissible under natural conditions from vertebrate animals to humans.

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