- 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

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.

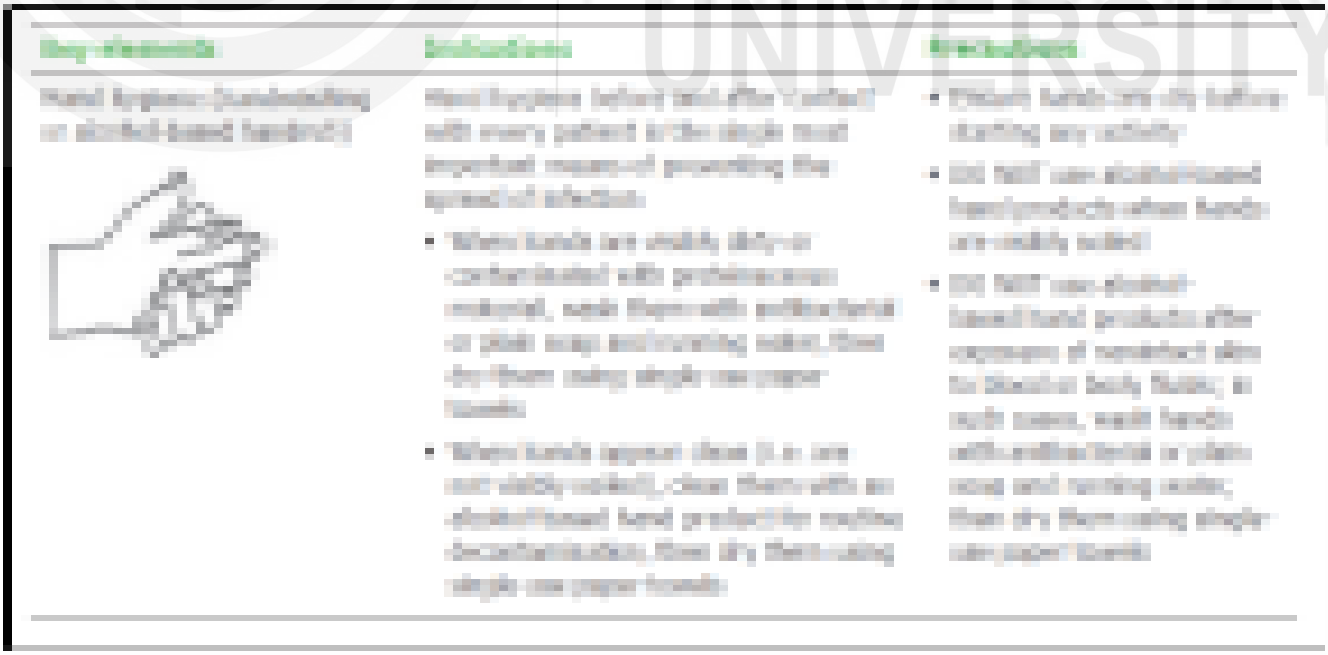
Let us look at two of the important components of standard precautions - hand hygiene and personal protective equipment.

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



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

When and why – follow World Health Organizations (WHO2 s) 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 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

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 *Staphylococcus aureus* (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

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.

Check Your Progress 4

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

- World Health Organization: Best Infection Control Practices for Skin-Piercing Intra-dermal, Subcutaneous, and Intramuscular Needle Injections. 2001, Safe Injection Global Network (SIGN), WHO: Geneva,

- Gazette of India, Extraordinary, Part II, Section 3, Sub-Section (I). Government of India Ministry Of Environment, Forest And Climate Change Notification. New Delhi, The 16th March, 2018.
- National Safety Implementation Framework 2018-25, MoHFW, NirmanBhavan New Delhi India, 2018.
- National Viral Hepatitis Control Program, MoHFW, NirmanBhavan New Delhi India, 2018.
- Injection safety to providers. http://www. cdc.gov/ncidod/dhqp/injection–www.cdc.injection safety.html
- Gyawali S, Rathore DS, Shankar PR, Vikash Kumar KC. Strategies and challenges for safe injection practice in developing countries. J PharmacolPharmacother2013;4:8-12.
- Kane A, Lloyd J, Zaffran M, Simonsen L, Kane M. Transmission of hepatitis B, hepatitis C and human immunodeficiency viruses through unsafe injections in the developing world: model-based regional estimates. *Bulletin of the World Health Organization*. 1999;77(10):801-807.
- Miller MA, Pisani E. The cost of unsafe injections. *Bulletin of the World Health Organization*. 1999;77(10):808-811.
- Kermode M. .Healthcare worker safety is a pre-requisite for injection safety in developing countries. Int J Infect Dis. 2004 Nov;8(6):325-7.
- Simonsen L[1], Kane A, Lloyd J, Zaffran M, Kane M. Unsafe injections in the developing world and transmission of bloodborne pathogens: a review. Bull World Health Organ. 1999;77(10):789-800.
- Michelle Kermode M, Holmes W, Langkham B, Thomas MS, Gifford S: Safer injections, fewer infections: injection safety in rural north India. Tropical Medicine and International Health. 2005, 10 (5): 423-432. 10.1111/j.1365-3156.2005.01421.x.
- https://en.wikipedia.org/wiki/Injection_(medicine)
- "Injection safety". *Health Topics A to Z*. World Health Organization.
- IPEN Study Group. Injection practices in India. WHO South-East Asia Journal of Public Health 2012;1(2):189-200.
- Sonugoel Anil kumargupta, Amarjeet Singh (2014). Hospital administration a problem solving approach. Elsevier ,Rajkamal press, Haryana.
- K.Park (2015). Parks textbook of preventive and social medicine. (23rd ed.). Bhanot publishers, Jabalpur.
- *WHO*. Health care without avoidable infections The critical role of infection prevention and control, 2016.

- Andhra Pradesh, First Indian State to use Auto-Disable Syringes for All Clinical Purposes. Available from: https://indiamedtoday.com/andhra-pradesh-first-indian-state-to-use-auto-disable-syringes-for-all-clinical-purposes/
- WHO calls for worldwide use of "smart" syringes. Available from: http://www.who.int/mediacentre/news/releases/2015/injection-safety/en/
- *WHO* Health care-associated infections fact sheet.
- Mehta Y et al. Guidelines for prevention of health care associated infections. Indian J Crit Care Med. 2014 Mar; 18(3): 149–163.
- Pai M, Kalantri S, Aggarwal AN, Menzies D, Blumberg HM. Nosocomial tuberculosis in India. *Emerg Infect Dis*. 2006;12(9):1311-8.
- Reed NG. The history of ultraviolet germicidal irradiation for air disinfection. *Public Health Rep*. 2010;125(1):15-27.

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/
- International Nosocomial Infection Control Consortium http://www.inicc.org/english/index.php
- Prevalence of latex hypersensitivity among health care workers in Malaysia. https://www.ncbi.nlm.nih.gov/pubmed/10972001.
- http://healthfacilityguidelines.com/Guidelines/ViewPDF/iHFG/iHFG_part_d_isolation_rooms
- https://www.who.int/ihr/training/laboratory_quality/3_cd_rom_bsc_selection_use_cdc_manual.pdf?ua=1
- Prevention of hospital-acquired infections. https://www.who.int

UNIT 3 MANAGEMENT OF INFECTIONS IN HEALTH CARE SETTINGS

Structure

3.0 INTRODUCTION

In the previous units, you were introduced to the various infections to which health care workers (HCWs) are at risk of development. It is pertinent to

understand that timely management of these infections in HCWs can ensure efficient delivery of health services Sometimes due to unforeseen circumstances, HCWs can suffer from needle stick injuries or be exposed to infectious body fluids of patients or certain airborne infections. This exposure places the health care worker at risk of contracting infections such as Tuberculosis, HIV/AIDS, hepatitis B and hepatitis C. Does this statement ring the alarm bells? Well, this not to create panic amongst you. There still exists an opportunity to prevent these disease from occurring after exposure. This is known as Post Exposure Prophylaxis (PEP).

