

PREVENTION AND CONTROL OF DISEASES



Every disease has certain weak points susceptible to attack. The basic approach in controlling disease is to identify these weak points and break the weakest links in the chain of transmission.





Measures, pending results of epidemiologic investigation:

- The reservoir or source of infection**
- The route(s) of transmission**
- The susceptible host (people at risk)**



I. Controlling the reservoir

Reservoir can be controlled

- 1. Early diagnosis**
- 2. Notification**
- 3. Isolation**
- 4. Treatment**
- 5. Quarantine**
- 6. Surveillance**
- 7. Disinfection**



(1) EARLY DIAGNOSIS

The first step in the control of a communicable disease is its rapid identification.

It is necessary for


- . Treatment of the infected population**
- .Epidemiological investigations**
- .for the institution of preventive control measures**



(2) NOTIFICATION

Once an infectious disease has been detected (or even suspected), it should be notified to the local health authority whose responsibility is to put into operation control measures, including the provision of medical care to patients, perhaps in a hospital.

Certain diseases are statutorily notifiable .The diseases to be notified vary from country to country and even within the same country .Usually, diseases which are considered 'to be serious threatening to public health are included in the list of notifiable diseases. Notifiable diseases may also include non-communicable diseases and conditions such as cancer congenital defects, accidents, etc.



Notification is an important source of epidemiological information. It enables early detection of disease outbreaks, which permits immediate action to be taken by the health authority to control their spread.

Notification of infectious diseases is often made by the attending physician or the head of the family, but any one including the lay people (e.g.. religious, political and administrative leaders, teachers and others) can report, even on suspicion. In all cases, the diagnosis is verified by the local health authority.



Under the International Health Regulations (IHR) certain prescribed diseases are notified by the national health authority to WHO. These can be divided into :

- ❑ Those diseases subject to International Health Regulations (1969) Third Annotated Edition. 1983 cholera, plague and yellow fever**
- ❑ Diseases under surveillance by WHO - louse-borne typhus fever,(Ricketts borne disease) relapsing fever, paralytic polio, malaria, viral influenza, etc**
- ❑ Health administrations are required to notify to WHO Geneva for any notification of communicable diseases under international surveillance and International Health Regulations.**



(3).EPIDEMIOLOGICAL INVESTIGATIONS


After any disease outbreak, the epidemiological investigation is necessary. It includes

- 1.The identification of the source of infection and**
- 2. The factors influencing its spread in the community.**




(4).ISOLATION

Isolation is the oldest communicable disease control measure. It is defined as "separation, for the period of communicability, of infected persons or animals from others in such places and under such conditions, as to prevent or limit the direct or indirect transmission of the infectious agent from those infected to those who are susceptible, or who may spread the agent to others". In general, infections from human/animal sources can be controlled by physical isolation of the case or carrier and it necessary, treatment until free from infection, provided cases and carriers can be easily identified and carrier rates are low.



The *purpose* of **isolation** is to protect the community by preventing transfer of infection from the reservoir to the possible susceptible hosts. The *type* of isolation varies with the mode of spread and severity of the disease. There are several types of isolation - standard isolation, strict isolation, protective isolation, high security isolation. For each patient, the relative risks to the patient and to others should be assessed and the appropriate type of isolation determined. Hospital isolation, wherever possible, is better than home isolation. Isolation is particularly difficult in rural areas. In some situations (e.g., cholera outbreaks) the entire village or rural community may have to be isolated.



