EPIDEMIOLOGY

IMMUNITY

- **1-Defense Mechanism of Body**
  - **Natural Barriers of Infection**
  - **Inner Body Defenses**

- **2-Specific Immunity**
  - **Humoral Immunity**
  - **Cellular Immunity**

1-Defense Mechanism of Body

A- Natural Barriers of Infection:

- **Skin (Intact skin)**
- **Respiratory Tract**
  - Hair at anterior nares catches dust in air
  - Cilia of epithelial lining
  - Mucous secretion of respiratory passages catches dust
  - Sneezing & coughing

- **Gastrointestinal Tract**
  - Saliva
  - Gastric acidity is bactericidal
  - Intestinal flora of colon

- **Eyes**
  - Healthy intact membranes are barrier of infection
  - Tears washing effect
  - Blinking reflex

1-Defense Mechanism of Body

B- Inner Body Defenses

- **Blood Plasma** (diluting effect, bactericidal role)
- **Phagocytosis by:**
  - Polymorphonuclear leucocytes of blood
  - Macrophages of reticuloendothelial system

2- Specific Immunity

- Humoral immunity
- Cellular immunity

B cells	T cells
•Humoral immunity •Antibody mediated immunity	•Cellular immunity •Cell mediated immunity
Produce antibody (Ig)	Produce killer cells
Lymphocytes educated in bone marrow	Lymphocytes educated in thymus
Effective against extracellular bacteria (some viruses)	Effective against intracellular viruses & cancer cells (some bacteria)

Antibodies (Immunoglobulin)

- **Immunoglobulin that is formed the plasma protein “gamma globulin” when introduced antigens stimulate the immune response.**

Types of Immunoglobulin:

- IgG
  - IgM
  - IgA
  - IgD
  - IgE

Immunoglobulin Classes

IgM

Location: Blood, lymph, B cell surface

Known Functions: First antibodies produced during an infection but not persists for long time

IgG

Location: Blood, lymph, intestine

Known Functions: Enhances phagocytosis, neutralizes toxins and viruses, protects fetus and newborn.

Immunoglobulin Classes

IgA

Location: Secretions (tears, saliva, intestine, milk), blood and lymph.

Known Functions: Localized protection of *mucosal* surfaces. Provides immunity to infant digestive tract.

IgE

Location: Bound to mast cells and basophils throughout body Blood.

Known Functions: Allergic reactions.

IgD

Trace is detected in serum & value is under

Cellular Immunity
Cell Mediated Immunity Response

- **Forms of response:**
  - **Cell mediated immunity:** sensitized lymphocytes to localize & prevent spread of invading organisms
  - **Delayed Hypersensitivity:** Infection is associated with inflammatory reactions that may sometimes cause severe adverse effect with necrosis & damage of host tissues (rejection of transplanted tissues and organs)
  - **How to detect immune response:**
    - Serologic testing
    - Skin test

ACQIRED IMMUNITY
I-Naturally Acquired Immunity

1--Passive acquired immunity

A- Maternal Acquired Immunity_

a-Naturally passive acquired immunity

Antibodies are passed through placenta to the fetus (as for measles, poliomyelitis, mumps),but not for (pertussis &tuberculosis)

b- Artificially passive acquired immunity

- **In childhood:** primary & booster active immunization of infants &children
- **For young & Premarital:** rubella or MMR vaccine, tetanus toxoid
- **During Pregnancy:** tetanus toxoid in high risk areas

Passive acquired immunity

B- Immunologic Value of Breast milk

- Anti infection properties: lower incidence of diarrheal & respiratory diseases
- Anti-infection due to antibodies, macrophages especially colostrums

2- Active acquired immunity

1- Subclinical infections: infection is not followed by diseases and passes unnoticed (as in poliomylitis, entrica), but no subclinical infection & immunity for measles,varicella, syphilis.

2- Manifest Disease:

- **Absolute:** no second attack is reported for yellow fever
- **Solid:** almost absolute immunity: More than one attack is rare for measles, mumps, rubella, varicella, diphtheria.

3- Persistence of infection:

Infection is followed by persistence of local focus of organisms that may be associated with either development of immunity or flare-up (reactivation) of infection according to circumstances of the host.

2- Active acquired immunity

Why an individual may have more than one attack of a particular infectious diseases?

- **True second attack**
  - **Agent factors:**
    - Many serotypes of causative agent
    - Frequent mutation as in influenza virus
  - **Host factors:**
    - Acquired immunity level may decline by time
    - When chemotherapy is given early in disease, infection would not stimulate efficiency protective immunity
    - Cases of impaired immune response (genetic, severe malnutrition,)
    - **Untrue second attack**

II- Artificially Induced Immunity

1- Immunization

2- Chemoprophylaxis

1- Immunization

A- Active Immunization for Infectious diseases:

- **The only reliable preventive measure**
  (as in yellow fever& rabies)
- **The major (main) preventive measure** (
  as in Poliomyelitis in endemic areas)
- **little preventive value**
  (as in enterica & cholera)

Classification of Vaccines

1- Single – antigen vaccines

I- Bacterial vaccines

1- Whole – organism vaccines

- Live attenuated
- killed vaccines

2- Vaccines of bacterial extracts or products

- surface antigen vaccine
- Polysaccharides vaccines
- Acellular vaccines
- Toxoids

II- Viral vaccines

- Live vaccine
- Live attenuated
- killed vaccines

I- Bacterial vaccines

1- Whole – organism vaccines

A- Avirulent Bacterial Vaccines:

"Live attenuated bacterial vaccines"(organisms are treated to lose their pathogenicity and become avirulent but remain antigenic (immunogenic).

Examples are:

- BCG vaccine of T.B.
- Oral typhoid vaccine
- Plague

b. Inactivated bacterial vaccines: "Killed bacterial vaccines"

Organisms are killed by heat or chemical but remain antigenic (as cholera & pertussis vaccines)

I- Bacterial vaccines

2- Vaccines of bacterial extracts or products

- **Vaccines Prepared from the pathogen by:**
  - **Extracted from the pathogen**
  - **By recombinant DNA techniques**
- **Vaccines Prepared of only a particular fraction of and not the whole organism:**

A- Surface antigen (recombinant) vaccines of hepatitis B.

B- Polysaccharide and polypeptide (cellular fraction) vaccines prepared of capsule of polysaccharide of the organisms

C- Acellular Pertussis vaccine

D- Toxoid: They are prepared by detoxifying the exotoxins of some bacteria rendering them antigenic but not pathogenic.

II- Viral Vaccines

1-Live Viral vaccine

- The only live vaccine is “Variola” small pox vaccine, made of live vaccinia virus (not variola virus) which is not pathogenic but antigenic, giving cross immunity for variola.

2-Live attenuated (avirulent) vaccines

- Virulent pathogenic organisms are treated to become attenuated and avirulent but antigenic.

3- Inactivated (killed) vaccines

- Organisms are killed or inactivated by heat or chemicals but remain antigenic. They are usually safe but less effective than live attenuated vaccines.