Timely introduction of PEP against HIV/AIDS, Hepatitis B and Tetanus has played a significant role in reducing significant morbidity and mortality due to these infections world over. Thus, as a HCW, you must understand the importance of PEP and learn the management following the exposure to any of the infectious agents as discussed above. For certain other airborne and hospital acquired infections, there are other modalities of management. This unit will introduce you to the concept of PEP, its advantages and steps involved in administering PEP to an exposed individual. It will also attempt to discuss PEP in relation to specific disease agents such as HIV/ AIDS, Hepatitis B, Hepatitis C and Tetanus and role of immunization in prevention and control of certain infections in health settings. The unit would also elaborate on important concepts of housekeeping and sterilization in prevention and management of hospital acquired infections. The concept of antimicrobial resistance has been briefly discussed at the end of the unit.

3.1 OBJECTIVES

After studying this unit, you will be able to:

- discuss the principles in management of infections amongst health care workers (HCWs);
- enumerate the potential infections arising from various modes of exposure in HCWs;
- describe the steps in management to prevent occupational exposure to various infectious agents in health care facilities;
- define and understand role of Post Eexposure Prophylaxis (PEP);
- list the various immunizations recommended for HCWs;
- explain concepts of sterilization and disinfection;
- enumerate the general principles of housekeeping in prevention and control of infections; and
- describe the concept of Antimicrobial resistance and factors responsible for it in India

3.2 MANAGEMENT OF INFECTIONS

As discussed in previous units, HCWs have the potential for exposure to infectious materials including body fluids, contaminated medical supplies and equipment, contaminated environmental surfaces and contaminated air,

while performing their duties.[1] Based on the modes of transmission, some of the diseases to which the HCWs are at risk of contracting, are as follows:

- Airborne/droplet: Chicken pox, influenza, tuberculosis, meningococcal infection, Severe Acute Respiratory Syndrome (SARS), mumps, measles, rubella, diphtheria
- Blood borne: Human Immunodeficiency Virus (HIV), Hepatitis B, Hepatitis C, TORCH infections during pregnancy
- Contact infections: Molluscum Contagiosium, , Tetanus, Pseudomonas infections, mpetigo
- Fomite borne: Methicillin-resistant Staphylococcus aureus (MRSA), Vancomycin-Resistant Enterococci (VRE), herpes simplex.

3.2.1 Principles of Management of Occupation Related Infections & Exposures

- Arrange for prompt diagnosis and management of job related illnesses.
- To provide appropriate post-exposure prophylaxis after job related exposures.
- Implement measures to prevent further transmission of infection which sometimes warrant isolation also.
- Report of their illnesses or exposures without penalizing them with loss of wages, benefits or job status.
- Access to adequate health counseling for HCWs regarding the risk and prevention of occupationally acquired infections, the risk of illness or other adverse outcome after exposures, management of exposures, including the risks and benefits of post exposure prophylaxis (PEP) regimens and the potential consequences of exposure or communicable diseases for family members, patients or other personnel.
- Maintenance of records on medical evaluations, immunizations, exposures, PEP and screening tests.

3.2.2 Management of Airborne Infections

Chicken pox: Laboratory diagnosis of chickenpox is rarely required as clinical signs are usually well defined. Notifying the case, isolation of case for about 6 days after the onset of rash and disinfection of articles soiled by nose and throat discharges are the important measures in management of this infection. Antiviral drugs like acyclovir, valaciclovir, famiciclovir and foscarnet provide effective therapy for varicella.

Influenza: Virus isolation and serology are needed to confirm the diagnosis. Two antiviral dugs (neuraminidase inhibitors-zanamivir and oseltamivir) are available for prophylaxis and therapy for influenza A and B. the dose of oseltamivir is 75 mg per day for prophylaxis and 75 mg twice daily for 5 days for therapy.

Tuberculosis (TB): Sputum smear examination by direct microscopy is considered investigation of choice for TB. Chest X rays are useful for

diagnosis of smear negative pulmonary TB and TB in children. Other tests include sputum culture, genotypic methods like polymerase chain reaction (PCR), cartridge based nucleic acid amplification test (CBNAAT), GeneXpert MTB/ RIF and phenotypic methods fast plaque TB. There are now twelve to thirteen drugs active against M. Tuberculosis. Anti-tuberculosis drugs are prescribed for treatment. For new TB cases, the treatment in intensive phase (IP) consists of 8 weeks of Isoniazid, Rifampicin, Pyrazinamide and Ethambutol, while in continuation phase (CP), only Pyrazinamide will be stopped and rest of the three drugs will be continued for another 20 weeks.

Healthcare facilities in India have poor airborne infection control systems. With emergence of Multi-Drug Resistant (MDR) strains, there is reported re-emergence of hospital based transmission of TB & MDR TB. Drug resistant TB is a laboratory based diagnosis and is performed either by phenotypic Drug Susceptibility Testing using solid/liquid culture or genotypic testing for detection of resistance by Line Probe Assay or CBNAAT. Standard regimen for MDR TB consists of 6-9 months of Intensive Phase with Kanamycin, Levofloxacin, Ethambutol, Pyrazinamide, Ethionamide and Cycloserine and 18 months of CP with Levofloxacin, Ethambutol, Ethionamide and Cycloserine

Meningococcal meningitis: Antibiotics should be started during the first 2 days of illness. Penicillin is the drug of choice. In penicillin allergic patients, ceftriaxone and third generation cephalosporins should be substituted. Isolation of cases is of limited usefulness in controlling epidemics because the carriers outnumber cases.

Severe Acute Respiratory Syndrome (SARS): Diagnostic tests for laboratory confirmation of SARS include conventional reverse transcriptase (RT-PCR) and real time RT PCR to detect viral RNA in at least 2 different (nasopharyngeal and stool) specimens or viral culture from any clinical specimen. Enzyme linked immunosorbent assay (ELISA) and immunofluorescent assay can also be used. Severe cases require intensive support. Severe cases require intensive support. A number of different agents including ribavirin, lopinavir/ritonavir, interferon, intravenous immunoglobulin and systemic corticosteroids are used to treat SARS but their efficacy remains inconclusive.

Mumps: The control of mumps is difficult because the disease is infectious before a diagnosis can be made. The long and variable incubation period and the occurrence of subclinical cases make the control difficult. However, cases should be isolated till the manifestations subside

Measles: Clinical diagnosis of the disease is made. Isolation of the patients for 7 days after onset of rash is the mainstay of management.

Rubella: A definitive diagnosis of rubella is possible through virus isolation and serology. Throat swabs should be cultured for virus isolation. The haemagglutination inhibition (HI) is a standard serological test for rubella. Vaccination against rubella is the most important preventive strategy.

