
UNIT 2 PREVENTION OF INFECTIONS IN HEALTH CARE SETTINGS

Structure

- 2.0 Introduction
- 2.1 Objective
- 2.2 Burden of Healthcare Associated Infections (HAI) in Patients and Healthcare Workers
- 2.3 Modes of Transmission and Preventive Strategies
 - 23.1 Blood Borne Pathogens
 - 23.2 Other Infections
- 2.4 General Principles of Prevention of Bio Hazards
 - 24.1 Engineering Control
 - 24.2 Administrative Control
 - 24.3 Medical Surveillance of Health Care Workers
 - 24.4 Isolation and Restricted Entry
 - 24.5 Training and Awareness Programmes for HCWs, Patients and Visitors
- 2.5 Specific Preventive Measures for HAI
 - 25.1 Injection Safety
 - 25.2 Prevention Strategies
 - 256.2 Standard precautions
- 2.6 Let Us Sum Up
- 2.7 Key Words
- 2.8 Answers to Check Your Progress
- 2.9 References and Suggested Further Readings

2.0 INTRODUCTION

Infections in the health care setting are referred to as Health care associated infections. Healthcare Associated Infection (HAI) is “*an infection that is acquired by a patient during care delivery in a hospital or other health care facility that was not present or incubating on admission*” (WHO). HAIs are mostly caused by microorganisms resistant to one or more commonly-used antibiotics. Common HAIs include urine, chest, blood and wound infections. Visitors, family members and health workers can also be affected by HAIs. These infections usually manifest after 48 hours of hospital contact. The source of the infection is usually due to cross infection from either staff or the other patients.

HAI should not occur in an ideal environment and it is imperative that you should be well aware about determinants of these infections. This will make you a good planner to take the preventive steps in your set up. Below mentioned is the list of determinants of HAI (Box 1).

- Inappropriate use of invasive devices and antibiotics.
- High-risk diagnostic or therapeutic procedures
- Immuno-suppression
- Sub-standard application
- Poor water, sanitation, waste management and environmental cleaning
- Insufficient equipment
- Understaffing, as well as overcrowding
- Poor knowledge of all measures including injection and blood transfusion safety
- Absence of local/national guidelines, policies and programmes
- Lack of surveillance and research.

Box 2.1: Determinants of HAI

There are hundreds of millions of patients affected by health care-associated infections worldwide each year, leading to significant mortality and financial losses for health systems. While urinary tract infection is the most frequent health care-associated infection in high-income countries, surgical site infection is the leading infection in settings with limited resources, affecting up to one-third of operated patients; this is up to nine times higher than in developed countries.

You have already read in details about the infections in a health care setting in the unit 1 of this block. We shall now learn more about burden of this disease in the next section before we discuss the strategies of preventing these infections.

2.1 OBJECTIVES

After studying this unit, you should be able to:

- describe the burden of health care associated infection, their mode of transmission and its preventive strategies;
- understand role of injection safety in prevention and control of health care associated infections among health care workers and patients; and
- understand in detail about personal protective equipment, universal precautions and health promotion in prevention of infections in health care settings.

Check Your Progress 1

1 What is the definition of HAI?

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2. What are the determinants of HAI?

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2.2 BURDEN OF HAI IN PATIENTS AND HEALTH CARE WORKERS

At any given time, the prevalence of healthcare-associated infection in developed countries varies between 3.5% and 12%. The prevalence of HAI varies between 5.7% and 19.1% in low- and middle-income countries. As per the hospital infection Society of India, the incidence of HAI in India ranges from 5 to 30%.

Hundreds of millions of patients are affected by HAI worldwide each year, leading to significant mortality and financial losses for health systems. While urinary tract infection is the most frequent HAI in high-income countries, surgical site infection is the leading infection in settings with limited resources, affecting up to one-third of operated patients; this is up to nine times higher than in developed countries.

Table 2.1: Key facts about healthcare associated infections and other aspects

HAI frequency On average, 1 in every 10 patients is affected by HAIs worldwide.	Hand hygiene On average, 61% of health workers do not adhere to recommended hand hygiene practices	Injection safety 16 billion injections are administered every year worldwide, up to 70% of which are given with reused syringes and needles in some developing countries	AMR (Anti-microbial resistance) Patients with methicillin-resistant <i>Staphylococcus aureus</i> (MRSA) are about 50% more likely to die than those infected with non-resistant strains
Intensive care In high-income countries, up to 30% of patients are affected by at least one HAI in intensive care units; in developing countries the frequency is at least 2–3 times higher	Neonatal care Among hospital-born babies, infections are responsible for 4%-56% of all causes of death in the neonatal period	Maternal care In Africa, up to 20% of women get a wound infection after a caesarean section, affecting their health and ability to care for their baby	Let's Research to explore more

In introduction part of this chapter you read in brief about HAI but knowledge has to be brought up to next level which is no doubt action. The actions in HAI is invariably prevention.

Check Your Progress 2

1. What are the key facts of HAI?

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2.3 MODE OF TRANSMISSION

In the context of health care sector predominantly three modes of transmission can occur:

1. Blood borne infections
2. Other infectious diseases
 - i. Contact infections
 - ii. Air borne infections
3. Faeco-oral route also present a risk but can be prevented in the same manner as contact infections.

Risk analysis and assessment procedures should be developed separately for each of the defined modes of transmission and protective measures should be stipulated respectively.

2.3.1 Blood Borne Pathogens

Health care workers are exposed to blood and other body fluids in the course of their work. Given their working conditions they are at risk of infections with blood borne viruses including HIV, Hepatitis B Virus (HBV) and hepatitis C virus (HCV). The risk of infections for health care workers depends on the prevalence of disease in the patient population and nature and frequency of exposure. Occupational exposure to blood can result from percutaneous injury (needle stick or other sharps injury), muco-cutaneous injury (splash of blood or other body fluids into eyes, nose or mouth) or blood contact with non-intact skin. Most common form of occupational exposure to blood and the most likely to result in infection is needle stick injury. The most common causes of needle stick injury are two handed recapping and unsafe collection and disposal of sharp waste.