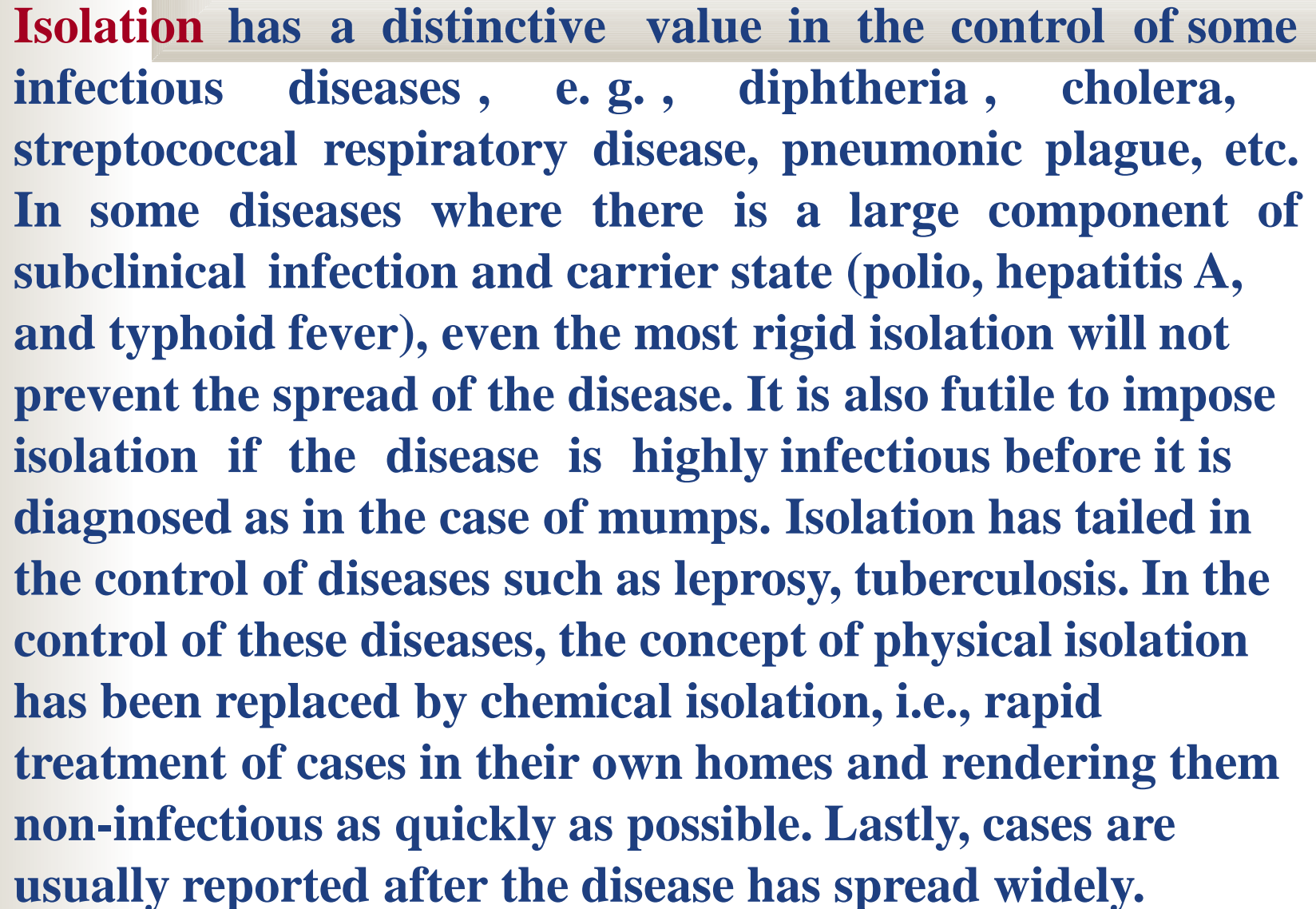
. Isolation may also be achieved in some diseases by **"ring immunization"**, that is encircling the infected persons with a barrier of immune persons through whom the infection is unable to spread. This method when applied worldwide in the 1960s and 1970s eradicated smallpox. In North America, ring immunization is being applied in measles control and eradication. The duration of isolation is determined by the duration of communicability of the disease and the effect of chemotherapy on infectivity .

Period of isolation recommended


Disease	Duration of isolation
Chickenpox	Until all lesion crusted about 6 days after onset of rash.
Measles	From the onset of catarrhal stage thought 3 rd day of rash.
Diphtheria Cholera	3 days after tetracycline started, until 48 hours of antibiotics/or negative culture after treatment.
Shigellosis	Until 3 consecutive negative stool cultures.
Salmonellosis	Until 3 consecutive negative stool cultures.
Hepatitis A	3 weeks.

Period of isolation recommended

Disease	Duration of isolation
Influenza	3 days after onset.
Polio	2 weeks adult, 6 weeks pediatrics.
Mumps	Until swelling subsides.
Pertussis	4 weeks or until paroxysm cease.
Meningococcal inf.	Until the first 6 hours of effective antibiotic therapy are completed.
Streptococcal pharyng.	Until the first 6 hours of effective antibiotic therapy are completed.