Diphtheria: Swabs should be taken from both the nose and throat and examined by culture methods for diphtheria bacilli. All cases, suspected cases and carriers should be promptly isolated for at least 14 days or until proved free of infection. At least 2 consecutive nose and throat swabs,

taken 24 hours apart, should be negative before terminating isolation. Diphtheria antitoxin should be given without delay intramuscular or intravenous in doses of 20,000 to 1,00,000 units depending upon the severity of the case. In addition, every case should be treated with penicillin or erythromycin for 5-6 days. The carriers should be treated with 10 days course of oral erythromycin.

3.2.3 Management of Blood Borne Infections

Human Immunodeficiency Virus (HIV): ELISA test is used to detect HIV antibodies while Western Blot is a highly specific test to confirm HIV. It is based on detecting specific antibody to viral core protein and envelope glycoprotein. Several laboratory markers are available to provide prognostic information. One such most widely used marker is the absolute CD4 lymphocyte count. According to the guidelines, once the patient is positive for HIV, antiretroviral treatment is started irrespective of the CD4 count.

Hepatitis B virus infection (HBV): There are three distinct antigen antibody systems that relate to HBV infection and a variety of circulating markers that are useful in diagnosis. Interpretation of common serological patterns is as follows:

Table 3.1: Common serologic patterns in hepatitis B virus infection and their interpretation

HBsAg	Anti-HBs	Anti-HBc	HBeAg	Anti-HBe	Interpretation
+	-	IgM	+	-	Acute hepatitis B
+	-	IgG	+	-	Chronic hepatitis B with active viral replication
+	-	IgG	-	+	Chronic hepatitis B with low viral replication
+	+	IgG	+ or -	+ or -	Chronic hepatitis B with anti-HBs
-	-	IgM	+ or -	-	Acute hepatitis B
-	+	IgG	-	+ or -	Recovery from hepatitis B (immunity)
-	+	-	-	-	Vaccination (immunity)
-	-	IgG	-	-	False positive, less commonly, infection in remote past

Since there is no specific treatment available, prevention is the key to management of viral hepatitis B.

Hepatitis C: Combination anti-viral therapy with interferon and ribavirin has been the mainstay of hepatitis C treatment. However, interferon not widely available and neither tolerated well. Two new therapeutic agents telaprevir and boceprevir have recently been licensed in some countries.

TORCH infection: They are vertically transmitted infections that are capable of causing significant fetal and neonatal morbidity and mortality. The acronym TORCH stands for:

T-Toxoplasmosis

O-others (including syphilis, varicella zoster virus, parvovirus, listeriosis)

R-Rubella

C-Cytomegalovirus (CMV)

H-Herpes simplex virus (HSV)

TORCH infections can cause numerous complex organ abnormalities, including central nervous system abnormalities, cardiac defects, vision and hearing loss as well as skeletal and endocrine abnormalities. Primary prevention includes vaccination for varicella and rubella (prior to pregnancy), screening for syphilis, and hygiene measures (washing hands and avoidance of certain foods) during pregnancy. Treatment of specific infections involve use of antibiotics and antiviral drugs for both pregnant worker and newborns.

3.2.4 Management of Contact and Fomite Infections

Usually eye and skin infections spread through contact with infective secretions or fluids of the patient. They can be prevented by appropriate practice of universal precautions and infection control practices. Once inflicted, the health worker needs to be treated with antibiotics and in some cases antiviral drugs (e.g. herpes simplex).

Methicillin-resistant Staphylococcus aureus (MRSA): The Staphylococcus aureus strains expressing mec A determinant are termed as MRSA. It can colonize the nose and other skin sites without causing infections. MRSA can spread by airborne route but is most commonly spread by the colonized hands of HCWs. Colonized HCWs may subsequently develop clinical infections and act as reservoir for infection among other vulnerable individuals including patients. Standard MRSA decolonization therapy includes the use of topical application of mupirocin 2%, bacitracin, tea tree oil of *Melaleuca alternifolia* plant, retapamulin of the pleuromutilins group of antibiotics, chlorhexidine gluconate and sodium hypochlorite. Oral therapies such as tetracyclines, folate inhibitors, quinolones, rifamycins and macrolides are usually used in combination with topical therapy

Vancomycin-Resistant Enterococci (VRE): Enteroccocci are bacteria that are normally present in the human intestines and in the female genital tract and are often found in the environment. These bacteria can sometimes cause infections. Vancomycin is an antibiotic that is used to treat some drug-resistant infections caused by enterococci. In some instances, enterococci have become resistant to this drug and thus are called vancomycin-resistant enterococci (VRE). Most VRE infections occur in hospitals. VRE is often transmitted from person to person by the contaminated hands of care-givers. VRE can get onto a caregiver's hands after they have contact with other people with VRE or after contact with contaminated surfaces. Most VRE infections can be treated with antibiotics other than vancomycin.

Check Your Progress 1

1. Enumerate any 3 airborne and blood borne infections to which a health worker is at risk of development.

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2. Enlist the principles of management of infections acquired due to occupation exposures.

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3. Define MRSA and VRE infections, their mode of transmission and their management

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3.3 POST EXPOSURE PROPHYLAXIS (PEP) IN OCCUPATIONAL SETTINGS

3.3.1 Definition

It refers to comprehensive management given to minimize the risk of infection following potential exposure to blood borne pathogens [Human Immuno-deficiency Virus (HIV), Hepatitis B Virus (HBV), Hepatitis C Virus (HCV)].[2] It begins from provision of first aid, counseling, risk assessment, relevant laboratory investigations of the source and exposed person, provision of vaccine or anti-retroviral therapy for short term and follow up.

Box 3.1: What is Post Exposure prophylaxis?

Post= After

Exposure= a situation where HIV/HBV/HCV enters someone's body

Prophylaxis= Prevention of development of the disease

The "exposure" to health care professional (HCP) at risk of infection due to infectious body fluids is defined as[2]:

1. Percutaneous injury (e.g. needle stick or cut with a sharp instrument)
2. Contact with mucous membrane of eye or mouth

3. Contact with non-intact skin (particularly when the intact skin is chapped, abraded, or afflicted with dermatitis)

4. Contact with intact skin when duration of contact is prolonged (e.g. several minutes or more) with blood or potentially infectious body fluids.

3.3.2 Potentially Infectious Body Fluids

Body fluids whose exposure to skin-intact or non-intact, mucous membrane and per-cutaneous has the potential of causing infection is referred as "potentially infectious body fluids."

When evaluating occupational exposures to fluids that might contain hepatitis B virus (HBV), hepatitis C virus (HCV), or human immunodeficiency virus (HIV), health care workers should consider that all blood, body fluids, secretions, and excretions except sweat, tear, urine and feces (unless stained with blood) may contain transmissible infectious agents.[2,3] (Table 3.2)

Table 3.2: List of potentially infectious body fluids

Potentially infectious body fluids	
Exposure to body fluids considered 'at risk'	**Exposure to body fluids considered 'not at risk'**
Blood	Tears
Semen	Saliva
Vaginal secretions	Sweat
Cerebrospinal fluids	Urine and feces
Synovial, peritoneal, pleural pericardial fluid Amniotic fluid Other body fluids contaminated with blood	**UNLESS THESE SECRETIONS CONTAIN VISIBLE BLOOD.**

Check Your Progress 2

1. Define Post Exposure Prophylaxis (PEP)

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2. Name any 5 potentially infectious body fluids

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3.3.3 Steps for Management of Occupational Exposure

The steps for management of occupational exposure is as follows:

Step I: Management of Exposure Site

Wash the wound and surrounding skin with water and soap. But do not scrub or use skin washes or antiseptics (bleach, chlorine, alcohol, betadine). In case of exposure of body fluids to eye, irrigate exposed eye immediately with water or normal saline. For mouth, spit the fluid immediately. Rinse the mouth thoroughly using water or saline and spit again. Repeat the process several times. Consult the designated physician of the institution for management of exposure immediately.