Types of vaccines

Live vaccines	Live Attenuated vaccines	Killed Inactivated vaccines	Toxoids	Cellular fraction vaccines	Recombinant vaccines
•Small pox variola vaccine	•BCG •Typhoid oral •Plague •Oral polio •Yellow fever •Measles •Mumps •Rubella •Intranasal Influenza •Typhus	•Typhoid •Cholera •Pertussis •Plague •Rabies •Salk polio •Intra-muscular influenza •Japanise encephalitis	•Diphtheria •Tetanus	•Meningococcal polysaccharide vaccine •Pneumococcal polysaccharide vaccine •Hepatitis B polypeptide vaccine	•Hepatitis B vaccine

Multiple (Mixed, combined) antigen Vaccines

Double Vaccines

- Diphtheria-tetanus of toxoid
  - TAB vaccine of typhoid & paratyphoid

Triple Vaccines

- DTP vaccines
- MMR vaccine

Qudriple Vaccine

- Salk DTP vaccine
- Haemophilus influenza b, DTP vaccine

System of Active Immunization

1- Primary Active Immunization

2- Booster Immunization

1- Primary Active Immunization

1- Single – dose Primary Immunization:

Vaccines of measles, mumps, rubella, MMR, yellow fever , BCG, Plague.

2- Multiple – dose Primary Immunization:

- **May be 2,3 or 4 doses**
- **Proper spacing of doses:**

➢ 4 weeks for tetanus toxoid, TAB vaccine, cholera vaccine

➢ 8 weeks for DPT of DTaP vaccine , DT toxoid , Sabin OPV, hepatitis B, Salk DTP

  ➢ Diphtheria toxoid, tetanus toxoid, pertussis, poliomyelitis

Booster Immunization

- So long certain individuals, groups or population are **at risk of certain infection** it is necessary to give a booster dose of vaccine at suitable interval

Periods of maintained immunity

- Short period (6months): cholera vaccine
- About 3 years: TAB vaccine of enterica
- Three to five years: DPT vaccine
- Five or more years: BCG vaccine
- Ten years: yellow fever vaccine
- Solid immunity: measles, mumps, and rubella vaccines.

Routes of administration

- **Deep subcutaneous or intramuscular route** (most vaccines as Measles, Mumps, rubella, MMR, diphtheria toxoid)
- **Oral route** (sabine vaccine, oral BCG vaccine)
- **Intradermal route** (BCG vaccine)
- **Scarification** (small pox vaccine)
- **Intranasal route** (live attenuated influenza vaccine)

ADVERSE REACTION OF ACTIVE IMMUNIZATION

General Reactions

- Local general reactions. The local reactions may be pain, swelling, redness, tenderness and development of a small nodule or sterile abscess at the site of injection.

Special Reaction

- **BCG**, when given subcutaneously not intracutsaneously may cause

  Local ulceration

  regional lymphadenitis , abscess formation

- **Rabies** nerve tissue vaccine , may cause postvaccinal encephalitis
- **Pertussis** vaccine: sever reaction especially neurologic in:

  older children 5 or 6 years

  Younger under 5 years with epilepsy or convulsions

Precaution with Active Immunization

- **Vaccination must be avoided in:**
  - **Hyper pyrexia** & infection in general
  - **Severe malnourishment** and debilitating disease
  - **Immunosuppressed cases**
  - **During pregnacy**
    - No Avirulent vaccines
    - Any other active immunization is preferably given before or after but not during pregnancy

Levels of effectiveness

- **Absolutely protective(100%):** yellow fever vaccine
- **Almost absolutely protective (99%):** Variola, measles, mumps, rubella vaccines, and diphtheria and tetanus toxoids.
- **Highly protective (80-95%):** polio, BCG, Hepatitis B, and pertussis vaccines.
- **Moderately protective (40-60%)** TAB, cholera vaccine, and influenza killed vaccine.

The Cold Chain

- The "**cold chain**" is a system of storage and transport of vaccines at low temperature from the manufacturer to the actual vaccination site.
- The cold chain system is necessary because **vaccine failure** may occur due to failure to store and transport under strict temperature controls.

The Cold Chain

- Among the vaccines, polio is the most sensitive to heat, requiring storage at minus 20 degree C.
- Vaccines which must be stored in the freezer compartment are : polio and measles.
- Vaccines which must be stored in the COLD PART but never allowed to freeze are : typhoid, DPT, tetanus toxoid, DT, BCG and diluents

Vaccination Coverage

- Vaccination coverage is the **percent** of at risk or susceptible individuals, or population who have been **fully immunized** against particular diseases by vaccines or toxoids.
- To be significantly effective in prevention of disease on mass or community level at least a satisfactory proportion **(80-85%)** of the at risk population must be immunized.

Application of Active Immunization
1-Extented Compulsory Immunization Program in Infant & Children in Egypt

Infant & Preschool	Vaccine Dosage & Route of administration	
After birth	Sabin, OPV	Zero dose, 3 drops on tongue
First 3 month	BCG	0.1 ml ,intradermal upper left arm
2,4,6 months	Sabin, OPV DPT Hepatitis B	3 drops on tongue 0.5 ml IM 0.5 ml IM
9 months	Sabin, OPV Measles Vit A	3 drops on tongue One dose 0.5ml SC Capsule 100.000IU squeezed in mouth
18 months	Sabin, OPV DPT MMR + Vit A	3 drops on tongue 0.5 ml deep SC or IM Primary one dose 0.5 ml Sc

Application of Active Immunization
1-Extented Compulsory Immunization Program in Infant & Children in Egypt

Schoolchildren	Vaccine Dosage & Route of administration	
5-6 years	Sabin, OPV	Booster dose
	DT	Booster dose
	BCG	Reactivation of tuberculin nonreactors or primary Single dose, 0.5 intradermal
	Meningococcal	0.5 ml deep SC
8 years	DT or D toxoid	Booster dose , 0.5 ml , deep SC
At any age when necessary	Tetanus toxoid Meningococcal	Booster dose when injured with risk of infection At risk when cases appear

2-Active immunization for Adolescents /adult

- **MMR vaccine** is given in adolescence before or after marriage, but not during pregnancy and has to be before 3 months of conception
- **Tetanus toxoid in pregnancy** to prevent tetanus neonatorum in the newborn. In the first pregnancy on the third month and after 1 month. The third dose in the second pregnancy, and the fourth on the third pregnancy with a maximum of 5 doses. If 10 years elapse, and then pregnancy occurs, the doses are given from the start.

- **BCG vaccine**: to protect tuberculin nonreactor especially at risk area (slums, Poor socioeconomic status, occupational groups)

3-Vaccination for occupational Groups

- **Health care workers**: hepatitis B, influenza, MMR, BCG for non reactors
- **In Camps**: tetanus, BCG for non reactors, meningococcal vaccine
- **Food handlers:** TAB, hepatitis A ,BCG (for non reactors)
- **Farmers and agriculture**: BCG (for non reactors), tetanus, preexposure rabies vaccination if necessary

4-International Active Immunization

- Varies according to the country of arrival and departure.
  - **Primary vaccine series**
  - **Continuation of booster doses**
  - **Specific vaccine** according to the country traveled to:
    - TAB, YF, cholera, meningiococcal, pneuomococcal, HIB, influenza, rabies, plague, Japanese encephalitis.
    - Haj for instance necessities meningococcal vaccination from all over, and YF from places like south Africa, and cholera from places like India.