Isolation has a distinctive value in the control of some infectious diseases, e. g., diphtheria, cholera, streptococcal respiratory disease, pneumonic plague, etc. In some diseases where there is a large component of subclinical infection and carrier state (polio, hepatitis A, and typhoid fever), even the most rigid isolation will not prevent the spread of the disease. It is also futile to impose isolation if the disease is highly infectious before it is diagnosed as in the case of mumps. Isolation has failed in the control of diseases such as leprosy, tuberculosis. In the control of these diseases, the concept of physical isolation has been replaced by chemical isolation, i.e., rapid treatment of cases in their own homes and rendering them non-infectious as quickly as possible. Lastly, cases are usually reported after the disease has spread widely.




Taking all these limitations into consideration, it may be stated that **isolation which is a "barrier approach" to the prevention and control of infectious disease is not as successful as one would imagine and may well give rise to a false sense of security . In modern-day disease control, isolation is more judiciously applied and in most cases replaced by surveillance because of improvements in epidemiological and disease control technologies . Today isolation is recommended only when the risk of transmission of the infection is exceptionally serious .**



(5) TREATMENT

Many communicable diseases have been tamed by effective drugs. The object of treatment is to kill the infectious agent when it is still in the reservoir, i.e., before it is disseminated. Treatment reduces the communicability of disease, cuts short the duration of illness and prevents development of secondary cases. In some diseases (e.g., syphilis, tuberculosis and leprosy), early diagnosis and treatment is of primary importance in interrupting transmission. Treatment is also extended to carriers.



Treatment can take the form of individual treatment or mass treatment. In the latter category, all the people in the community are administered the drugs whether they have the disease or not (e.g.. trachoma). If the treatment is inadequate or inappropriate, it may induce drug resistance in the infectious agent and may frustrate attempts to control the disease by chemotherapy It is well to remember that no disease has ever been conquered through attempting to treat every affected individual.




(6) QUARANTINE

Quarantine has been defined as "the limitation of freedom of movement of such well persons or domestic animals exposed to communicable disease for a period of time not longer than the longest usual incubation period of the disease, in such manner as to prevent effective contact with those not so exposed". Quarantine measures are also "applied by a health authority to a ship, an aircraft, a train, road vehicle, other means of transport or container, to prevent the spread of disease, reservoirs of disease or vectors of disease" .



Quarantine may comprise :

- ❑ *absolute* quarantine or complete quarantine
- ❑ modified *quarantine*, e.g.. a selective partial limitation of freedom or movement, such as exclusion of children from school
- ❑ *segregation* which has been defined as "the separation for special consideration, control of observation of some part of a group of persons (or domestic • animals) from the others to facilitate control of a communicable disease, e.g.. removal of susceptible children to homes of immune persons"



In contrast to isolation, **quarantine applies to restrictions on the healthy contacts of an infectious disease. Quarantine which was once a popular method of disease control has now declined in popularity . With better techniques of early diagnosis and treatment, quarantine, as a method of disease control, has become outdated. It has been replaced by active surveillance.**



II. Interruption of transmission

A major aspect of communicable disease control relates to “breaking” the chain of transmission. This may mean changing some components of man’s environment to prevent the infective agent from a patient or carrier from entering the body of susceptible host. For example, water can be a medium for transmission of many disease such as dysentery, hepatitis A, cholera. Water treatment will eliminated these diseases. Depending upon the level of population, this may vary from simple chlorination to complex treatment.



Interruption of transmission

- **Food–born disease is particularly prevalent in areas having low standards of sanitation. Clean practices such as hand washing, adequate cooking, prompt refrigeration of prepared foods and withdrawal of contaminated food will prevent most food-born illnesses.**



Interruption of transmission

- **When the disease is vector-borne, control measures should be directed primarily at the vector and its breeding places.**



Interruption of transmission

- **On the other hand, episodes of infection either by droplets or droplet nuclei are not usually controlled effectively by attempting to interrupt their mode of spread; reliance is placed on early diagnosis and treatment of patients, personal hygiene and proper handling of secretions and excretions.**



III. The susceptible host

The third link in the chain of transmission is the susceptible host or people at risk.