Step II: Establish the eligibility of PEP

The following information should be included in the exposure report, recorded in the exposed person's confidential medical record, and made available to qualified HCP[3]:

- Date and time of exposure
- How and when the exposure occurred.
- Details of the exposure-type and amount of fluid or material and the severity of exposure. For a percutaneous injury, details would include the depth of the wound, the gauge of the needle, and whether fluid was injected; for a skin or mucous membrane exposure they would include the estimated volume of material, the duration of contact, and the condition of the skin (e.g., chapped, abraded, or intact).
- Details about the exposure source- whether the patient was infected with hepatitis B virus (HBV) and his or her hepatitis B e antigen (HBeAg) status; hepatitis C virus (HCV); or human immunodeficiency virus (HIV); and, if the source was infected with HIV, the stage of disease, history of antiretroviral therapy, and viral load, if known. If the information is not known, then the serologic testing for these infections should be done for the source patient.
- Details about the exposed person- Assessment of the exposed person (e.g., hepatitis B vaccination and vaccine-response status).

For assessment of source and exposed, laboratory evaluation needs to be done for HIV, HBV and HCV. Other blood tests such as liver function tests, pregnancy tests may also be done.

Step III: Counseling for PEP

The individuals who are exposed to infectious body fluids must receive information about the PEP to be instituted, the risks and benefits of PEP in order to provide informed consent. This information would help in in allaying their anxiety and fears. Documentation of counseling on records is essential. Informed consent should be taken before starting PEP especially in case of exposure to HIV. (Note: In case of HIV, post test counseling is done, discussing the results of the tests).

Step IV: Prescribe PEP

Assess the Anti-retroviral (ARV) status of source patients. Check for pregnancy amongst exposed female HCP. Explain the side effects of PEP drugs or vaccine (as in hepatitis B). Explain PEP measures against HBV and HCV.

Step V: Follow up and monitor adherence

Whether or not PEP is initiated, follow up is indicated to monitor for possible infections and provide psychological support. In the weeks following exposure, the exposed person must be monitored for clinical appearance of symptoms and signs of infections such as HIV, HBV, HCV and rabies. For example, the symptoms with HIV primary (acute) infection appear in 50%-70% of individual within 3-6 weeks following exposure. Laboratory follow up should also be done (particularly in case of HIV). In case of HIV, testing at the completion of PEP may give an initial indication of sero-conversion outcome. However, sometimes testing at 4-6 weeks may not be enough as use of PEP may prolong the sero-conversion therefore, testing at 3 and 6 months is recommended.

Table 3.3: Recommended follow up laboratory tests

Timing	In persons taking PEP	In persons not taking PEP
Weeks 2 and 4	Transaminases Complete blood count	Clinical monitoring for hepatitis
Week 6	HIV antibody	HIV-Ab
Months 3	HIV antibody, anti-HCV, HBsAg Transaminases	HIV-Ab, anti-HCV, HBsAg
Months 6	HIV antibody, anti-HCV, HBsAgTransaminases	HIV-Ab, anti-HCV, HBsAg

3.3.4 Advantages of PEP

Evidence supporting the use of ARV drugs for PEP demonstrated that these drugs could prevent the establishment of chronic infections if taken within stipulated period following the exposure.[4] PEP is likely to be cost-effective intervention particularly in high risk groups. However, the adherence and completion of the prescribed course are important factors that impact the effectiveness of PEP intervention.

Check Your Progress 3

1. Enumerate the important information that needs to be collected for establishing the eligibility of PEP.

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2. Post test counseling is done in HIV. True/False

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3.3.5 Post Exposure Prophylaxis in HIV/AIDS

PEP recommendations in case of occupational exposure is as follows[5]:

Exposure codes	HIV source codes	PEP recommendations	Duration
1	1	Not warranted	28 days
1	2	Recommended	
2	1		
2	2		
3	1 or 2		
2/3	Unknown	Consider PEP, if HIV prevalence is high in the given population & risk categorization	

HIV exposure code (EC) is defined as: Source material is blood, bloody material or potentially infectious body fluids or any instrument contaminated with any of these substances. It is EC1 if small volume-few drops are exposed for short duration to mucous membrane or skin where integrity is compromised. It is EC2 if large volume, major splash of above fluid is exposed for longer duration to mucous membrane or skin where integrity is compromised. It also includes less severe percutaneous exposure with solid needle or superficial scratch. It is EC3 if percutaneous exposure with hollow bore needle or deep injury.

HIV source code (SC) is defined as: SC1 if HIV status of the source is positive but with low titre, asymptomatic and high CD4 count. It is considered SC2 if source status is HIV positive, high titre exposure, advanced disease and low CD4 count. If status of source is HIV negative, no PEP is required. If status or source unknown, it is labeled as HIV SC unknown.

(Note:-In case of sexual assault, PEP should be provided to exposed person as a part of post sexual assault care.)

PEP Regimen

- Where PEP is indicated and source is not on ART or status is unknown, recommended regimen is **Tenofovir 300 mg + Lamivudine 300 mg + Efavirenz 600 mg once daily for 28 days**. Wherever available, single pill containing these formulations should be used.
- The first dose of PEP should be started as soon as possible, preferably within 2 hours of exposure and subsequent doses should be given at

bed time, 2-3 hours after dinner and intake of fatty food in dinner should be avoided. There is little benefit if PEP is started after 72 hours of exposure.

- In case of tolerance to Efavirenz, regimen containing Tenofovir + Lamivudine + protease inhibitor-Lopanivir/ritonavir (LPV/r) can be used after expert consultation by experienced physician.
- In case of exposure where source is on ART, **Tenofovir 300 mg + Lamivudine 300 mg + Efavirenz 600 mg** should be started immediately
- Appropriate counseling should be provided to the exposed individual regarding possible side effects of PEP regimen, adherence to regimen and follow up protocol.
- Report the exposure immediately to appropriate authority

Check Your Progress 4

1. Name the drugs recommended in PEP for HIV/AIDS

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3.3.6 Post Exposure Prophylaxis in Hepatitis B

PEP recommendations in case of occupational exposure to HBV is as follows[6]:

Vaccine status of exposed	Regimen
Unvaccinated	1. If source patient is HBsAg positive, single dose of hepatitis B immunoglobulin (HBIG) and initiate hepatitis B (Hep B) vaccine series. 2. If source patient is HBsAg negative, initiate hepatitis B (Hep B) vaccine series.
Previously vaccinated Antibody response unknown	Test exposed person for anti-HBs 1. If adequate (anti-HBs e”10 mIU/mL), no treatment is required 2. If inadequate and source is HBsAg positive, one dose of HBIG and second series of Hepatitis B.