Most blood exposure in health settings are preventable. Strategies to protect health workers include implementation of universal precautions, immunization against hepatitis B, provision of personal protective equipment and the management of exposures. Successful implementation of these strategies requires an effective infection control committee with support from the health administration.

2.3.2 Other Infectious Disease

In addition to blood borne pathogens health care workers are also at risk of number of other occupationally acquired infectious diseases. Health sector

personnel face an increased risk of contracting an infection, for which numerous and to some extent quite disparate pathogens play a significant role. Depending on specific pathogen, transmission can occur via direct contact with patients and contaminated surfaces or airborne exposure to bio aerosols, generated mainly by sneezing and coughing. The potential threats associated with new and emerging infectious diseases have caused much concern. These threats include SARS, avian influenza, pandemic influenza and multi drug resistant pathogens such as methicillin resistant staphylococcus aureus (MRSA) and extensively drug resistant tuberculosis (XDR-TB). In most cases however simple interventions will prevent transmission. Hand washing, vaccination, and rapid recognition and appropriate isolation of potentially contagious patients are especially important interventions.

Table 2.2: Comparison of three major contact/airborne infections

MRSA (methicillin resistant Staphylococcus Aureus)	SARS (Severe Acute Respiratory Syndrome)	Extensively drug resistant tuberculosis (XDR-TB)
<p>MRSA is an acronym for methicillin resistant staphylococcus aureus. An antibiotic resistant strain of staph bacteria that is found in healthcare facilities and now in the community.</p> <p>Overuse of antibiotics in hospitals due to continued lapses in infection control.</p> <p>MRSA has spread globally some countries with highest rates are: United States, Canada, Japan & Indonesia. MRSA is spread by contact by HCW's who do not wash their hands, contaminated surfaces & equipment.</p> <p>How to Prevent an Infection: Insist all HCW's wash their hands before wearing gloves, Disinfect your room with wipes – frequently touched surfaces, Prudent use of antibiotics</p>	<p>Severe acute respiratory syndrome (SARS) is a viral respiratory illness caused by a coronavirus, called SARS-associated coronavirus (SARS-CoV). SARS was first reported in Asia in February 2003. primary way that SARS appears to spread is by close person-to-person contact. SARS-CoV is thought to be transmitted most readily by respiratory droplets (droplet spread) produced when an infected person coughs or sneezes.</p> <p>How to Prevent an Infection:</p> <ul style="list-style-type: none"> ● PPE ● N-95 respirator use ● Gown and gloves should be worn. 	<p>Transmission to hospital staff occurs through airbornedroplet nuclei, usually from patients with pulmonary tuberculosis. The association of tuberculosis with HIV infection and multidrug-resistant & extensively drug resistant tuberculosis are a current major concern. Several factors illustrate that nosocomial TB must be addressed, even in such areas.</p> <ol style="list-style-type: none"> 1. Nosocomial transmission is of concern because it affects not only patients who are exposed but also the healthcare workforce, which could adversely affect healthcare services over time. 2. Transmission of TB can have serious consequences, particularly with multidrug-resistant TB (MDRTB). Therefore, interventions to reduce nosocomial transmission TB are useful and cost-effective preventive measures to control TB, including MDRTB, particularly in tertiary care settings.

A risk assessment is crucial to the prevention of infection. Any assessment of risk potential must take account the natural virulence of the pathogens, its capacity to survive in the environment, the severity of the disease and the dose or exposure level necessary to cause illness or infection. The mode of transmission and other epidemiological factors will also inform the choice of preventive measures.

Hypersensitivity Due to Latex (Natural Latex Rubber)

Immediate hypersensitivity reaction to latex was first reported in Germany in 1927. Since then, there has been considerable increase in the number of reported cases of immediate type hypersensitivity to latex products. The clinical manifestations of the allergic reaction concerned are similar to symptoms experienced by anyone who is allergic to food, drug, animal dander or pollen. These include urticaria, asthma, rhinitis, conjunctivitis and even anaphylactic reactions. Cause of the allergic reaction is attributed to some residual water soluble proteins found in the latex products. This latex protein allergy occurs in well-defined risk groups which include the health care workers, rubber industry workers and patients with spina bifida. Furthermore, the use of low EP (extractable protein) gloves should be encouraged. It may be heartening to know that, manufacturers of natural rubber latex gloves are making great efforts to improve their products.

Check Your Progress 3

1. What are the different modes of Transmission of HAI?

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2. What is MRSA and SARS?

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2.4 GENERAL PRINCIPLES OF PREVENTION OF BIOHAZARDS

2.4.1 Engineering Control

Let us learn more about some of the engineering controls that can be adopted in a health care setting

1. **Dedicated negative pressure isolation rooms:**

Negative Pressure Isolation Rooms are for those patients who require airborne droplet nuclei isolation (this includes pathogens such as measles, varicella zoster (chicken pox), legionella, tuberculosis). Purpose of placing patients in negative pressure rooms is to reduce the risk of infection via airborne transmission to other persons. Negative pressure rooms area also known as “airborne infection isolation” rooms or “infectious isolation”

facilities. Negative pressure rooms should be located at the entry to an inpatient unit, so that the patient requiring isolation does not need to pass other patient areas to access the isolation room. A dedicated exhaust system must be provided to the negative pressure isolation room. To maintain negative pressure the exhaust system removes a quantity of air greater than that of the supply air. The Isolation room pressure is lower than the adjacent rooms or corridor. Pressure differentials should not be less than 15 Pa between isolation rooms and the adjacent ambient air.