They may be protected by:

❑ Active immunization

Active immunization is one of the most powerful and cost-effective weapons of the modern medicine.



□ Active immunization

For examples:

Against cholera	Given subcutaneously in 2 equal doses of 0,5 ml at an interval of 4 to 6 weeks. immunity develops 6 days after inoculation. booster doses are recommended every 6 months.
Against plague	Given subcutaneously or I.m. 2 doses at an interval of 7 to 14 days. Immunity starts 5 to 7 days after inoculation and lasts for about 6 months.



□ Passive immunization

- **Passive immunization is a short-term expedient useful only when exposure to infection has just occurred or is imminent within the next few days. The duration of immunity induced is short and variable-1-6 weeks.**

□ Combined active and passive immunization

☐ Chemoprophylaxis

Chemoprophylaxis implies the protection from, or prevention of, disease. For examples:

Cholera	Tetracycline or furazolidone(furoxone) for house-hold contacts/Selective chemoprophylaxis (one dose of doxycycline)
Diphtheria	Erythromycin and first dose of vaccine.
Plague	Tetracycline for contacts of pneumonic plague.
Meningococcal meningitis	Sulphadiazine for 4 days only if strain is shown to be no-resistant, for household and close community contacts;immunization against serogroups A, C, Y, W135; rifampin, ciprofloxacin;



□ Non-specific measures

- Improvement in the quality of life (e.g. better housing, water supply, sanitation, nutrition, education) fall into this category.**

BREAKING THE CHAIN OF INFECTION

PREVENTION AND CONTROL OF NOSOCOMIAL INFECTIONS



Incidence (epidemiology)

The incidence of disease is defined as the number of new cases of disease occurring in a population during a defined time interval. The number is useful to epidemiologists because it is a measure of the risk of disease.

□ The incidence per 1,000 is defined as follows:

$$\frac{\text{Number of new cases of a disease occurring in a specified period of time} \times 1000}{\text{Number of individuals at risk of developing the disease during that time period}}$$



Mortality "Rate":

The proportion of individuals in a population that die in a given period of time, usually a year and usually multiplied by a 10ⁿ population size so it is expressed as the number per 1,000, 10,000, 100,000, ... individuals per year. These proportions are often broken into cause-specific and age-specific proportions and are often standardized so different groups can be compared and the population at the middle of the time interval is often used as the denominator.

Nosocomial Infections



Nosocomial Infections

- Infection developing in patients after admission to the hospital, which was neither present nor in the incubation period at the time of hospitalization
- They may become evident during patient's stay or after their discharge
- Hospital acquired infections
- Hospital associated infections
- Hospital infections

Where do the microbes come from?

- Patient's own flora
- Cross infection from medical personnel
- Cross infection from patient to patient
- Hospital environment (inanimate objects):
 - Air
 - Water
 - Dust
 - IV fluids & catheters
 - Washbowls
 - Bedpans
 - Endoscopes
 - Ventilators & respiratory equipment

Sources of Infection

Endogenous:

- Patients own flora may invade patient's tissue during some surgical operations or instrumental manipulations
- Normal commensals of the skin, respiratory, GI, UG tract

Exogenous:

- From another patient / staff member / environment in the hospital
- Environmental sources: Inanimate objects, air, water, food
- Cross infection from: other patients, hospital staff (suffering from infections or asymptomatic carriers)