For exposed HCP thought to be susceptible to HBV infection, HBIG and Hep B vaccine should be administered as soon as possible after an exposure when indicated. The effectiveness of HBIG when administered >7 days after percutaneous, mucosal, or non-intact skin exposures is unknown.[7]

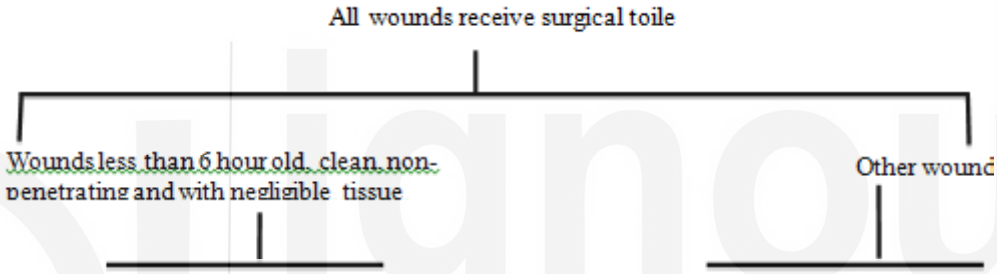
3.3.7 Post Exposure Prophylaxis in Hepatitis C

Hepatitis C virus is inefficiently transmitted by occupational exposures. PEP is not recommended after exposure as immunoglobulin is not effective and no data is available on effectiveness of antivirals drugs (e.g. interferon) in post exposure management.

3.3.8 Post Exposure Prophylaxis in Tetanus

All wounds must be thoroughly cleaned soon after injury –removal of foreign bodies, soil, dust, necrotic tissue. This procedure will abolish anaerobic conditions which favor germination of tetanus spores.

A test dose of Anti-Tetanus Serum (ATS) (0.1 ml in a tuberculin syringe) should be given subcutaneously and the patient should be observed carefully at least for half an hour for any evidence of general reaction, e.g. alteration in pulse, fall in blood pressure, dyspnea and distress. If there is reaction, ATS should be withheld.[8]



Immune category	Treatment
A	Nothing more required
B	Toxoid 1 dose
C	Toxoid 1 dose
D	Toxoid complete course

Immune category	Treatment
A	Nothing more required
B	Toxoid 1 dose
C	Toxoid 1 dose + Human Tetanus Immunoglobulin
D	Toxoid complete course + Human Tetanus Immunoglobulin

A = has had a complete course of toxoid or a booster dose within past 5 years

B= has had a complete course of toxoid or a booster dose > 5 years but less than 10 years

C= has had a complete course of toxoid or a booster dose more than 10 years ago

D= has not had a complete course of toxoid or immunity status unknown

3.3.9 Post Exposure Prophylaxis in other Diseases

Varicella-Zoster immunoglobulin can be given within 72 hours of exposure for prevention of chickenpox in exposed susceptible HCW. Measles may be prevented by administration of immunoglobulin (if vaccine is contraindicated) within 3-4 days of exposure. Other wise, susceptible contacts of measles should be vaccinated against it within 3 days of exposure. Close contacts of meningococcal disease are at increased risk of developing meningococcal illness. Ideally, where indicated, treatment

should be started within 24 hours of identification of index case. Antibiotics effective for this purpose include rifampicin, ciprofloxacin, ceftriaxone or azithromycin. For diphtheria Benzathine penicillin 1.2 million units intramuscular, single dose or erythromycin 1 g/day per oral for 7 days can be given.[9]

3.3.10 Adverse Effects of PEP

The most common side effects are associated with PEP regimen for HIV, commonly nausea and fatigue.[2] Other possible side effects include headaches, vomiting, and diarrhea.[10] Anemia, leucopenia or thrombocytopenia may also occur. Most of these side effects begin during the start of the regimen, but they are mild and transient. Therefore, persons taking the PEP for HIV/ AIDS must be counseled about these side effects and dissuaded from stopping the treatment. Side effects can also be avoided by giving medicines to reduce nausea and gastritis. Further, patients could be told to take PEP regimen with food.[2]

Serious adverse effects from HBIG, when administered as recommended, are rare.[3] Local pain and tenderness at the injection site, urticaria, and angioedema might occur; anaphylactic reactions, although rare, have been reported following the injection of human immune globulin (IG) preparations. HBIG is not contraindicated for pregnant or lactating women.[2] HepB vaccines have been demonstrated to be safe among persons in all age groups. The most frequently reported side effects are pain at the injection site (3%–29%) and temperature of >99.9°F (>37.7°C) (1%–6%). It is not contraindicated for pregnant or lactating women.[3]

Reactions following injections of tetanus toxoid are uncommon. However, persons giving history of allergy, usual precautions must be taken. Hypersensitivity to ATS may occur leading to anaphylaxis. Therefore, sensitivity testing of ATS must always be done before prescribing it.[8]

3.4 IMMUNIZATION

Immunity to vaccine preventable diseases is essential part in management of infections amongst HCWs in occupational settings. Immunization can prevent transmission of vaccine preventable diseases and eliminate unnecessary work restrictions.[9]

Immunizations recommended for staff include: hepatitis B, measles, mumps, rubella, tetanus and diphtheria. Immunization against varicella (chicken pox) and meningococcal vaccine may be considered in specific cases. Similarly, influenza vaccines are recommended for certain selected population groups including those involved in medical care. The Mantoux skin test* will document a previous tuberculosis infection and must be obtained at baseline.[8]

*Note: The Mantoux test is carried out by injecting 1 tuberculin unit (TU) of purified protein derivative (PPD) in 0.1 ml intradermally on the flexor surface of the left forearm, mid way between elbow and wrist. The injection should produce a pale wheal of the skin, 6-10 mm in diameter. The result of the test is read after 48-96 hours but 72 hours is the ideal. Horizontal transverse diameter of induration is measured in millimetres, using a

transparent plastic scale. Reactions exceeding 10 mm ar considered "positive". Those less than 6 mm are considered "negative". Those between 6 and 9 mm are considered "doubtful".

Table 3.4: Immunizing agents strongly recommended for health care personnel[10]

Name of the vaccine	Dose schedule
Hepatitis B (recombinant vaccine)	Two doses intramuscular 4 weeks apart, 3rd dose 5 months after second dose.
Influenza Vaccine (inactivated whole vaccine)	Annual single dose vaccination intramuscular with current vaccine
Measles live vaccine	One dose subcutaneously; 2nd dose at least 1 month later
Mumps live vaccine	One dose subcutaneously
Rubella live vaccine	One dose subcutaneously
Varicella zoster live vaccine	Two 0.5 ml doses subcutaneously, 4-8 wk apart if >=13 years
Meningococcal polysaccharide vaccine	One dose in volume and route specified by manufacturers
Tetanus and diphtheria	Two doses intramuscular 4 wk apart; 3rd dose 6-12 months after 2nd dose; booster every 10 years.

Check Your Progress 5

1 You are medical superintendent (MS) of hospital X. Some new doctors have been appointed in your hospital. As the head of organization, what all vaccines you would recommend for the newly recruited staff?

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3.5 ROLE OF STERILIZATION IN MANAGEMENT OF INFECTIONS

3.5.1 Concept of Sterilization and Disinfection

Sterilization describes a process that destroys or eliminates all forms of microbial life and is carried out in health care facilities by physical or chemical methods.[11] On the other hand disinfection refers to a process that eliminates many or all pathogenic microorganisms, except bacterial spores on inanimate objects.[11] To conclude, unlike sterilization, disinfection is not sporicidal.

Some other concepts that need to be understood are: Cleaning is removal of visible soil (e.g. organic and inorganic material) from objects and surfaces

and normally is accomplished manually or mechanically using water with detergents or enzymatic products. Decontamination removes pathogenic microorganisms from objects so they are safe to handle, use or discard.