5- Active Immunization for Control of Infectious Diseases

- National goal of mass active immunization
  - **High coverage primary & booster** active immunization of target groups
  - Ultimate **elimination** of infection and **eradication** of disease

Recently Developed Vaccines

- **Varicella Vaccine**: live attenuated vaccine use for:
  - Children of 2 months & over (single dose)
  - Adolescents & adult (2 doses)
- **Hepatitis A Vaccine** (2 doses& 1 booster dose)
- **Haemophilus influenza b vaccine** (for children from 24 months of age & over), efficacy up to 98%
- **Haemophilus influenza b conjugate vaccine**: combined with protein antigen e.g. diphtheria toxoid or DTP for active immunization of infant & young children under 24 months of age (3 doses at 2,4,&6 months)
- **Pneumococcal vaccine** (2 doses & booster dose /5 years)
- **Meningococcal Vaccine**: prepared of capsule polysaccharides A,C,Y,&W135, for risk group,0.5 ml SC

Under Trial Vaccines

Infectious Diseases

- Rotavirus
- Cholera

Parasitic Diseases

- Schistosomiasis
- Malaria
- Leishmania

Passive Immunization

- **Seroprophylaxis** is valuable for specific prevention of certain infectious diseases , through **giving the ready – formed antibodies** to provide artificially induced passive immunity.
- Seroprophylaxis is **needed for rapid but temporary protection of at risk susceptible** either:

  1-After exposure of infection usually

  2-Before expected exposure to infection occasionally.

  preparations used are immune sera (antisera) that may be either human or animal

  Human preparations: immunoglobulins preferable, antitoxins,& antivirals

  Animal preparations: antitoxins & rabies antiserum

1- Immunoglobulin (Human Serum Globulin)

- It is the antibody-bearing gamma globulin available in 2 forms (in sterile or vials)

1- Human Normal Immunoglobulin: prepared in endemic areas from pooled human blood, it contains antibodies of certain endemic diseases specially measles, mumps, rubella, poliomyelitis and virus A hepatitis.

2- Human specific immunoglobulin: hyper immune gamma globulin, anti (name of disease) gamma globulin . Prepared from plasma of healthy Donors actively immunized for particular disease , so contain high antibody level of encountered disease valuable for:

- Antiviral seroprophylaxis
- Antitoxin seroprophylaxis for diphtheria
- Antipertussis seroprophylaxis for exposed susceptible infants

Application of Immunoglobulin

1- Seroprophylaxis: post exposure usually or pre exposure occasionally

Post exposure:

- The common application
- Preventive value varies with dosage and when given whether early or late in incubation period:
- **Seroprevention:** prevent disease when given early
- **Seroattenuation:** not prevents disease but is mild when given later
- **Not effective** when given late in incubation period

Pre exposure: before expected exposure to infection (**for travelers from free to endemic areas** e.g. hepatitis virus)

Application of Immunoglobulin

2- Serotherapy: human specific antitoxin immunoglobulin of diphtheria and tetanus can be used for prophylaxis and therapy in bigger doses but is no for viral diseases

2- Animal Antisera

1- Antitoxin Sera: antitoxins for prevention and therapy of toxaemia of some infections (diphtheria, tetanus, gas gangrene, botulism) and **for diagnosis** of scarlet fever.

2- Antiviral Serum: antirabies serum , used with vaccination in severe exposure to infection and expected short incubation period.

Reaction:

- Serum reactions (anaphylaxis and hypersensitivity) due to sensitivity to protein of animal serum.

Precautions:

- To prevent occurrence of reactions
- To be ready for rapid management if reactions occur

Incubation Period (I.P)

Period between invasion of the body by the pathogenic organisms until appearance of symptoms of the disease.

Epidemiological importance of I.P.

1- control of the infectious diseases to trace the source of infection (in food poisoning)

2- control the contacts of cases

- surveillance for maximum I.P as in typhoid, diphtheria
- Isolation as in cholera, pneumonic plague

3- International measure for quarentinable diseases as cholera, yellow fever

4- specific protection of exposed individual in cases of exposure to small pox in early I.P person could vaccinated as the immunity after 8 days while the I.P is 14 days

Anti sera & immunoglobulin could be given after exposure as diphtheria & viral hepatitis

Spread of Infectious Diseases
A. Spread in Man

Endemic: The disease is constantly present in the community, due to maintenance of infection by existing ecologic host, agent, environment factors

Hyperendemic: some endemic infectious diseases in underdeveloped communities may show more incidence of cases than the common sporadic spread (community socioeconomic and ecologic circumstances e.g. infective diarrheal diseases)

Pandemic: a disease spread in between countries & simultaneously involve some countries of the world. **In the past :smallpox, cholera, influenza**

Outbreak: localized epidemic that involves a confined group or closed community as camps, school. Nursery.

- Infective diarrheal diseases including food poisoning
- Meningococcal meningitis, influenza

Epidemic: increases number of cases that are significantly more than the common pattern (as in typhoid, Meningococcal meningitis, influenza)

Classification of Epidemics & Epidemic Curves

1. **Common Source epidemic.**

   The origin of epidemic is a common source". For example, water poisoning. Only those People who drink infected water from a particular water supply will develop the disease.

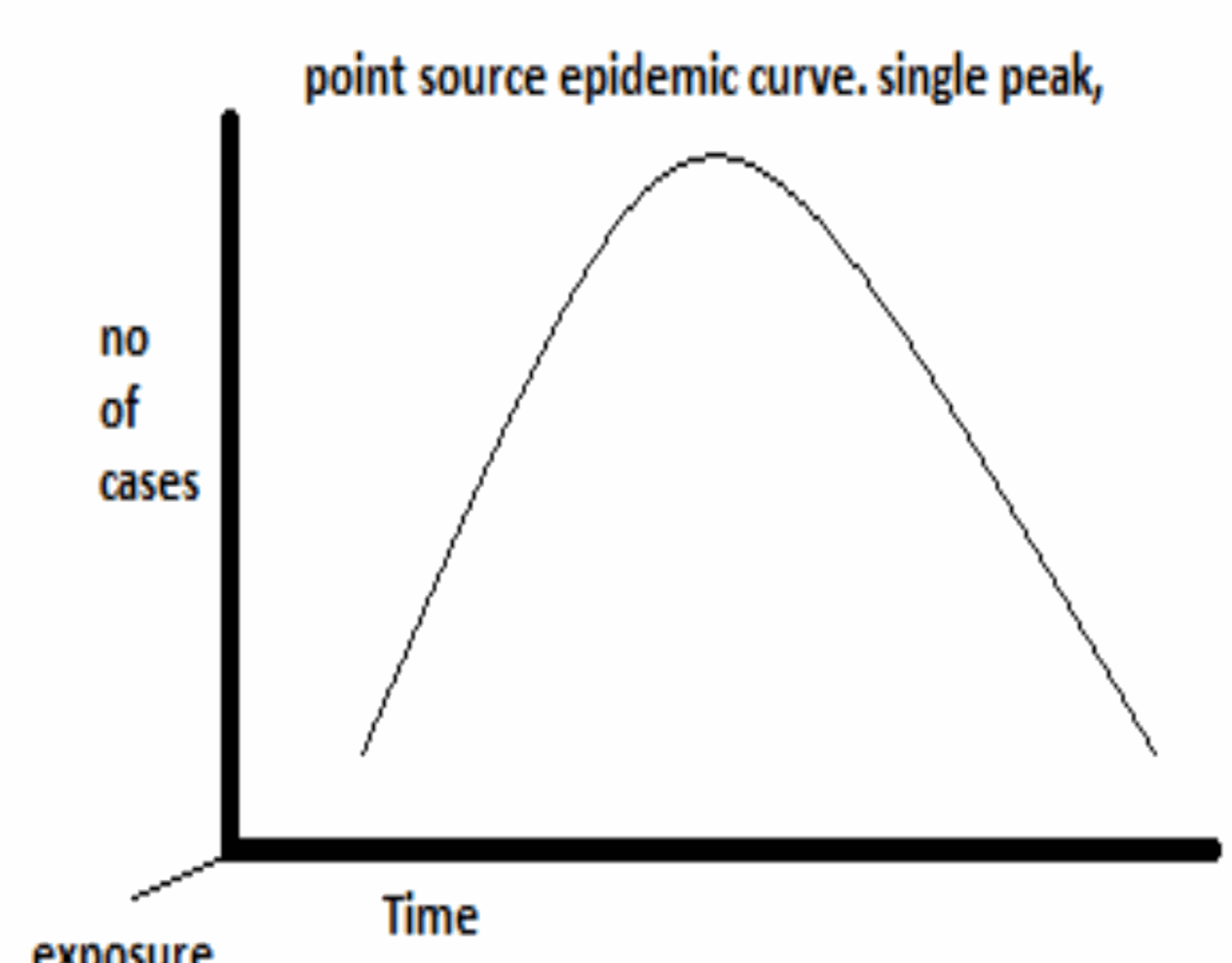
   Intermittent exposure: curve shows irregular peaks reflecting timing & exposure