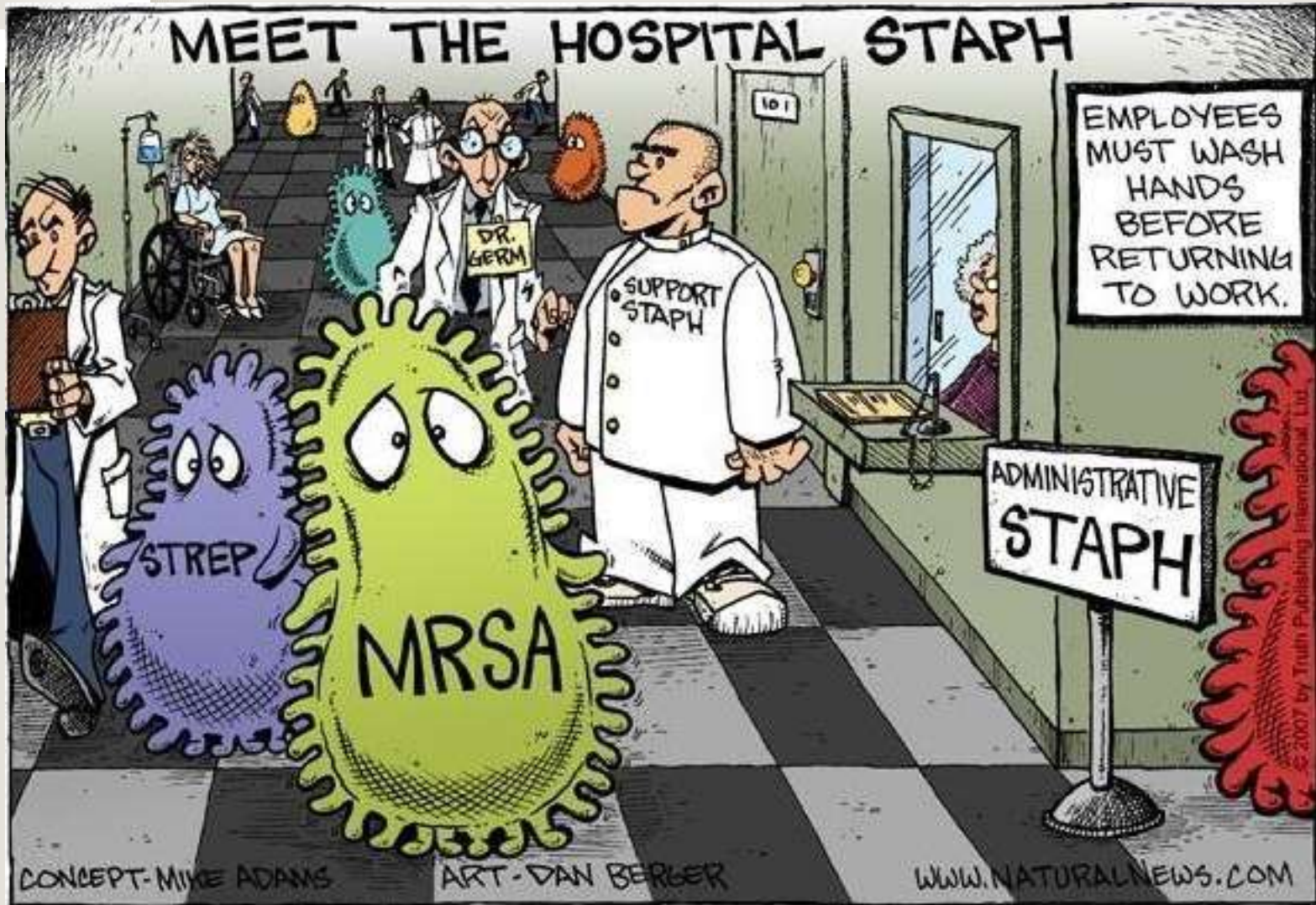
Microorganisms

- Any pathogen , on occasion, can cause HAI
- Those that are able to survive in hospital environment & develop resistance to antibiotics & disinfectants: major cause
- **Commensal bacteria:** found in the normal flora of healthy people. significant protective role by preventing colonization by pathogenic microorganisms.
Some commensal bacteria may cause infection if the host is compromised.
Eg: *Staphylococcus epidermidis* (cause of i.v. infections),
Escherichia coli (cause of urinary infections).
- **Pathogenic bacteria:** they have greater virulence, and cause infections (sporadic or epidemic) regardless of host status.

Bacteria:

Gram positive bacteria:

- *Staphylococcus aureus*:
bacteria that colonize the skin, nose and throat of patients and hospital staff. They cause a wide variety of lung, bone, heart and bloodstream infections and are frequently resistant to antibiotics.
- In hospitals commonly 40-50% of *S. aureus* isolates are MRSA.
- *Staph epidermidis* & Group D Streptococci
- Streptococci: *Streptococcus hemolyticus*,
 Streptococcus Pyogenes
- *Clostridium tetani* spores: survive in dust for very long time



Multidrug resistant *Staphylococcus aureus* (MRSA):
colonize hospitals & cause Nosocomial infections.
Thus, known as ‘Hospital Staphylococci’