Rational approach to disinfection and sterilization: Earle H. Spaulding devised a rational approach to disinfection and sterilization of patient care items and equipment by categorizing items as critical, semi-critical and non-critical according to the degree of risk for infection involved with use of the items.[12]

- Critical items: confer a high risk for infection if they are contaminated with any microorganism. It includes: surgical instruments, cardiac and urinary catheters, implants, and ultrasound probes used in sterile body cavities. They should be purchased as sterile or be sterilized with steam.
- Semi-critical items: These items contact mucous membranes or non-intact skin.

  This category includes respiratory therapy and anesthesia equipment, some endoscopes, laryngoscope blades[13], esophageal manometry probes, cystoscopes[14], anorectal manometry catheters, and diaphragm fitting rings. These medical devices should be free from all microorganisms; however, small numbers of bacterial spores are permissible.
- Non-critical items: These items are those come in contact with intact skin but not mucous membrane. Examples include: bedpans, blood pressure cuffs, crutches, and computers.

Check Your Progress 6

1. Activity: Categorize following items and equipment on the basis of criticality bedpans, anorectal manometry catheters, ultrasound probes, crutches, endoscopes, implants.

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3.5.2 Disinfection of Healthcare Equipment

Disinfection of healthcare equipment is based upon the criticality of the item. The disinfectants which kill all micro-organisms except large numbers of bacterial spores are called as high level disinfectants (2% glutaraldehyde). However, these disinfectants when present for prolonged exposure times (3-12 hours) generally kill spores. Intermediate level disinfectants might be cidal for mycobacteria, vegetative bacteria, most viruses, and most fungi but do not necessarily kill bacterial spores. Low-level disinfectants can kill most vegetative bacteria, some fungi and some viruses in a practical period of less than 10 minutes.

While high-level disinfection is recommended for critical and semi-critical items, low level disinfection is generally done for non-critical items.

3.5.3 Sterilization-Methods and Practices

As discussed above, critical items should be sterile when used because any microbial contamination could result in disease transmission. The devices that are heat stable primarily undergo steam sterilization, while the devices made of materials such as plastics require low temperature sterilization systems (e.g. hydrogen peroxide gas plasma, peracetic acid immersion, ozone). Ethylene oxide gas is used for heat and moisture sensitive medical devices.

Methods of sterilization:

- Steam Sterilization: It is the most widely used and most dependable method of sterilization. There are four parameters of steam sterilization: steam, pressure, temperature and time. Healthcare equipment must be wrapped and kept for sterilization for 30 minutes at 121 degree Celsius in a gravity displacement sterilizer or 4 minutes at 132 degree Celsius in a pre-vacuum sterilizer. It is used for heat and moisture resistant equipment like respiratory and anesthesia equipment. It is also used to decontaminate microbiological waste and sharps container.
- Flash sterilization: It is a modification of conventional steam sterilization in which the flashed item is placed in an open tray or is placed in a specially designed, covered, rigid container to allow for rapid penetration of steam. It is considered acceptable for processing cleaned patient-care items that cannot be packaged, sterilized and stored before use.
- Low temperature sterilization technologies: Ethylene oxide-The four essential parameters are: gas concentration (450-1200 mg/l); temperature (37-63 degree Celsius); relative humidity (40%-80%); and exposure time (1 to 6 hours). Hydrogen peroxide Gas Plasma-They are generated in an enclosed chamber under deep vacuum using radio-frequency or microwave energy to excite the gas molecules and produce charged particles, many of which are in the form of free radicals which are capable of interacting with essential cell components (e.g. enzymes, nucleic acids) and thereby disrupt the metabolism of microorganisms. Per acetic Acid Sterilization- It is highly biocidal oxidizer. It is diluted to 0.2% with filtered water at a temperature of approximately 50 degree Celsius.
- Other techniques include: ionizing radiation; dry heat sterilizers; liquid chemicals; microwave; vaporized hydrogen peroxide; ozone; infrared radiation.

Check Your Progress 7

1. Enlist various methods of sterilization.

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3.6 ROLE OF HOUSEKEEPING IN MANAGEMENT OF INFECTIONS

Housekeeping plays a key role in prevention and control of infection and sanitation is one of the important aspect of it. Housekeeping services includes activities aimed to maintain a healthy, clean, orderly, safe and pleasant environment by making the maximum use of the facilities of hospitals.[15]

3.6.1 General Guidelines Relating to Cleaning Activities[16]

- A neutral detergent and cold/warm water should be used for all environmental cleaning;
- Use hazard signs to warn people you are carrying out a cleaning task.
- High level disinfectants should only be used to clean up spills from body fluids or for "terminal cleaning" of an area after an infection outbreak.
- When you wash your cleaning equipment there is potential for splatter (aerosols) to occur. Keep the water tap on low pressure to reduce water splatter.
- One should never spray bottles in a health care environment when applying cleaning agents to surfaces as it creates aerosols.
- Every health facility must have documented policies and practices to ensure environment is clean. These policies must specify:
    - The areas and equipment that need cleaning, how they will be cleaned and how often.
    - How waste will be disposed of-soiled materials, chemical sharps etc.
    - The method of cleaning and related equipment-how often, the specific cleaning materials to be used and any manufacturer operating instructions that need to be observed.
- Clean all high contact (touch) surfaces and objects such as toilet seats, flush, handles, wash hand basin taps, soap dispenser and toilet door handles. It should be more cleaned more frequently than routinely recommended daily cleaning.
- Clean all work surfaces with a neutral detergent that should remove soiled materials.
- Terminal cleaning of an affected area, unit or section should be carried out 72 hours (3 days) after the final case in an outbreak has recovered. The 72 hours takes into account the period of 48 hours (without new infection) plus the average incubation period of 24 hours for any newly infected individuals. Terminal cleaning should involve cleaning of all surfaces, furniture, bedding, equipment and items in contact with ill persons.

3.7 ANTIMICROBIAL RESISTANCE (AMR) AND ITS PREVENTION

Antimicrobial resistance (AMR) is a major public health problem globally. Amongst all types of AMR antibacterial resistance (ABR) is seen as currently posing the most serious health threat. Bacteria are present in every living being and in the soil, water, and air. With the interconnected ecosystems (humans, animals, the environment), the exchange of bacteria is continuous, and thus the ABR problem is no longer limited to medical science alone.

3.7.1 Concept of AMR

Antimicrobial resistance – also known as drug resistance – occurs when microorganisms such as bacteria, viruses, fungi and parasites change in ways that render the medications used to cure the infections they cause ineffective. When the microorganisms become resistant to most antimicrobials they are often referred to as "superbugs".

This is a major concern because a resistant infection may kill, can spread to others, and imposes huge costs to individuals and society.

AMR occurs naturally but is facilitated by inappropriate use of medicines, low quality medicines, wrong prescriptions (like prescribing antibiotics in viral infections such as cold or flu) and poor infection prevention and control practices.

3.7.2 Current status of AMR in India

India has tremendous burden of infectious diseases in the world. Easy availability, higher consumption of medicines, indiscriminate use of antimicrobials and unsatisfactory public sector healthcare delivery are some of the factors favoring increased development of AMR in India. The country has some of the highest rates of antibiotic resistance among bacteria commonly causing infections in the community and healthcare facilities. More than 70% resistance is reported to broad spectrum fluroquinolones and third generation cephalosporin. Carbapenem is used to treat some serious bacterial infections caused by gram negative bacteria. The reported resistance ranges from 11.5% in E. coli to 70.9% in A. baumannii. Bloodstream infections due to dual carbapenem and colistin resistant K. pneumoniae are associated with 69.3% mortality. Besides, resistance to first line drugs in TB, malaria and HIV is already a global threat.