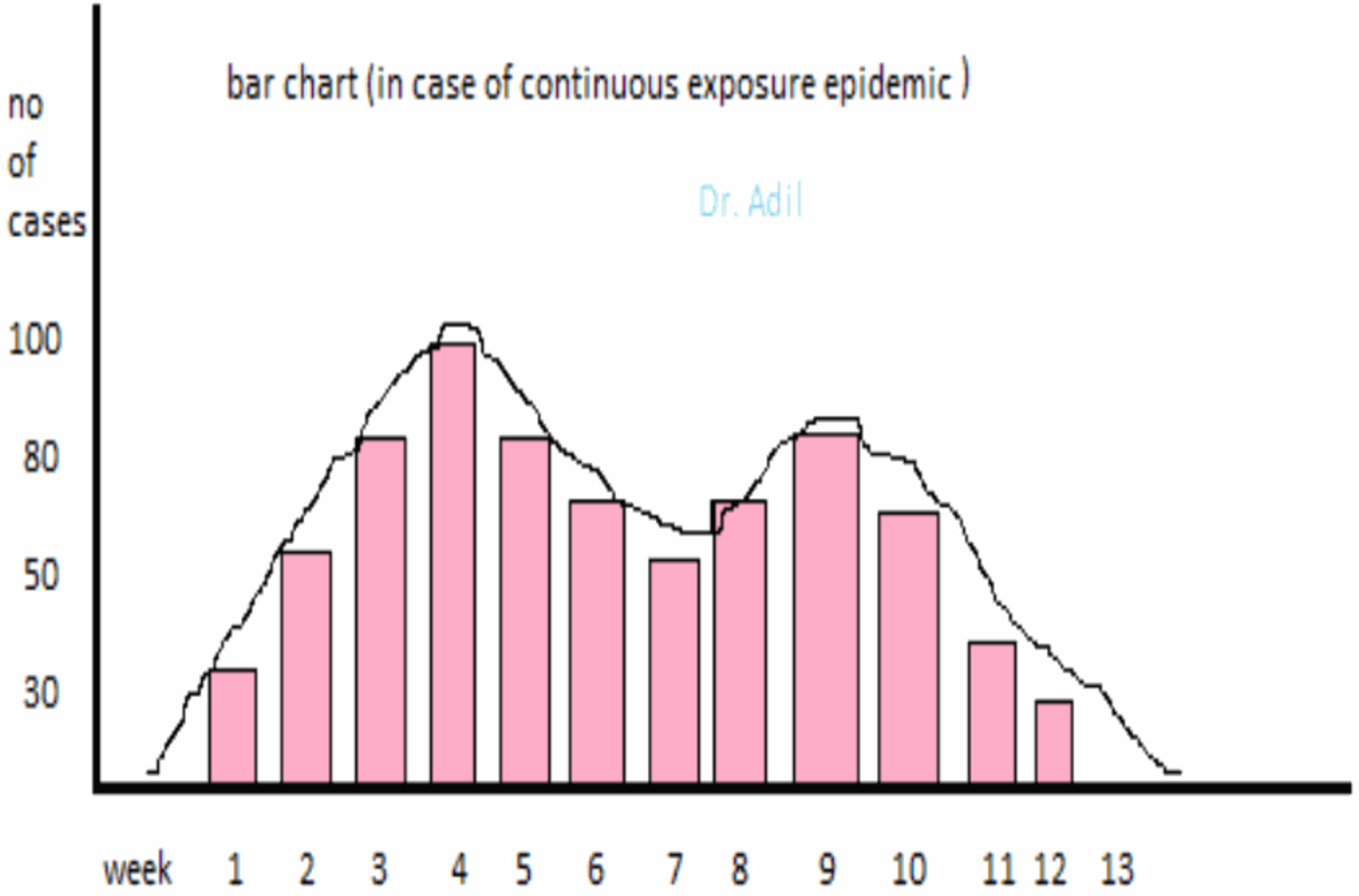
   Continuous exposure: cases rise gradually & possibly plateau rather than peak

   Point source exposure :

   Epidemic curve in this case shows a sharp peak and sharp decline

   All the resultant cases develop the disease within the incubation period of disease at the same time.


point source epidemic curve. single peak,
no
of
cases
Time
exposure


bar chart (in case of continuous exposure epidemic)
Dr. Adil
no of cases
100
80
50
30
week
1
2
3
4
5
6
7
8
9
10
11
12
13

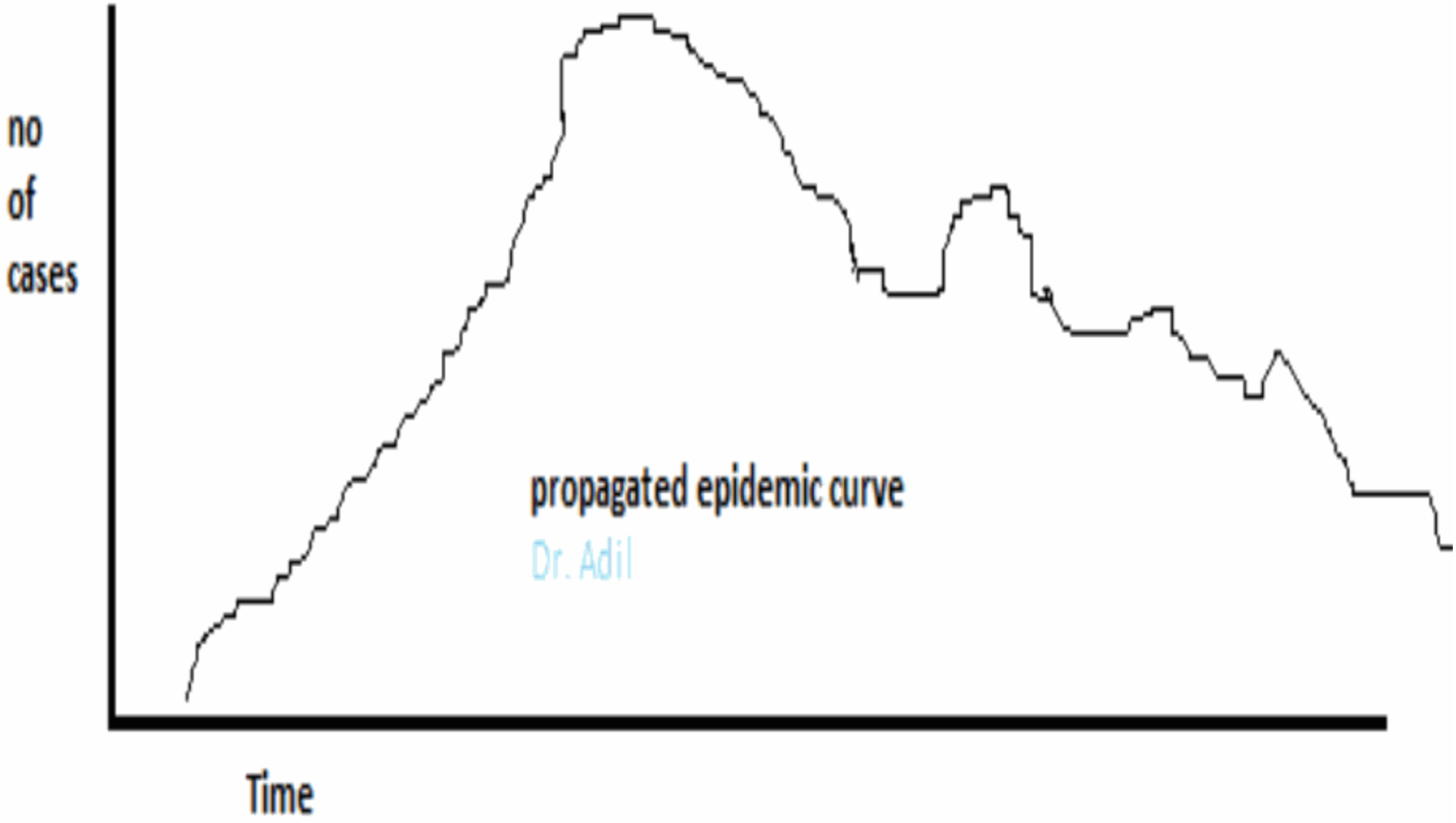
Classification of Epidemics & Epidemic Curves