2. High-Efficiency Particulate Air (HEPA) Filtration System:

HEPA filters are generally effective at removing 0.3 μ m-sized particles with an efficiency of at least 99.97%; they are even more effective at removing both smaller and larger particles. For minimizing airborne particles, air must be circulated into the room with a velocity of at least 0.25 m/sec through a high-efficiency particulate air (HEPA) filter, which excludes particulate matter of defined size. If particles 0.3 microns in diameter and larger are removed, the air entering the room will be essentially clean and free of bacterial contaminants.

3. Containment of biohazard:

Bio-containment is basically related to laboratory biosafety, and pertains to microbiology laboratories in which the physical containment of pathogenic organisms or agents (bacteria, viruses, and toxins) is required, usually by isolation in environmentally and biologically secure cabinets or rooms, to prevent accidental infection of workers or release into the surrounding community.

- **Primary containment** is the first container in direct contact with biohazardous materials as well as protection of personnel and the immediate laboratory environment from exposure to infectious agents. Primary containment requires using proper storage containers, good microbiological technique, and the use of appropriate safety equipment such as biological safety cabinets.
- **Secondary containment** is the protection of the environment external to the laboratory from exposure to infectious materials and is provided by a combination of facility design and operational practices.

Biosafety cabinet (BSC) biological safety cabinet or microbiological safety cabinet—is an enclosed, ventilated laboratory workspace for safely working with materials contaminated with (or potentially contaminated with) pathogens requiring a defined biosafety level. purpose of a BSC is to serve as a means to protect the laboratory worker and the surrounding environment from pathogens.

4. Ultra-Violet Germicidal Irradiation (UVGI) Systems

Ultraviolet germicidal irradiation (UVGI) is a disinfection method that uses short-wavelength ultraviolet (UV-C) light to kill or inactivate microorganisms by destroying nucleic acids and disrupting their DNA, leaving them unable to perform vital cellular functions. UVGI is used in a variety of applications, such as food, air, and water purification.

2.4.2 Administrative Control

Certain administrative controls are also required for effectively preventing the occurrence of infections in a health care setting.

1 Record keeping

Record keeping has a vital role in the prevention and control of HCI. Keeping a good record of things will lead to corrective action on time. For example, *hospital pharmacist should maintain the records* of potency of drugs, incompatibility, conditions of storage and deterioration, records of antibiotics distributed to the medical departments. *Central sterilization service should maintain complete records* of each autoclave run, and ensure long-term availability of records. *Maintenance dept should have records* of inspections and regular maintenance of the plumbing, heating, and refrigeration equipment, and electrical fittings and air conditioning etc.

Apart from above active use of information technologies such as electronic medical record, hospital information system, computerized physician order entry and clinical decision support facilitates delivery of the antibiotic stewardship program

2.4.3 Medical Surveillance of High Risk Workers

Nosocomial infection rate in patients and among health care workers at a facility is an indicator of quality and safety of care being rendered. The development of a surveillance process to monitor this rate is an essential first step to identify local problems and priorities, and evaluate the effectiveness of infection control activity. Surveillance is an effective process to decrease the frequency of hospital-acquired infections.



Fig. 2.1: Surveillance is a circular process

Source: World Health Organization (2002): Prevention of Hospital Acquired Infections: a practical guide.

2.4.4 Isolation and Restricted Entry:

Wherever needed strict isolation policies should be followed and entry of visitors to meet the patients should be kept minimum or restricted. This will reduce the chances of spread of infections from patients to others.

2.4.5 Training and Awareness Programmes for HCWs, Patients and Visitors

Effectiveness of staff education on HAI prevention is controversial but as a part of comprehensive infection control program it's value had been appreciated. Designated infection control personnel can help in imparting prescheduled training, maintaining record, monitoring the knowledge base and bed side application of the knowledge. Ongoing staff education is also a regulatory need. Education of HCW and periodic assessment of adherence to insertion and maintenance of intravascular catheters protocol had been given higher level of recommendation. New employee orientation to infection control program and making the employees responsible for infection prevention had been recommended. Awareness campaign may be organized time to time to make patients and visitors aware about HCI and preventive measures on their part.

2.5 SPECIFIC PREVENTIVE MEASURES FOR HAI

2.5.1 *Injection Safety*

Injection is an important health care procedure used worldwide for administration of drugs. Billions of injections are used worldwide for curative care and for immunization. Injections are among the most common health care procedures, with at least 16 billion administered in developing and transitional countries each year.

Medical treatment is intended to save life and improve health, and all health workers have a responsibility to prevent transmission of health-care associated infections. Adherence to safe injection practices and related infection control is part of that responsibility – it protects patients and health workers.

You have already read about the increased chances of acquiring the various blood borne infections through unsafe injections in the first unit of this block.

Burden of diseases from unsafe injections is presented here:

Unsafe injections may lead to transmission of a variety of pathogens, including viruses, bacteria, fungi and parasites. They can also cause adverse events such as abscesses and toxic reactions. Reuse of syringes or needles is common in many settings. It exposes patients to pathogens either directly (via contaminated equipment) or indirectly (via contaminated medication vials). The risks of unsafe injection practices have been well documented for the three primary blood borne pathogens – human immunodeficiency virus (HIV), hepatitis B virus (HBV) and hepatitis C virus (HCV). The estimated global burden of disease for the year 2000 from unsafe injection practices for these pathogens included:

- 21 million HBV infections (32% of new HBV infections);
- 2 million HCV infections (40% of new HCV infections);
- 260 000 HIV infections (5% of new HIV infections).