Gram negative bacteria:

- In recent decades, enteric Gram negative bacilli → most important group of hospital pathogens
- *Enterobacteriaceae*:
(*E. coli*, *Proteus*, *Klebsiella*, *Enterobacter*, *Serratia*) may colonize sites when the host defences are compromised. They may also be highly antibiotic resistant.
- *Pseudomonas* spp:
 - often isolated in water and damp areas. They may colonize the digestive tract of hospitalized patients.
 - Ability to survive & multiply at low temp
 - Resistance towards antibiotics & disinfectants

Viruses:

- HIV and Hepatitis B & C viruses: transmitted through blood & blood products
- Viral diarrhea & Chickenpox can be spread in hospitals
- Cytomegalovirus, Herpes virus, Influenza, Enteroviruses & Arenaviruses can cause HAI

Fungi:

- *Candida albicans*, *Aspergillus*, *Mucor*

Protozoa:

- *Entamoeba histolytica*, *Plasmodia*, *Toxoplasma gondii*, *Pneumocystis carinii*

Modes of Transmission

1. Contact:

Most common route of transmission

- Hands or Clothing:

- Hands of staff: important vehicle of spread
- Contact of hands & clothing of attendants

Eg: *Staphylococcus aureus*, *Streptococcus pyrogenes*

- Inanimate objects:

- Improper disinfection of Instruments: endoscope, bronchoscope, cystoscope

Eg: *Pseudomonas aeruginosa*

2. Airborne:

- Droplets:

- Droplets of Respiratory infections: transmitted by inhalation

- Dust:

- Dust from bedding, floors, wound exudates & skin

Eg: *Pseudomonas aeruginosa*, *Staphylococcus aureus*

- Aerosols:

- Aerosols from nebulizers, humidifiers & AC

Eg: *Legionella pneumophila*

3. Oral Route:

- Hospital food may contain Antibiotic-resistant bacteria → may colonize intestine → can cause infections

4. Parenteral route:

- Disposable syringes & needles
- Certain infections may be transmitted by blood transfusion, tissue donation, contaminated blood products

Eg: Hepatitis B, HIV

Common Nosocomial Infections

- UTI:
 - Most common HAI (40% of Nosocomial infections)
 - Usually associated with catheterization or instrumentation of urethra, bladder or kidneys
 - Eg: *E. coli*, *Klebsiella*, *Proteus*, *Serratia*, *Pseudomonas*, *Candida albicans*
- Pneumonia (Respiratory Infections):
 - Leading cause of mortality in patients suffering from HAI
 - During aspiration in unconscious patients & pulmonary ventilation
 - Eg: *Staph. aureus*, *Klebsiella*, *Enterobacter*, *Serratia*, *Proteus*, *Pseudomonas*, *Acinetobacter*, *Legionella*, *E. coli*

■ Wound & skin sepsis:

- Follow surgical procedure where causative agents are introduced into the tissue during operations
- Higher in elderly patients
- Manifest within a week of surgery
- Non-surgical wounds due to burns, bed sores.
- Eg: *Staph aureus*, *Pseudomonas aeruginosa*, *E. coli*, *Proteus*, *Enterococci*

■ Gastrointestinal infections:

- Food poisoning due to *Salmonella*, *Shigella sonnei*
- Enterotoxic manifestation due to Staphylococcal contamination of cooked food
- Diarrhea due to *E. coli*

■ Bacteremia & Septicemia:

- Bacterial invasion of bloodstream in various Hospital Acquired Infections.
- Mostly caused by infected intravenous cannulae
- Gram negative bacilli: common pathogens

■ Tetanus:

- Inadequate attention to aseptic precautions during surgery
- Use of contaminated dressings or improperly sterilized dressings
- Improper disinfection of site of intramuscular injection
- Inadequate care while cutting umbilical cord of new-born

Diagnosis

- HAIs may occur sporadically/ occasionally or as an outbreak
- Diagnosis by routine bacteriological methods:
 - Direct smear examination
 - Culture
 - Sensitivity testing
- Identification & elimination requires sampling from possible sources of infections such as hospital personnel, inanimate objects, water, air or food
- Typing of isolate (phage, bacteriocin): may indicate a causal connection