B. Propagated Epidemic.

A propagated epidemic occurs due to transmission of infections agent either

- Person to Person
- Through Vectors (insects etc)
- Through animal reservoir
- An infected person can transfer the infection to other healthy person and make him infectious as well and then he can further transmit the infection to other persons by various means (direct contact, sexual contact, through vectors, etc).
- The disease remain in the community until susceptible and unimmunized individuals are present.
  The epidemic start to terminates when susceptible individuals decrease in number or the people develop immunity against the disease.
- The curve has a series of progressively taller peaks, each after an incubation period

Epidemic curve rises gradually and tails off over a much longer period of time.



B- Spread In Animal

Enzootic : It is endemic spread of infectious diseases in animals with the potential risk of transmission to man e.g.:

- Tuberculosis, salmonellosis, brucellosis in cattle
- Rabies in dogs, cats

Epizootic: It is epidemic spread of infectious diseases in animals with the potential risk of transmission to man e.g.:

- Plague & salmonellosis in rats
- Rift Valley fever, foot & mouth disease in cattle

Prevention of Infectious Diseases

General Preventive Measures

Specific preventive Measures

International Preventive Measures

Prevention of Infectious Diseases

1-General Preventive Measures

1- Sanitary Environment: the environment should free of:

- **Vehicles of infection:** polluted air, water, milk, food ,soil
- **Vectors of diseases:** insects
- **Rodents**
- **Infected animal reservoirs:** cattle
- **Stay dogs & cats**

Components of sanitary environment:

- Proper town, village
- Good housing
- Sanitary collection & disposal of community wastes
- Eradication or control of insects, Rodents, stray dogs & cats
- Food & milk sanitation

Prevention of Infectious Diseases

General Preventive Measures

2- Health Education of the public:

- Health awareness
- Proper knowledge, attitude, & practices

3- Health promotion of the public:

- Physical , mental & social health
- Prenatal, natal, postnatal requirements

Prevention of Infectious Diseases

2-Specific Prevention

1- Immunization

- **Active immunization** by vaccines
- **Passive immunization** (seroprophylaxis)

2- chemoprophylaxis

Administration of antimicrobial drugs for specific prevention of certain infectious diseases.

Pre exposure

Post exposure

Local chemoprophylaxis: antibiotic eye drops to prevent eye infection as opthalmia neonatorum

Prevention of Infectious Diseases

Limitation of chemoprophylaxis:

- Chemoprophylaxis ought to be given to particular at risk or high – risk individuals and groups only , under medical supervision.
- Abuse & indiscriminate (under controlled) use of antimicrobials must not be applied, to avoid:
  - Cost /benefit disadvantage
  - Adverse effects of given drugs: reactions & toxicity
  - Development of drug resistant strain of organisms
  - Provided protection is temporary for short time only

Drug commonly used for chemoprophylaxis

1- Penicillin

2- Tetracycline: to prevent cholera& plague

3- oral Isonicotinic acid hydrazide for T.B

4- Rifampacin: to prevent meningococcal meningitis

5- Erythromycin: to prevent pertussis, rheumatic fever for the penicillin sensitive

6- Neomycin: to prevent neonatal diarrhea caused by E.C.

7- Antimicrobial eye drops

Prevention of Infectious Diseases

3- International Prevention:

- International regulation are followed by different countries to prevent transmission of certain infectious diseases called “quarantinable diseases” in between countries
- They are legal instructions binding all WHO members 6/2007

A- International travelers

- At present quarantine measures are taken for: cholera, yellow fever & plaguge
- Variola was quarantinable disease before being eradicated
- They are required for means of transport by air, sea, or land for:
  - Travelers
  - Carried vehicles (food , contaminated materials) and vectors (mosquitoes)

  Valid international vaccination certificate is required for:
  - Cholera
  - Yellow fever

Prevention of Infectious Diseases

3- International Prevention:

B- Imported Animals

- Quarantine measures are taken for certain animals coming from endemic or infected areas to prevent transmission of particular zoonoses.
- Monkey: for yellow fever
- Psittacine birds: for psittacosis
- Cattle: for Rift valley fever
- Dogs&cats: for rabies
- Poultry : Avian influnza

C- Imported Goods

- Raw wool, skin , hair: quarantined for anthrax (authorized disinfection certificate)
- Shaving brushes made of natural bristles: quarantined for anthrax

Control of Infectious Diseases

Case Finding: detection and diagnosis of the cases

Management of cases & protecting them against hazards, complications

Measures for contacts, and protecting susceptible and at risk group

Preventing or minimizing spread of disease **in involved community or group**

Control measures are taken for:

- **Reservoirs of infection**
- **Contacts**
- **Involved community**

Control of Reservoirs
1-Animals Reservoirs

1-Eradication of animal reservoir: if applicable

- Rodents
- Stray dogs and cats
- Diseased cattle for particular zoonoses (tuberculosis, Foot and mouth diseases)

2- Control of farm and pet animals: to prevent animals – animals & animal – man spread

Control measures:

- Sanitary clean pollution-free animal environment
- Adequate feeding and not to overwork animals
- Veterinary care:

✓ Active immunization

✓ Regular supervision to segregate & manage the diseased

- Protection of farm workers against occupational infection

2-Human Reservoirs

Control of Carriers: may be difficult

1- The majority of carriers is unnoticed or undetected

2- A small percent only of carriers may come to notice (convalescent and contact carriers of diagnosed cases of bacterial diseases)

Detection of carriers : on laboratory examination for:

- Control of some infectious diseases
- Preemployment and periodic medical examination of certain occupational groups

2-Human Reservoirs

Control of Cases:

1- case finding: clinical diagnosis & laboratory confirmation if necessary

2- Notification: cases of definite or suspected diagnosis must be notified to the local health office .