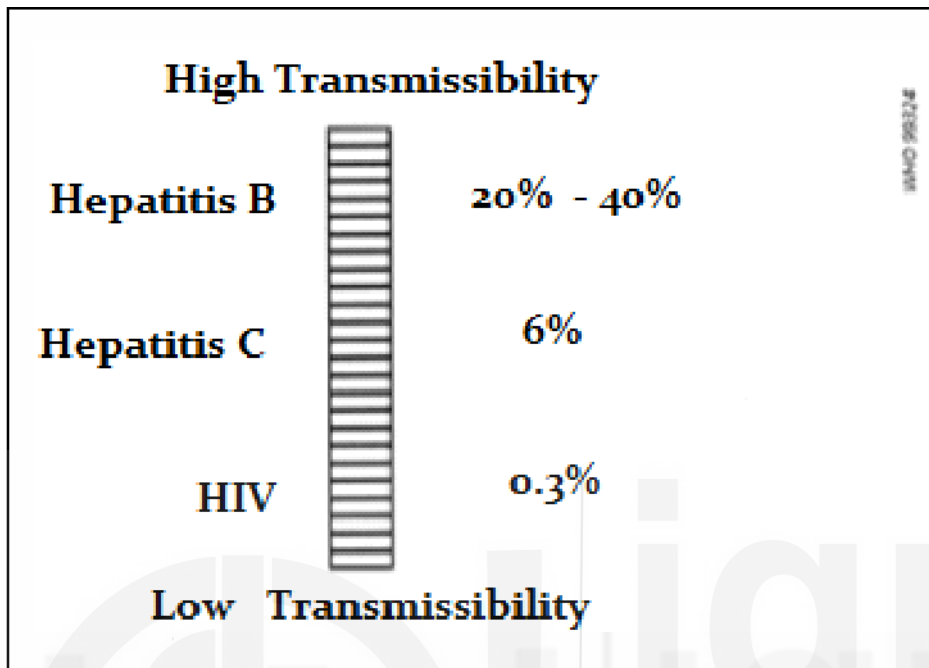


Fig. 2.2: Probability of transmission of infection by injection equipment's contaminated with blood

(Source: Simonsen L, et al Bull World Health Organ. 1999)

Among susceptible health workers who do not receive post-exposure prophylaxis (PEP), the risk of infection after needle-stick injury is 23–62% for HBV and 0–7% for HCV. Infections may also be transmitted (to other health workers and to patients) from cross-contamination of health workers' hands, medications, medical equipment and devices or environmental surfaces. Thus, right injection techniques and procedures contribute to the safety of both patients as well as health workers.

A safe injection, phlebotomy (drawing blood), lancet procedure or intravenous device insertion is one that:

- does not harm the recipient;
- does not expose the provider to any avoidable risk;
- does not result in any waste that is dangerous for other people.

Some of the statistics related to the injection practices in India have been placed in the Box 2.2 for your awareness and realization of the importance of injection safety.

Injection in a hospital waste:

Syringes should be either mutilated or needles should be cut and or stored in tamper proof, leak proof and puncture proof containers for sharps storage. Wherever the occupier is not linked to a disposal facility it shall be the

responsibility of the occupier to sterilize and dispose in the manner prescribed. Mutilation or shredding must be to an extent to prevent unauthorized reuse.

Box 4: Duties of the occupier of a Healthcare facility

1. Handle waste as per norms
2. Arrange safe storage of waste
3. Follow onsite pre-treatment of infective waste
4. Replace chlorinated plastic bags with non-chlorinated.
5. Dispose of solid waste separate from bio medical waste other than bio-medical waste in accordance
6. Provide training to all its health care workers at the time of induction and thereafter at least once every year and the details of training programmes conducted, number of personnel trained and number of personnel not undergone any training shall be provided in the Annual Report
7. Immunise all its health care workers against Hepatitis B and Tetanus as per protocol
8. Establish a Bar- Code System for bags or containers containing bio-medical waste.
9. Ensure segregation of liquid chemical waste at source and ensure pre-treatment or neutralization.
10. Provide PPE to healthcare workers
11. Report major accidents
12. Make available the annual report on its web-site
13. Inform the prescribed authority immediately if waste is not picked or retained for more than 48 hrs
14. Establish a committee to review and meet once in every six months and the record of the minutes of the meetings of this committee and incorporate in annual report
15. Maintain all records for a period of 05 yrs
16. Conduct health check up at the time of induction and at least once in a year for all its health care workers
17. Maintain daily register and upload monthly records on website

What is safe and unsafe injection?

An injection is counted safe if it does not harm the recipient, does not expose the provider to avoidable risk, and does not result in wastes that is dangerous for the community. This is achieved by administering the injection using a sterile device (syringe, needle etc.), using sterile technique by

a qualified and well-trained person and discarding the used devices in a puncture proof container. Any breach in the process makes the injection unsafe. Hence the safety of both the recipient as well as the provider is important.

Safety of recipient:

The risk of harming recipient can be avoided by administering useful injection (right medication) with a new sterile single use device, observing proper technique by qualified and well-trained health workers increasing awareness of the people about injection safety

Safety of the provider:

The injection provider can reduce avoidable risks by disposing used syringe in a puncture proof closed container immediately after use & stopping practices such as bending or trying to recap needles. Needle stick injury (NSI) is commonly encountered by the provider especially during recapping.

Vaccination for Hepatitis B

About thirty infectious diseases may be transmitted by NSI but chances of acquiring hepatitis B infection are much higher than other infections. Hence, full immunization against Hepatitis B is important to ensure safety of the provider. Unfortunately, less number of health care workers in developing countries, are vaccinated against Hepatitis B and they work in adverse conditions where the chance of exposure to BBVDs is very high compared to developed nations. Furthermore, the unsafe practice is under reported. Some health workers are aware about safe practices but are unable to translate this into practice, one of the important reasons being the heavy work load.