3.7.3 Strategies for Prevention and Control of AMR in India

The issue of AMR came to attention of policymakers with discovery of New Delhi Metallo-beta-lactamase-1 (NDM-1) in 2010. Since then several initiatives have been undertaken by the government in this regard. It is presented as timeline below.

Table 3.5: Timeline of AMR Policy related activities in India

2010	Establishment of the National Task Force on AMR containment
2011	Publication of situation analysis on AMR
2011	Publication of National Policy on AMR containment
2011	Jaipur Declaration on AMR containment
2011	Establishment of the National Programme on AMR containment under 12th Five Year Plan (2012-2017)
2012	National Programme on Antimicrobial Stewardship, Prevention of infection and control by Indian Council Medical Research (ICMR)
2013	Establishment of National AMR surveillance network by National Centre for Disease Control (NCDC) and ICMR
2014	Inclusion of antibiotics in Schedule H1 category to avoid nonprescription sales of antibiotics
2016	Launch of the Red Line Campaign on Antibiotics to create awareness on rational use of antibiotics
2016	Publication of National Treatment Guidelines for antimicrobial use in infectious diseases by NCDC
2016	National address by prime minister on the issue of antibiotic resistance in radio program 'Mann ki Baat'
2017	Publication of the National Action Plan for containment of AMR and Delhi Declaration

Check Your Progress 8

1. Define Antimicrobial resistance giving suitable examples

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2. What factors are responsible for high incidence of AMR in India?

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3.8 KEY WORDS

Health care professional: Health professionals are individuals who maintain health in humans through the application of the principles and procedures of evidence-based medicine and caring. They study, diagnose, treat and prevent human illness, injury and other physical and mental impairments in accordance with the needs of the populations they serve.

Immunoglobulin: Immunoglobulin preparations are used to provide passive immunization, that is, the direct administration of antibodies to a non-immune person to provide immediate protection against infection or disease.

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

3.9 LET US SUM UP

There are numerous infections to which HCWs are exposed to by virtue of their occupation. Airborne infections in health care settings include TB, influenza, meningococcal infection. HIV, HBV and HCV are blood borne viruses which can produce chronic infections and they are very commonly transmissible in occupational settings. Fomite borne infections usually include some of the serious bacterial infections to which most of the antibiotics are resistant (like MRSA, VRA etc.). These infections can be prevented if the HCWs follow the universal precautions. However, exposure to potentially infection body fluids may occur if there is breach in the work practices. The risk of contracting the infection would depend upon the prevalence of infection among the source patient, type and severity of exposure. Post exposure management needs to be instituted immediately after exposure. Also, immunization plays a critical role as pre-exposure prophylaxis and must be followed by each HCW even before they start practicing. Further, the health facility and health equipment should be adequately sterilized. Housekeeping facilities also play key role infection control and prevention.

AMR has emerged as global threat to prevention and control of infections. The AMR is reported to high in India. Rational use of medicines holds the key to combat this problem.

3.10 ANSWERS TO CHECK YOUR PROGRESS

Check Your Progress 1

1. Airborne/droplet: Chicken pox, Influenza, Tuberculosis, Meningococcal infection, Severe Acute Respiratory Syndrome (SARS), Common cold, Mumps, Measles, Rubella, Diphtheria

   Blood borne: Human Immunodeficiency Virus (HIV), Hepatitis B, Hepatitis C, Malaria, Syphilis

2. ● Arrange for prompt diagnosis and management of job related illnesses.

   ● To provide appropriate post-exposure prophylaxis after job related exposures.

   ● Implement measures to prevent further transmission of infection which sometimes warrant isolation also.

   ● Report of their illnesses or exposures without penalizing them with loss of wages, benefits or job status.

   ● Access to adequate health counseling for HCWs regarding the risk and prevention of occupationally acquired infections, the risk of illness or other adverse outcome after exposures, management of exposures, including the risks and benefits of post exposure prophylaxis (PEP) regimens and the potential consequences of exposure or communicable diseases for family members, patients or other personnel.

   ● Maintenance of records on medical evaluations, immunizations, exposures, PEP and screening test

3. The Staphylococcus aureus strains expressing mec A determinant are termed as MRSA. It can colonize the nose and other skin sites without causing infections. MRSA can spread by airborne route but is most commonly spread by the colonized hands of HCWs. Colonized HCWs may subsequently develop clinical infections and act as reservoir for infection among other vulnerable individuals including patients. Standard MRSA decolonization therapy includes the use of topical application of mupirocin 2%, bacitracin, tea tree oil of *Melaleuca alternifolia* plant, retapamulin of the pleuromutilins group of antibiotics, chlorhexidine gluconate and sodium hypochlorite. Oral therapies such as tetracyclines, folate inhibitors, quinolones, rifamycins and macrolides are usually used in combination with topical therapy

   Vancomycin is an antibiotic that is used to treat some drug-resistant infections caused by enterococci. In some instances, enterococci have become resistant to this drug and thus are called vancomycin-resistant enterococci (VRE). Most VRE infections occur in hospitals. VRE is often transmitted from person to person by the contaminated hands of care-givers. VRE can get onto a caregiver's hands after they have contact with other people with VRE or after contact with contaminated surfaces. Most VRE infections can be treated with antibiotics other than vancomycin.

Check Your Progress 2

1. It refers to comprehensive management given to minimize the risk of infection following potential exposure to blood borne pathogens [Human Immuno-deficiency Virus (HIV), Hepatitis B Virus (HBV), Hepatitis C Virus (HCV)].

2. Blood; Semen; Vaginal secretions; CSF; Amniotic fluids

Check Your Progress 3

1.
   - Date and time of exposure
   - How and when the exposure occurred.
   - Details of the exposure-type and amount of fluid or material and the severity of exposure. For a percutaneous injury, details would include the depth of the wound, the gauge of the needle, and whether fluid was injected; for a skin or mucous membrane exposure they would include the estimated volume of material, the duration of contact, and the condition of the skin (e.g., chapped, abraded, or intact).
   - Details about the exposure source- whether the patient was infected with hepatitis B virus (HBV) and his or her hepatitis B e antigen (HBeAg) status; hepatitis C virus (HCV); or human immunodeficiency virus (HIV); and, if the source was infected with HIV, the stage of disease, history of antiretroviral therapy, and viral load, if known. If the information is not known, then the serologic testing for these infections should be done for the source patient.
   - Details about the exposed person- Assessment of the exposed person (e.g., hepatitis B vaccination and vaccine-response status).

2. True

Check Your Progress 4

1. Tenofovir 300 mg + Lamivudine 300 mg + Efavirenz 600 mg \

Check Your Progress 5

1. Hepatitis B, measles, mumps, rubella, tetanus and diphtheria. Immunization against varicella (chicken pox), influenza and meningococcal vaccine may be considered in specific cases.

Check Your Progress 6

1. (Activity: bedpans-non-critical, anorectal manometry catheters-semi-critical, ultrasound probes-critical, crutches-non-critical, endoscopes-semi-critical, implants-critical).

Check Your Progress 7

1. Steam sterilization, Flash sterilization, low temperature sterilization technologies, ionizing radiation; dry heat sterilizers; liquid chemicals; microwave; vaporized hydrogen peroxide; ozone; infrared radiation.