Value:

- **To take prevention & control measures** for cases, contact, and the community.
- **To help tracing sources** & channels of infection in outbreaks or epidemics
- **To collect significant statistical data**

2-Human Reservoirs

Control of Cases:

3- Isolation: at home, hospital, or special place

Value:

- **To stop activity & movement of the case in the community to prevent spread**
- **To protect the case against secondary infection**

4- disinfection: the process of destroying pathogenic organisms outside the body

A- concurrent disinfection: during course of disease for:

- Excreta & discharges
- Solid articles & fomites
- Any object or material used in nursing

2-Human Reservoirs

B- Terminal disinfection: after transferring the case to hospital or cure or death.

- For sporadic home – isolated cases
- During epidemics or outbreaks
- For hospitalized cases

5- Treatment

A- specific therapy for bacterial diseases:

- Chemotherapy
- Antitoxins

B- nursing & proper feeding

C- symptomatic treatment

D- prevention & control of squeals and complication

- Secondary bacterial infection
- Dehydration
- Rheumatic fever

2-Human Reservoirs

6- Release of case after:

- Clinically recovery
- Satisfactory general condition
- Becoming bacteriologically free in diseases that have convalescent carriers

7- Other Measures for cases:

- **Social service**: e.g. pulmonary tuberculosis
- **Tertiary prevention and rehabilitation** : polio, meningococcal meningitis
- **Follow up**

Control of Contacts

Control measures of contacts are:

1- Enlistment: “list of contacts”

2- Examination: general health status

3-Not to be exposed to isolated case

4- Surveillance, segregation, or isolation:

a- Surveillance: contacts are put under supervision for case finding (go to school or work)

b- Segregation: contacts are excluded from school or work but not isolate as in:

- Diseases that have contact carriers e.g. enterica, diphtheria
- Diseases that highly infectious in the early days: measles & pertussis

c- Isolation: contacts are isolated each for a certain period of time e.g. cholera, pneumonic plague, pneumonic anthrax

Control of Contacts

Control measures of contacts are:

5- specific protection:

a- Immunization:

- **Seroprophylaxis commonly (immunoglobulin)**
- **Active immunization :** limited post exposure application specially booster diphtheria toxoid for contact

b- chemoprophylaxis: for contacts of meningococcal meningitis (oral rifampcin)

Community Control Measures

1- Apply preventive measures:

a) **Control of the Environment, vehicles and vectors e.g.:**

adequate ventilation and spacing of confined places in respiratory infections especially meningococcal meningitis

super chlorination of water & sanitary disposal of community wastes in food borne infections

b) Health education of at – risk group

c) Specific prevention: mass active immunization or chemoprophylaxis of at risk group

2- Control measures:

b) Case finding and control of cases and contacts

c) Epidemiologic study & investigation

d) Drastic control measures : if necessary e.g. closing schools

Eradication of Infectious Diseases

- It is getting rid of causative organism and consequently of disease in certain area, country or worldwide: **no reported cases nor reservoirs of infection**

Examples

- Smallpox
- Rabies in developed countries
- Bovine tuberculosis: some countries followed a program that eradicated infection in cattle.
- Brucellosis: eradicated through applying agglutination test in animals

Elimination of Infectious Diseases

- Elimination means that **existing endemic infectious disease is so controlled to reach the level of “no reported cases”**
- This is usually by protection of at risk groups or population
- **Poliomyelitis** is in the way to be eliminated , then eradicated in Egypt through efficient high coverage vaccination program

Surveillance

- Surveillance is the **ongoing systematic** collection of data, analysis of that data, and the dissemination of health data to people who can use it.
- Surveillance data should also be used develop, implement, and then evaluate public health policy and action.

Objective of Surveillance

- Estimate magnitude of the problem
- Portray the natural history of a disease
- Determine distribution and spread of illness
- Detect outbreaks
- Generate hypotheses, stimulate research
- Evaluate control and prevention measures
- Monitor changes in infectious agents
- Detect changes in health practices
- Facilitate planning

Surveillance

Collection of Data

- Mortality report
- Morbidity reports
- Epidemic reports
- Laboratory data
- Demographic data
- Environmental data
- Special surveys (hospital admission)
- Report of case investigations

Analysis of data:

- To know the specific **pattern of disease** occurance
- **Descriptive analysis** : time, person, place
- **Analytic analysis:** case control & cohort studies

Surveillance

Interpretation of data: when disease shows **a pattern different than expected** for population in particular time and place further investigation is needed

Dissemination of data:

- To policy makers& administrators for action
- To media to avoid misinformation & misunderstanding

How to improve a surveillance system?

- Improve awareness of practitioners & simplify the reporting
- Frequent feedback & active surveillance

Types of Surveillance

A- Routine Surveillance:

- It is national population – based surveillance.
- Data are collected for all identified cases by all levels according to a predetermined time and method of communication

B- Sentinel Surveillance :

- Health officials define homogenous population subgroups and regions to be sampled.
- They identify institutions that serve the population subgroups of interest to report the specific disease

Passive

- Inexpensive, provider-initiated
- Good for monitoring large numbers of typical health events
- Under-reporting is a problem

Active

- More expensive, Health Department-initiated
- Good for detecting small numbers of unusual health events

Communicable Diseases under Surveillance in Egypt

Prioritized through a process that took into consideration the following elements:

- Public health importance of the disease including morbidity, mortality
- The existence of effective and feasible preventive measures
- The epidemic potential of the disease
- The existence of international or regional targets of eradication, elimination or control

	Group A **Immediate reporting by phone or fax**
1	Meningitis
2	AFP
3	HIV/AIDs
4	Rabies/animal bite
5	Diphtheria
6	Malaria
7	Plague
8	Tetanus
9	Acute food poisoning
10	Viral Hemorrhagic fever
11	Rift valley fever
12	Botulism
13	Cholera
14	Others

	Group B **Weekly reporting**
1	Typhoid
2	Brucellosis
3	TB
4	Measles
5	Pertussis
6	Bloody diarrhea
	Group C **Monthly reporting**
1	Viral Hepatitis
2	Mumps
3	Rubella
4	Shistosomiasis
5	Leprosy
6	Fasciola
7	Filaria

Terms used in Case Classification

Case: A person who meets the case definition.

Case definition: diagnostic criteria that must be fulfilled to be a case of a particular disease

Suspected case: A case that is classified as suspected, on clinical basis for reporting purposes.

Probable case: A case that is classified as Probable, on clinical plus either epidemiological or laboratory basis for reporting purposes.

Confirmed case: A case that is classified usually on laboratory basis as confirmed for reporting purposes. There is exception for certain diseases.

Epidemiological link case

Laboratory confirmed case

Limitations of Surveillance

1- Under reporting

- Unaware of responsibilities
- Lack of knowledge
- Lack of incentive
- Lack of feedback

2- Lack of representativeness

- Seek medical care
- Hospitalized
- Reported
- Influence of media

3- lack of timeliness

- Disease dependent
- Reporting procedure

4- Inconsistency of case definition

- Vary by time & place
- Standard case definition

STEPS OF AN INVESTIGATION OF EPIDEMIC

1. **Prepare for field work**
2. **Establish the existence of the outbreak**
3. **Verify the diagnosis and determine the etiology of the disease**
4. **Develop a case definition, start case-finding, and collect information on Cases**
5. **Descriptive epidemiology (Describe person, place, and time and generate hypotheses)**
6. **Develop hypotheses**
7. **Evaluate hypotheses using an analytic study**
8. **Refine hypotheses and carry out additional studies**
9. **Implement control measures**
10. **Communicate findings**

1- Prepare for field work

- **Research the disease** and **gather the supplies and equipment** you will need
- Make necessary **administrative and personal arrangements** for such things as travel
- **Consult** with all parties to determine your role in the investigation & contacts