Safety of the community

Safety of the community comes into consideration when the safe disposal of the syringes is not carried out. The injection material should be disposed according to local and international health and environmental standards so that the waste does not produce any hazard to other people.

There are some core strategies to remember for injection safety. These have been summarized in the Table 2.3

Table 2.3: Three core strategies to remember for injection safety

Educational strategy	Managerial strategy	Regulatory strategy
<ul style="list-style-type: none"> ● The educational strategy should mainly focus on the General population (recipient) and HCWs (providers). ● Strategy should target the general population through radio and television advertisements and HCWs through practical training in providing injections. 	<ul style="list-style-type: none"> ● Well trained and well intentioned HCWs cannot practice safely unless their working environment is favourable ● organizational commitment to safe injection practice. ● Creating a climate of safety includes formation of an infection control 	<ul style="list-style-type: none"> ● Support from local, state and national governments. ● Continuous availability of sufficient quantities of injection equipment (including safety boxes) in all health facilities. ● all sectors (formal, informal, illegal and domestic) should be targeted simultaneously.

<ul style="list-style-type: none"> • Strategy for the general population should focus on activities which would make the recipients aware about safe practices so that they would demand for useful and safe injections only. • do not adversely affect the use of useful injections such as vaccine, contraceptive and other rational injections. 	<p>committee, ensuring an adequate supply of quality disposable injecting devices and sharps containers at affordable prices, promoting injection safety awareness, vaccination of workers against Hepatitis B and supervising workers with low education levels. Training in safe injection practice for both injection providers and waste handlers can be planned.</p>	<ul style="list-style-type: none"> • Mandatory use of auto disable syringes for vaccination is a good step for ensuring injection safety.
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2.5.2 Prevention Strategies

You have already read that the three categories of people who need to be protected from the impact of unsafe injections are the patients, health care personnel and the community. Let us now learn about the preventive strategies in detail.

1. Eliminating the need for injections

Eliminating unnecessary injections is the best way to prevent injection-associated infections. When effective treatment can be given by other routes (oral or rectal), this is preferred, because it reduces potential exposure to blood and infectious agents, and thus reduces infection risks.

2. Adopting standard precautions which using injections

All standard precautions should be followed to make health care setting devoid of infection and this in turn will definitely make sure safety of injections for both injections provider and receiver too. Likewise, few of these precautions are mentioned in detail later in this chapter given the conversion of injection safe.

3. Skin preparation and disinfection:

To disinfect skin, use the following steps:

- Apply a 60–70% alcohol-based solution (isopropyl alcohol or ethanol) on a single-use swab or cotton-wool ball. **DO NOT** use methanol or methyl-alcohol as these are not safe for human use.
- Wipe the area from the centre of the injection site working outwards, without going over the same area.
- Apply the solution for 30 seconds then allow it to dry completely.

DO NOT pre-soak cotton wool in a container – these become highly contaminated with hand and environmental bacteria.

DO NOT use alcohol skin disinfection for administration of *vaccinations*.

3. Selecting the correct Injection devices:

Health-care settings should ensure that an adequate supply of single-use devices is available, to allow providers to use a new device for each procedure.

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

A brief of the types of syringes used in health care have been summarized in the Table 2.4 for your reference.

Table 2.4: Types of syringes used in health care

Types of syringes used in healthcare			
Type of syringes	Key Advantages	Key Disadvantages	Cost (INR)
Traditional single use syringes (10 safety features to prevent reuse)	- Widely available - Low cost	- Can be used more than once	INR 1.50 to 1.00 per piece
Auto-disable syringes (10 safety features to prevent reuse)	- Widely available - The most common of the 3 types	- Usually suitable settings	INR 1.50 to 1.00 per piece
ADP syringes (10 safety features to prevent reuse)	- Widely available - Full range of sizes - Proven success	- Similar to AD syringes, but with more safety features	INR 2.00 to 2.00 per piece
Sharp Injury Prevention (SIP) syringes - Plastic needle should fold to a syringe - Proven potential needle recapping	- Full range of sizes - Sharp is contained	- Activated the safety mechanism dependent on user activated compliance	INR 2.00 onwards

(Source: Authors).

In the year 2018, Punjab and Andhra Pradesh became first two Indian state to use auto-disable syringes for all clinical purposes and decided to make usage of AD syringes mandatory for all clinical purposes.

4. Precautions to be adopted while giving Medication:

When giving medication:

- DO NOT use a single loaded syringe to administer medication to several patients (i.e. ensure one needle, one syringe, one patient!);
- DO NOT change the needle in order to reuse the syringe;

- DO NOT use the same mixing syringe to reconstitute several vials;
- DO NOT combine leftover medications for later use.
 - *Single-dose vials* – Whenever possible, use a single-dose vial for each patient, to reduce cross-contamination between patients.
 - *Multidose vials* – Only use multidose vials if there is no alternative.
- Open only one vial of a particular medication at a time in each patient-care area.
 - If possible, keep one multidose vial for each patient, and store it with the patient's name on the vial in a separate treatment or medication room.
- DO NOT store multidose vials in the open ward, where they could be inadvertently contaminated with spray or spatter.
- *Discard a multidose vial:*
 - if sterility or content is compromised;
 - if the expiry date or time has passed (even if the vial contains antimicrobial preservatives);
 - if it has not been properly stored after opening;
 - within 24 hours of opening, or after the time recommended by the manufacturer, if the vial does not contain antimicrobial preservatives;
 - if found to be undated, improperly stored, inadvertently contaminated or perceived to be contaminated, regardless of expiration date.