Check Your Progress 8

1. Antimicrobial resistance – also known as drug resistance – occurs when microorganisms such as bacteria, viruses, fungi and parasites change in ways that render the medications used to cure the infections they cause ineffective.

When the microorganisms become resistant to most antimicrobials they are often referred to as "superbugs". Example: Multidrug Resistant Tuberculosis, Resistance to Anti-malarial drugs etc.

2. AMR occurs naturally but is facilitated by inappropriate use of medicines, low quality medicines, wrong prescriptions (like prescribing antibiotics in viral infections such as cold or flu) and poor infection prevention and control practices. Easy availability, higher consumption of medicines, indiscriminate use of antimicrobials and unsatisfactory public sector healthcare delivery are some of the factors favoring increased development of AMR in India

3.11 REFERENCES AND SUGGESTED FURTHER READINGS

1. Assiri AM, Hathout HM, Anwar MM, El Dalatony MM, Abdel Kader NM. Occupational Infections among Health Care Workers in a Secondary Care Hospital Saudi Arabia. Occup Med Health Aff 2013;1: 137. doi: 10.4172/2329-6879.1000137

2. Post Exposure Prophylaxis (PEP)- NACO Guidelines. [Internet] 2017 [Accessed on 2017, Apr 13]. Available from: http://upsacs.in/pdf/GUIDELINES/PEP.pdf

3. CDC. Oral Health: Infection Control. Frequently Asked Questions [Internet] 2013 [Accessed on 2017 Apr 10]. Available from: <https://www.cdc.gov/oralhealth/infection control/faq/bloodborne_exposures.htm>.

4. WHO. Post Exposure prophylaxis for HIV [Internet] 2014 [Accessed on 2017 Apr 10]. Available from: http://www.who.int/hiv/pub/guidelines/arv2013/December2014-ARVsupplement-chap5.pdf?ua=1

5. MoHFW, GoI. Revised guidelines for Post Exposure Prophylaxis (PEP) for HIV [Internet] 2014 [Accessed on 2017, Apr 10]. Available from: http://www.naco.gov.in/sites/default/files/RevisedGuidelinesforPostExposureProphylaxis(PEP)forHIV.pdf

6. WHO. Guidelines for the management of Occupational Exposures to HBV, HCV and HIV and recommendations for Post exposure prophylaxis [Internet] 2017 [Accessed on 2017 Apr 10]. Available from: <http://www.who.int/occupational_health/activities /5pepguid.pdf>

7. Schillie S, Murphy TV, Sawyer M, Ly K, Hughes E, Jiles R, et al. CDC Guidance for Evaluating Health-Care Personnel for Hepatitis B Virus Protection and for Administering Post exposure Management. MMWR 2013; 62(RR10);1-19.

8. K Park. Park's textbook of Preventive & Social Medicine. 23rd ed. Bhanot Publishers: Jabalpur; 2015.

9. Bolyard EA, Tablan OC, Williams WW, Pearson ML, Shapiro CN, Deitchman SD. Guideline for infection control in healthcare personnel

[Internet] 1998 [Accessed on 2017, Jun 1]. Available from: https://www.cdc.gov/hicpac/pdf/infectcontrol98.pdf

10. West Virginia. Department of Health & Human resources. Post Exposure Prophylaxis (PEP) FAQs [Internet] 2017 [Accessed on 2017 Apr 10]. Available from: http://www.dhhr.wv.gov/oeps/prevention/Pages/Post-ExposureProphylaxis(PEP)FAQs .aspx.

11. Rutala WA, Weber DJ, Healthcare Infection Control Practices Advisory Committee. Guidelines for Disinfection and Sterilization in Healthcare Facilities, 2008. [Internet] 2008 [Accessed on 2017, Jun 1]. Available from: https://www.cdc.gov/hai/pdfs/disinfection_nov_2008.pdf

12. Spaulding EH. Chemical disinfection of medical and surgical materials. In: Lawrence C, Block SS, eds. Disinfection, sterilization, and preservation. Philadelphia: Lea & Febiger, 1968:517-31.

13. Bhattachatyya M, Kepnes LJ. The effectiveness of immersion disinfection for flexible fiberoptic laryngoscopes. Otolaryngol Head Neck 2004;130:681-5.

14. Hamasuna R, Nose K, Sueyoshi T, Nagano M, Hasui Y, Osada Y. High-level disinfection of cystoscopic equipment with ortho-phthalaldehyde solution. J. Hosp. Infect. 2004;57:346-8.

15. Erkal S, Safak S. The Role of Housekeeping department in the control of hospital infections [Internet] 2017 [Accessed on 2017, Jun 1]. Available from: https://www.novapublishers.com/catalog/product_info.php?products_id=14517

16. Hospitality Institute of Australasia. Infection Control for Cleaning and Hosuekeeping Staff-course notes [Internet] 2014 [Accessed on 2017, Jun 1]. Available from: http://www.hia.edu.au/wp-content/uploads/2014/06/Infection-Control-for-Cleaning-v12.2-course-notes.pdf

17. WHO. What is antimicrobial resistance? [Internet] 2017 [Accessed on 2nd Feb, 2019]. Available from: https://www.who.int/features/qa/75/en/

18. Sumanth Gandra, Jyoti Joshi, Anna Trett, Anjana Sankhil Lamkang, and Ramanan Laxminarayan. 2017. Scoping Report on Antimicrobial Resistance in India. Washington, DC: Center for Disease Dynamics, Economics & Policy.

1. https://www.cdc.gov/hiv/basics/pep.html

2. http://v2020eresource.org/home/newsletter/news72006

3. Hospital hygiene and infection Control-WHO (http://www.who.int/water_sanitation_health/medicalwaste/148to158.pdf)

4. https://www.youtube.com/watch?v=YeHLiJIy8DI

3.13 ANNEXURES

Annexure 1 HIV Transmission Risk of different routes.

Exposure route	HIV
Blood Transfusion	90-95%
Perinatal	20-40%
Sexual intercourse	0.1-10%
Vaginal	0.05-0.1%
Anal	0.065-0.5%
Oral	0.005-0.01%
Injecting drug use	0.67%
Needle stick exposure	0.3%
Mucous membrane splash to eye, oro-nasal	0.09%

Note: Needle stick exposure for HBV is 9-30% and HCV is 1-10%.

Annexure II: Disinfection process followed for healthcare equipment

Name of the equipment	Disinfection process
Endoscopes	The equipment be immersed in 2.4% glutaraldehyde or 0.55% ortho-phthaldehyde for 20 degree Celsius for at least 20 minutes.
Laparoscopes and arthroscopes	2% glutaraldehyde for 20 minutes
Tonometer	Tips be wiped clean and disinfected for 5-10 minutes with 3% hydrogen peroxide or 70% ethyl alcohol or 70% isopropyl alcohol
Diaphragm fitting ring	Soap and water wash followed by a 15 minute immersion in 70% alcohol
Transvaginal transducers	Mechanical removal of the gel from the transducer, cleaning it with soap and water, wiping the transducer with 70% alcohol or soaking it for 2 minutes in 500 ppm (parts per million) chlorine and then rinsing and air drying.
Dental instruments	Sterilization
HBV, HIV, HCV or TB contaminated devices	2% glutaraldehyde for 20 minutes
Blood spills	1:10 dilution of hypochlorite solution