2- Establish the existence of the outbreak

- **Increase in cases above what is expected** in that population in that area
- Health department **surveillance records** for a notifiable disease
- If no local data is available **make estimates using neighboring districts or national data**

3-Verify the diagnosis

- **Ensure** that the problem has been properly diagnosed
- **Obtain medical records and lab reports**
- **Contact** Public Health Epidemiologist in Hospital & Infection Preventionists
- **Visit** several of the people who become ill
- For outbreaks involving infectious or toxic chemical agents , be **sure that the increase in diagnosed cases is not the result of a mistake in the laboratory**

4- Define & identify cases

Components of Case Definition

- **Person**..... Type of illness (e.g., “a person with...”)
- **Place**..... Location of suspected exposure
- **Time**..... Based on incubation (if known)

Sample Outbreak Case Definition

Hepatitis A outbreak:

- Person: An acute illness involving jaundice or elevated liver function tests
- Place: Occurring after visiting or residing on Property A
- Time: During May–August 2006

✓ **Case definition criteria** (possible, probable, confirmed)

✓ **Active case-finding**

✓ **Collecting information on cases** (Identifying information, Demographic information, Clinical information, Suspected risk factors

5- Descriptive epidemiology

Person, place and time

a)Time

- **Line lists and Epi curves** useful in developing hypotheses
- Epi Curves Can suggest type of exposure
- Point-source , Person-to-Person
- **Suggest time of exposure** if agent known
- **Suggest possible agents** if time of exposure known

b) Place

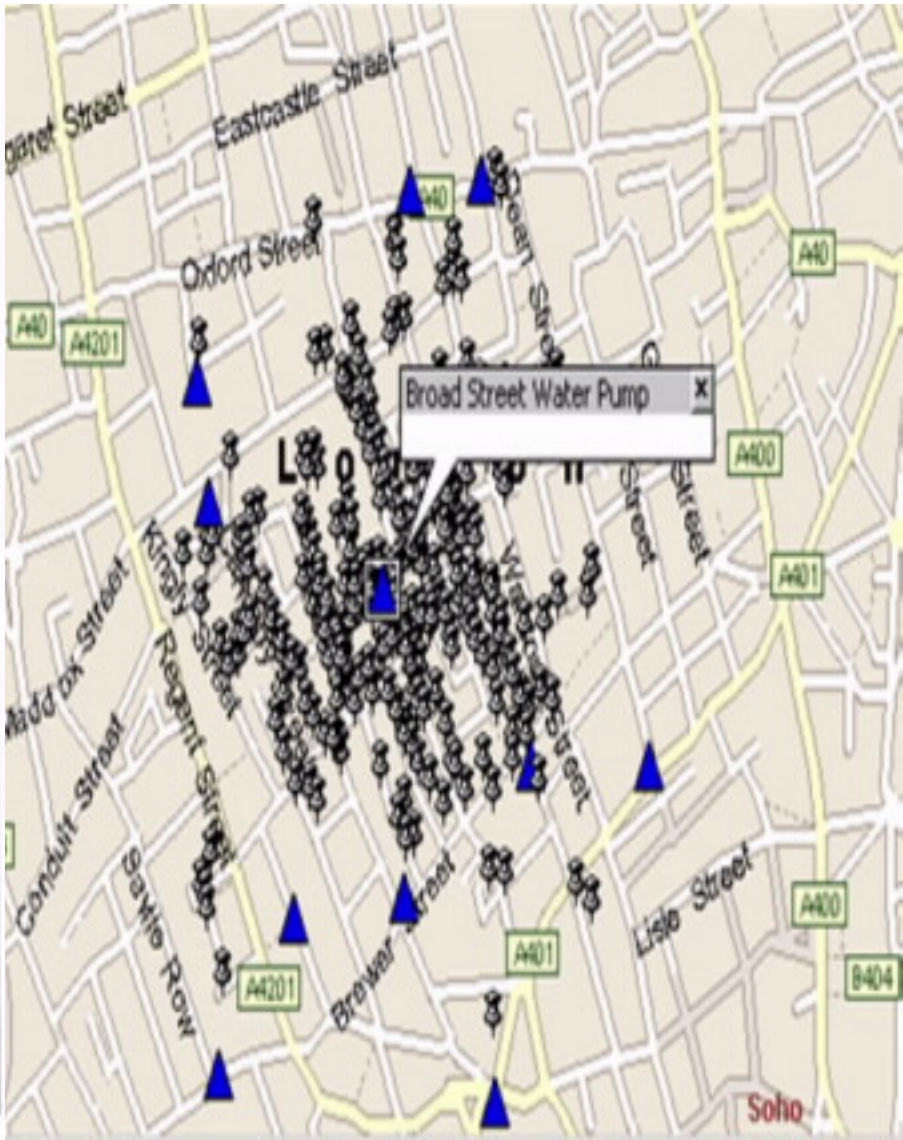
- Investigators can **calculate the attack rate of** cases by different places.
- **A spot map showing the location of cases** can give a very good idea of the source

c) Person: determine which people are at risk (age, sex, race, medical status, calculate attack rate)

					Diagnostic							Lab		
					Signs and Symptoms									
Case#	Initials	Date of Report	Date of Onset	Physician Diagnosis	N	V	A	F	DU	J	HAIgM	Other	Age	Sex
1	JG	10/12	12/6	Hep A	+	+	+	+	+	+	+	SGOT ↓	37	M
2	BC	10/12	10/5	Hep A	+	-	+	+	+	+	+	Alt↓	62	F
3	HP	10/13	10/4	Hep A	±	-	+	+	+	S*	+	SGOT↓	30	F
4	MC	10/15	10/4	Hep A	-	-	+	+	?	-	+	Hbs/ Ag-	17	F
5	NG	10/15	10/9	NA	-	-	+	-	+	+	NA	NA	32	F
6	RD	10/15	10/8	Hep A	+	+	+	+	+	+	+		38	M
7	KR	10/16	10/13	Hep A	±	-	+	+	+	+	+	SGOT = 240	43	M

S*=Sclera;, N=Nausea; V=Vomiting; A=Anorexia; F=Fever; DU=Dark urine; J=Jaundice;
HAIgm=Hepatitis AIgM antibody test

SPOT MAPS


Broad Street Water Pump
Oxford Street
Eastcastle Street
Regent Street
Conduit Street
Brewer Street
Lisle Street
Soho
A40
A4201
A400
A401
B404

6- Develop hypotheses

In an outbreak of infectious disease, the investigator needs to answer the following questions.

- **What is the aetiology** of the disease?
- **What is the source** of infection?
- **What is the pattern** of spread?
- **What are the risk factors** for an individual to get the disease?
- **What are the determinants** of the outbreak or the factors which when combined together result in the outbreak?

7- Evaluate hypotheses using an analytic study

1- Analytic epidemiology

Types

- Cohort
- Case-control

2- Comparison of the hypotheses with established facts: when evidence is so strong that the hypothesis does not need to be tested

8- Refine hypotheses and carry out additional studies

- **When analytic studies do not confirm** the hypotheses reconsider the original one
- Consider **what questions remain unanswered** and what kind of study used

9- Implement control measures

Include:

- Control the source of pathogen
- Interrupt transmission
- Modify host response

10- Communicate findings

- **Media attention** desirable if public action needed
- Response to media attention important to address public concerns about outbreak
- **An oral briefing** for local health authorities
- **A written report** to a journal or higher authorities

Emerging and Re-Emerging Diseases

Definition:

- Emerging infectious diseases are infections that **newly appeared** in population or existed **but rapidly vanished incidence or geographic range.**
- **Not previously in humans**
- **Previously in humans but in isolated populations & areas**
- **Occurred for a long time but recently recognised**

Emerging Diseases:

AIDS	SARS
Pandemic influenza	Avian/swin flu
Lassa fever	Ebola haemorrhagic fever
Legiooaire disease	Haemolytic uremic syndrom
Lyme borreliosis	Hantavirus pulmonary syndrom

Emerging and Re-Emerging Diseases

ReEmerging diseases (old diseases)

In the past caused major health problems then decreases and are increasing now.