5. Prevention of sharps injuries to health workers:

To avoid sharps injuries:

- ensure that the patient is adequately prepared for the procedure;
- do not bend, break, manipulate or manually remove needles before disposal;
- avoid recapping needles, but if a needle must be recapped, use a single-handed scoop technique;
- discard used sharps and glass ampoules immediately after use in the location where they were used, disposing of them into a robust sharps container that is leak and puncture resistant;
- place the sharps container within arm's reach (preferably in a secured area) to allow for easy disposal of sharps; ● seal and replace sharps container when the container is three quarters full.
- The main interventions that are needed to prevent exposure and infection are:

- Basic occupational health care, including immunization and awareness of current health status;
- Prevention of needle-stick injuries and other blood exposures;
- Management of exposures to blood; this includes **PEP (post exposure prophylaxis)**.


Source: WHO BEST PRACTICES FOR INJECTIONS AND RELATED PROCEDURES TOOLKIT, YEAR 2010

Situations where PEP is required in HIV exposure:

- administer the antiretroviral drugs for PEP as soon as possible after the exposure (ideally within 4 hours);
- continue the PEP regimen continuously for 28 days;
- use the two-drug regimen (recommended by WHO) unless there is suspicion or evidence of drug resistance, or unless there are national guidelines on choice of PEP regimen (in which case, follow these in preference);
- Evaluate the person taking PEP within 72 hours, to monitor for possible adverse drug reactions and adherence and follow-up (as described below) for at least two weeks.

Health workers should wear non-sterile, well-fitting latex or latex-free gloves when coming into contact with blood or blood products. Indications for glove use in injection practice are shown in Table 2.5 below:

Table 2.5 : Indications and precautions for wearing gloves

Key elements	Indications	Precautions
	<p>Wear non-sterile, well-fitting, nitrile gloves:</p> <ul style="list-style-type: none"> • when there is a likelihood of coming into direct contact with patient/blood or other potentially infectious materials (e.g. body fluids, mucously secretions and excretions [in dental procedures]), mucous membranes and soiled sites • when performing venipunctures or various skin injections, because of the potential for blood exposure at the puncture site • if the healthworker's skin is NOT intact (cut through exposure or cracked dry skin) • if the patient's skin is NOT intact (e.g. through exposure, burn or skin infection). 	<p>Wear nitrile gloves, DO NOT use gloves:</p> <ul style="list-style-type: none"> • for routine intradermal, subcutaneous and intramuscular injections • if the healthworker's skin is intact • if the patient's skin is intact. <p>Gloves DO NOT provide protection against needle-stick or other puncture wounds caused by sharp objects. Needles, scalpels and other sharps should be handled with extreme caution.</p>

Source: WHO (2010). Best practices for injections and related procedures toolkit.

2.5.3 Standard Precautions

Standard precautions are simple set of effective practices designed to protect health care workers and patients from infection with a range of pathogens including blood borne viruses. These practices are used when caring for all patients regardless of diagnosis. They are applied universally. Implementation of universal precaution includes following interventions:

- Hand washing after any direct contact with patient.
- Safe collection and disposal of needles and sharps with puncture proof and liquid proof boxes in each patient area.
- Wearing of gloves
- Wearing mask, eye protection and a gown.
- Covering all cuts and abrasion with water proof dressing.
- Promptly and carefully cleaning up spills of blood and other body fluids.
- Using the safe system for hospital waste management and disposal.


Let us look at two of the important components of standard precautions - hand hygiene and personal protective equipment.

1. Hand hygiene disinfection

If there is actual or possible microbial contamination of hands, hand hygiene is essential. Hand hygiene is a general term that applies to either hand washing, antiseptic hand wash, antiseptic hand rub or surgical hand antisepsis. It is the best and easiest way to prevent the spread of microorganisms. Use reliable bactericidal, fungicidal and virucidal preparation is mandated. Hand hygiene disinfection must be carried out in such a way that contamination of flora still on hands largely killed off.

Table 2.6 summarizes indications and precautions during hand hygiene:

Table 2.6: Indications and precautions of Hand Hygiene

Key elements	Indications	Precautions
<p>Hand hygiene (handwashing or alcohol-based handrub)</p> 	<p>Hand hygiene before and after contact with every patient is the single most important means of preventing the spread of infection.</p> <ul style="list-style-type: none"> • When hands are visibly dirty or contaminated with profuse secretions, wash them with antiseptic or plain soap and running water, then dry them using single-use paper towels. • When hands appear clean (i.e. are not visibly soiled), clean them with an alcohol-based hand product or routine decontamination, then dry them using single-use paper towels. 	<ul style="list-style-type: none"> • Always hand-dry or dry before starting any activity. • Do not use alcohol-based hand products when hands are visibly soiled. • Do not use alcohol-based hand products after exposure of hands to body fluids; in such cases, wash hands with antiseptic or plain soap and running water, then dry them using single-use paper towels.

Source: WHO (2010). Best practices for injections and related procedures toolkit.

When and why – follow World Health Organizations (WHO) hand hygiene (source : WHO)

The alcoholic preparation is rubbed in over all the areas of the dry hands paying special attention to the inner and outer surface including wrist and area between fingers ,finger tips , nail folds and thumbs and these are to be kept moist for entire exposure time.

2. Personal protective equipment

Personal protective equipment (PPE) provides a physical barrier between harmful organisms and health care personal. It also prevents cross transmission of microorganisms. PPE includes glove, protective eye wear, mask, apron, gown, cap/hair cover, boots/shoe covers etc.