Prevention

- Administration of antibiotic therapy to the carrier staff or source patients to destroy the pathogenic agents
- Proper sterilization & disinfection of inanimate objects. This helps to control the source of infection
- Disinfection of excreta & infected material is necessary to control the exit point of infection
- Transmission can be controlled by regular washing of hands, disinfection of equipments & change of working cloths
- Use of sterile dressings, surgical gloves & face-masks further contribute in control of nosocomial infection
- Pre-operative disinfection of patient's skin
- Proper investigation of HAI & treatment of such cases

Hospital Infection Control Committee (HICC)



- Every hospital must have an effective Hospital-acquired Infection Control Committee
- Responsible for the control of HAIs

The membership of the hospital ICC should reflect the spectrum of clinical services and administrative arrangements of the health care facility. The committee should include:

1. Chief executive, or hospital administrator or Medical superintendent (Chairperson).
2. Clinical microbiologist (Infection control officer).
3. Infection Control Nurse (ICN).
4. Infectious Diseases Physician (if available)
5. Chief of nursing services.
6. Medical record officer (if available).
7. Representative from the major clinical specialties.
8. Additionally representatives of any other department (pharmacy, maintenance, housekeeping, etc) may be invited as necessary

Functions:

- To formulate & update policies on matters related to hospital infections
- Review and approve surveillance and infection prevention program, emergence of drug resistance
- Use of different antimicrobial agents
- Proper sterilization & disinfection procedures
- To assess and promote improved practice at all levels of health facility.
- To Obtain and manage critical bacteriological data and information, including surveillance data

- To ensure appropriate staff training
- Safety management
- Development of policies for the prevention and control of infection
- To develop its own infection control manual
- Monitor and evaluate the performance of program
- To recognize and investigating outbreaks of infections in the hospital and community



Hospital Infection Control



- Reduce patient exposure to pathogens
- Reduce the number & virulence of nosocomial pathogens
- Use of aseptic technique during patient care
- Hand washing
- Proper isolation of patients known or suspected of harboring infectious diseases
- Whenever possible, avoid crowding wards
- Use gloves when necessary
- Wash hands immediately after glove removal and between patients
- Masks, Eye protection, Gown: Wear during activities likely to generate splashes or sprays
- Gowns: Protect skin and soiling of clothing

Sharps:

- Avoid recapping of needles
- Avoid removing needles from syringes by hand
- Place used sharps in puncture-resistant containers

Ensure clean environment:

- Establish policies and procedures to prevent food and water contamination
- Establish a regular schedule of hospital cleaning with appropriate disinfectants in, for example, wards, operating theaters, and laundry
- Dispose of medical waste safely
- Needles and syringes should be incinerated
- Other infected waste can be incinerated or autoclaved for landfill disposal

Your Hands can be Dangerous...



Wash them with Soap & Water
to keep bacteria away

Hand Hygiene is the single most effective intervention to reduce



Handwashing:

- Must be "bacteriologically effective"
- Wash hands before any procedure in which gloves and forceps are necessary
- After contact with infected patient or one colonised with multi-resistant bacteria
- After touching infective material
- Use soap and water (preferably disinfectant soap)



1 Rub palm to hand



2 Rub left palm over back of right hand then vice versa



3 Rub palm to palm with fingers interlaced



4 Rub backs of fingers in opposing palms, with fingers interlocked



5 Rotational rubbing of left thumb clasped in right palm, then vice versa



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

Standard safety measures to minimize the infection:

- Assume that all specimens/ patients are potentially infectious for pathogens
- All blood specimens or body fluids must be placed in leak-proof impervious bags for transportation to the laboratory
- Use gloves while handling blood & body fluid specimens & other objects exposed to them



- If there are chances of spattering, use face masks and glasses
- Wear laboratory coat or gowns while working in the laboratory. These should not be taken outside
- Never pipette by mouth. Mechanical pipetting devices should be used
- Decontaminate laboratory work surfaces with appropriate disinfectant after the spillage of blood or other body fluids



- Limit use of needles & syringes to situations for which there are no other alternatives
- Biological safety hoods should be used for laboratory work
- All potentially contaminated materials of laboratory should be decontaminated before disposal or reprocessing
- Always wash hands after completing laboratory work
- Remove all protective clothings before leaving the laboratory





Thank you!