These should be used by:

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

Adequate supply should be ensured in all areas. The staff should be involved in the selection of personal protective equipment, as equipment that is of poor quality or to wear will not be used. All staff must be trained in the correct use of the equipment. Staff must also be motivated to consistently use the protective equipment in the appropriate manner at all times. The use of influential senior staff as role models to promote personal protective equipment is often seen to be an effective management strategy. Compliance and inappropriate use must be monitored. Inappropriate glove use waste resources and compliance eye protection often requires additional effort. Large hospital should institute GLOVE PLANS, which lay down the types of protective gloves to be used by the wearer in a variety of settings depending on the assessed risk of exposure to microbial contamination. This would mean that some low risk settings like caterer or nursing assistants could make use of disposable poly urethane gloves, while waste workers who are at increased risk of per cutaneous injury use heavy duty industrial gloves. A surgeon who is not only at increased risk of exposure but whose work also involves retention of a high degree of tactile stimulus is best served by sterilized latex gloves. Some of most widely used personal protective equipments are described below:

Gloves

- Sterile gloves should be worn after hand hygiene procedure while touching mucous membrane and non-intact skin and performing sterile procedures e.g. arterial, central line and Foley catheter insertion

- Clean, non-sterile gloves are safe for touching blood, other body fluids, contaminated items and any other potentially infectious materials.
- Change gloves between tasks and procedures in the same patient especially when moving from a contaminated body area to a clean body area
- Never wear the same pair of gloves for the care of more than one patient
- Remove gloves after caring for a patient
- Practice hand hygiene whenever gloves are removed.

Gown:

- Wear a gown to prevent soiling of clothing and skin during procedures that are likely to generate splashes of blood, body fluids, secretions or excretions
- The sterile gown is required only for aseptic procedures and for the rest, a clean, non-sterile gown is sufficient
- Remove the soiled gown as soon as possible, with care to avoid contamination.

Mask, eye protection/face shield:

- Wear a mask and adequate eye protection (eyeglasses are not enough), or a face shield to protect mucous membranes of the eyes, nose and mouth during procedures and patient care activities that are likely to generate splashes/sprays of blood and body fluids, etc.,
- Patients, relatives and health care workers (HCWs) presenting with respiratory symptoms should also use masks (e.g. cough).

Shoe and head coverings:

- They are not required for routine care.

Patient-care equipment:

- Used patient-care equipment soiled with blood, body fluids, secretions, or excretions should be handled carefully to prevent skin and mucous membrane exposures, contamination of clothing and transfer of microorganisms to HCWs, other patients or the environment.
- Ensure that reusable equipment is not used for the care of another patient until it has been cleaned and sterilized appropriately
- Ensure that single use items and sharps are discarded properly.

Table 2.7 shows the preventive measures for HAI on the basis of different mode of transmission:

Table 2.7: Preventive measures for HAI

Air borne transmission	Droplet transmission	Contact transmission
Implementing standard precautions.Placing patients in single rooms having negative air flow pressure.Anyone who enters the room must wear a special high filtration, particulate respirator (e.g. N-95)Restricting the movement and transport of the patient from room for the essential purposes only.	Implementation of standard precautions.Only one patient per room.Wear surgical mask when coming in contact with in 1-2 m of the patient.Place a surgical mask on the patient during transportation.	Implementation of standard precautions.Place a patient in single room.Wear gloves.Wear gown.Limit the movement and transport of the patient from room for the essential purposes only.

(Source: authors)

Check Your Progress 4

1. What do you understand by PPE and standard precautions?

.....

2. Define safe injection?

.....

2.6 LET US SUM UP

- An HAI is an infection that is acquired by a patient during care delivery in a hospital or other health care facility that was not present or incubating on admission. Visitors, family members and health workers can also be affected by HAIs.
- There are hundreds of millions of patients are affected by health care-associated infections worldwide each year, leading to significant mortality and financial losses for health systems.
- Injection safety, Personal protective equipment, immunization to health care workers, stringent following of universal precautions along with health promotion remains the core strategies for the prevention and control HAIs.
- Majority of injections are given unnecessarily which upholds its possibility to become unsafe. Country like India where removal of injection practices

seems unrealistic in current scenario, efforts should be made to convert these entire injections safe at all three levels i.e. provider, receiver & community level.

- **One needle, One syringe at One time** policy must be followed. This will diminish the possibility of transmission of infection.
- Injection device security should be ensured in all health-care facilities, including therapeutic services, so that injectable medicines, diluents, AD/RUP/SIP injection devices and safety boxes are supplied in a timely manner in adequate quantities.
- Injection safety is a basic expectation in patient safety. Safe practices should not be sacrificed in efforts to save time or money. If you have to justify or qualify your injection practices, you might be doing something wrong.

2.7 KEY WORDS

Healthcare Associated Infection (HAI): An infection that is acquired by a patient during care delivery in a hospital or other health care facility that was not present or incubating on admission

Neonate: A neonate is also called a newborn. The neonatal period is the first 4 weeks of a child's life.

Hepatitis: Hepatitis refers to an inflammatory condition of the liver. It's commonly caused by a viral infection, but there are other possible causes of hepatitis.

Percutaneous : Made, done, or effected through the skin.

Immunization : Refers to the process where the body induces immunity to a disease as a result of a vaccine.

Sharps waste: Sharps waste is a form of biomedical waste composed of used "sharps", which includes any device or object used to puncture or lacerate the skin.

Personal protective equipment (PPE): Personal protective equipment (PPE) is protective clothing, helmets, goggles, or other garments or equipment designed to protect the wearer's body from injury or infection.

XDR TB: Extensively drug-resistant TB (XDR TB) is a rare type of multidrug resistant tuberculosis (MDR TB) that is resistant to isoniazid and rifampin, plus any fluoroquinolone and at least one of three injectable second-line drugs.

MRSA: MRSA is an acronym for methicillin resistant staphylococcus aureus. An antibiotic resistant strain of staph bacteria that is found in healthcare facilities and now in the community.

SARS: Severe acute respiratory syndrome (SARS) is a viral respiratory illness caused by a coronavirus, called SARS-associated coronavirus (SARS-CoV).

Nosocomial: Originating or taking place in a hospital, acquired in a hospital, especially in reference to an infection.

N95 Mask: N95 respirator is the most common of the seven types of particulate filtering facepiece respirators (mask) that covers the nose and mouth and helps protect the wearer from breathing in some hazardous substances. This product filters at least 95% of airborne particles but is not resistant to oil.

Universal precautions: Universal precautions refers to the practice, in medicine, of avoiding contact with patients' bodily fluids, by means of the wearing of nonporous articles such as medical gloves, goggles, and face shields.

Airborne infection: An airborne infection is an infection that is contracted by inhalation of microorganisms or spores suspended in air on water droplets or dust particles.

Biomedical waste: Biomedical waste is any kind of waste containing infectious (or potentially infectious) materials.

(Sources of definitions: CDC (<https://www.cdc.gov>) & WHO(<https://www.who.int/>))

2.8 ANSWERS OF CHECK YOUR PROGRESS QUESTIONS

Check Your Progress 1

1. WHO (World health organization) defines Healthcare Associated Infection (HAI) is *“an infection that is acquired by a patient during care delivery in a hospital or other health care facility that was not present or incubating on admission”*.
2. Following are the determinants of Hospital acquired infections:
 - Inappropriate use of invasive devices and antibiotics.
 - High-risk diagnostic or therapeutic procedures
 - Immuno-suppression
 - Sub-standard application
 - Poor water, sanitation, waste management and environmental cleaning
 - Insufficient equipment
 - Understaffing, as well as overcrowding
 - Poor knowledge of all measures including injection and blood transfusion safety
 - Absence of local/national guidelines, policies and programmes
 - Lack of surveillance and research.

Check Your Progress 2

1. following are the key facts of HAI

<p>HAI frequency On average, 1 in every 10 patients is affected by HAIs worldwide.</p>	<p>Hand hygiene On average, 61% of health workers do not adhere to recommended hand hygiene practices</p>	<p>Injection safety 16 billion injections are administered every year worldwide, up to 70% of which are given with reused syringes and needles in some developing countries</p>	<p>AMR (Anti-microbial resistance)Patients with methicillin-resistant <i>Staphylococcus aureus</i> (MRSA) are about 50% more likely to die than those infected with non-resistant strains</p>
<p>Intensive careIn high-income countries, up to 30% of patients are affected by at least one HAI in intensive care units; in developing countries the frequency is at least 2–3 times higher</p>	<p>Neonatal careAmong hospital-born babies, infections are responsible for 4%-56% of all causes of death in the neonatal period</p>	<p>Maternal care In Africa, up to 20% of women get a wound infection after a caesarean section, affecting their health and ability to care for their baby</p>	<p>Let's Research to explore more</p>

Check Your Progress 3

1. In the context of health care sector predominantly three modes of transmission can occur:
 1. Blood borne infections
 2. Other infectious diseases
 - i. Contact infections
 - ii. Air borne infections
 3. Faeco-oral route also present a risk but can be prevented in the same manner as contact infections.
2. MRSA is an acronym for methicillin resistant staphylococcus aureus. An antibiotic resistant strain of staph bacteria that is found in healthcare facilities and now in the community. Overuse of antibiotics in hospitals due to continued lapses in infection control are some of the favorable factors for the occurrence of this strain and poses serious threats to patients as well as health care staff.

Severe acute respiratory syndrome (SARS) is a viral respiratory illness caused by a coronavirus, called SARS-associated coronavirus (SARS-CoV). Primary way that SARS appears to spread is by close person-to-person contact. SARS-CoV is thought to be transmitted most readily by respiratory droplets (droplet spread) produced when an infected person coughs or sneezes.

1. Personal protective equipment (PPE) provides a physical barrier between harmful organisms and health care personal. It also prevents cross transmission of microorganisms. PPE includes glove, protective eye wear, mask, apron, gown, cap/hair cover, boots/shoe covers etc.

These should be used by:

- Health care workers who come in direct contact to patients and/or work in situations where they may have contact with blood, body fluids, excretions or secretions.
 - Support staff including medical aids cleaners and laundry staff in situations where they may have contact with blood, body fluids, secretions and excretions.
 - Laboratory staff, who handles patient specimens.
 - Family members who provide care to patients and are in a situation where they may have contact with blood, body fluids, secretions and excretions.
 - Standard precautions are simple set of effective practices designed to protect health care workers and patients from infection with a range of pathogens including blood borne viruses. They are applied universally. Following are the set of standard precautions to be followed religiously by all health care workers.
 - Hand washing after any direct contact with patient.
 - Safe collection and disposal of needles and sharps with puncture proof and liquid proof boxes in each patient area.
 - Wearing of gloves
 - Wearing mask, eye protection and a gown.
 - Covering all cuts and abrasion with water proof dressing.
 - Promptly and carefully cleaning up spills of blood and other body fluids.
 - Using the safe system for hospital waste management and disposal.
2. A safe injection, phlebotomy (drawing blood), lancet procedure or intravenous device insertion is one that:
 - does not harm the recipient;
 - does not expose the provider to any avoidable risk;
 - does not result in any waste that is dangerous for other people.

2.9 REFERENCES AND SUGGESTED FURTHER READINGS

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Related links for further reading:

- WHO, Clean Care is Safer Care www.who.int/gpsc
- WHO, Infection Control http://www.who.int/csr/bioriskreduction/infection_control/en/index.html
- European Centre for Disease Prevention and Control (ECDC) <http://www.ecdc.europa.eu/en/Pages/home.aspx>
- Centre for Disease Prevention and Control (CDC) and National Healthcare Safety Network (NHSN) <http://www.cdc.gov/nhsn/>
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