Sub-category of emerging diseases

ReEmerging Diseases:

- Cryptosporidiosis
- Diphtheria
- Malaria
- Meningitis
- Pertussis
- Rabies
- Rubeola (measles)
- Schistosomiasis
- Tuberculosis
- Yellow fever

Emerging and Re-Emerging Diseases

Re-Emerging Drug Resistant Diseases: TB, malaria, shigellosis, salmonellosis, streptococcosis, pneumococcosis

Predisposing factors for emerging diseases:

- Environmental changes (technology & industry)
- Population overgrowth & man behavior
- International traveler worldwide transport
- Under suitable circumstances (living conditions)
- Breakdown in public health measures
- Microbial adaptation
- New infection can travel all over world

Predisposing factors for re-emerging (drug resistance) diseases:

- Inappropriate use
- Poor patient compliance to complete treatment series
- Over use of antiseptics

Emerging and Re-Emerging Diseases

At risk groups:

- People with low immunity
- Pregnant
- International travelers

Public health approach to new emerging infections

- Surveillance, investigation, data collection, analysis & interpretation
- Notification & reporting to local health department then WHO
- Epidemiology for early detection, change pattern
- Early response to outbreak
- Laboratory support
- Communication with health providers alert of outbreak
- Communication with media
- Aggressive education
- Vaccine develop and use

Disinfection and Sterilization

Disinfection: the process of destroying pathogenic organisms outside the body of reservoirs of infection (man & animal) which may be found in:

- Excreta and discharges of reservoirs
- Polluted environment : air, water, milk, food, soil
- Contaminated articles and fomites

Sterilization: destroying all forms of microorganisms including spores

Application of disinfection and sterilization

1- Control of infectious diseases

2- Control of environment

- Disinfection of air : by ultraviolet radiation
- Disinfection of potable water: by chlorination
- Incineration of refuse
- Heat treatment milk

  pasteurization or sterilization of milk

  boiling at home

3- prevention of hospital infection

4- Bacteriological laboratories

Methods of Disinfection and Sterilization

I- Physical Methods

1-Heat

a) **Dry heat:**

- **Incineration:** applied in refuse of hospitals, camps
- **Red – hot heat :** points of forceps, needle tip can sterilized by flame of burner until becoming red hot
- **Hot-air Oven:** used in laboratories
- **Infrared radiation:** used in sterilization of syringes/needles
- **Ironing:** of clothes

b) Moist heat

Under 100C Temperature

- **Pasteurization of milk:** applied 75C for 20 seconds
- **Sterilization of protein containing body fluids** (serum) and bacterial vaccines using 56C

100C Temperature: boiling milk ,water

Over 100C Temperature: sterilization by steam under pressure

- **Terminal disinfection**
- **Medical purposes:** autoclave for clinics and laboratories

Methods of Disinfection and Sterilization

2- Radiation

1-Natural radiation: sunlight that kills organisms within hours

- **Ultraviolet rays:** biological effect
- **Infrared rays:** thermal effect

2-Artificial radiation:

a) UV rays given by mercury – vapour lamps

affect bacteria & not virus nor spores

penetrating power of rays: slight in fluids & nearly nil in solids

Application:

- Disinfection of air
- Disinfection of biological fluids : immunoglobulin
- Disinfection of water : with limited application

b) Ionizing radiation: gamma rays are used

- Effective High penetrating power
- Not cause ionizing radioactivity

Application:

Food preservation Sterilization of surgical sutures, catheter

Methods of Disinfection and Sterilization

3- Filtration

Filters made of suitable material are used

1-Bacterial filters: made of porous or filtering material

Used for: lab purposes

Small – scale purification of potable water :Household bacterial filters

2-Sand filters: for large – scale filtration of potable water in water purification plants of cities & towns (efficacy 95%).

Methods of Disinfection and Sterilization

II- Chemical Methods

1- Liquid Disinfectants

1- Volatile Disinfectants:

a) **Alcohol:** ethyl alcohol in 75% concentration

b) **Ether :** weak ,used for skin & injections

c) **Chloroform:** used for lab purposes

2- halogens:

d) **Iodine :** 2% either in alcohol or in water for disinfection of skin in surgery , minor injuries

e) **Chlorine:** used for disinfection of potable water

3) Phenol group: pure carbolic acid (expensive) used in hospitals & lab

4) Heavy Metals:

- **Mercury preparations:** mercurochrome
- **Sliver preparations :** silver nitrate : 1% eye drops
- **Copper Sulphate:** can added in proper concentration in sedimentation tanks of water purification to control growth of algea

5) Formalin: saturated 40% aqueous solution of formaldehyde gas. Used for:

Raw wool, hairs to destroy anthrax Contaminated floors ,surfaces

Methods of Disinfection and Sterilization

2- Gaseous Disinfection

1- Chlorine Gas

2- Ozone (O_3) liberate oxygen to be used for disinfection of :

a) Air: of limited application

b) water of swimming pools: expensive

3- Formaldehyde: cheap, water soluble, irritant gas that destroys organisms & spores (used as alternative to pressure steam for materials that may be damaged by steam as silk, wool, paper, rubber

- ✓ **Disinfection stations** for terminal disinfection of infectious disease
- ✓ **Infectious disease hospitals** to disinfect objects of cases
- ✓ **Quarantine stations** to disinfect objects of international travelers

Hospital Infection (Nosocomial Infection)

Definition : infection acquired by a patient attending any hospital, clinic, medical center or unit for medical care

Reservoirs of infection

I- within hospital reservoirs

1- patient (case) may infect himself or others

2- personnel

a) reservoir role : a case or carrier

b) Third – person role (not reservoir) infection is carried on contaminated hands& clothes

3- Unknown reservoir: insanitary environment

II- Outside hospital reservoirs

1- Visitors

2- Unknown reservoir

Hospital Infection

Forms of hospital infection

- **Common infections** occur in hospital
- **Particular infections** that may vary according to infection of hospital or medical center

General Hospital

- Streptococcus haemolyticus
- Virus of hepatitis (B,C)
- Clostridium tetani (occasionally)

Staphylococcus aureus: the commonest causal of hospital infection due to:

- The organism is **widespread in hospital environment** from the nose and skin of infected individuals
- The organism is **relatively resistant outside the body** & may survive away from sunlight for several months
- A big proportion of hospital strains of organism is **penicillinase-producing**
- **Find entry through 3 portals:** contact. Inhalation, ingestion infection

Hospital Infection

Streptococcus haemolyticus

A common causative agent from throat discharges of carriers & cases, it may cause:

- **Contact infection** (wound infection)
- **Inhalation infection** (pneumonia)

Hepatitis Viruses

- **When exposed to infected blood** e.g. contaminated syringes & needles or transfusion
- **Personnel are also at risk of professional infection** when exposed to infected blood without taking preventive precautions

Hospital Infection

Tetanus Spores

- **Rarely** reported
- Case may arise from:
- **Using improperly sterilized catgut**
- **Contamination of injuries or postoperative wounds** by improperly sterilized articles & dressing
- **Contamination of any wound with dust** borne tetanus spores

Hospital Infection

Tetanus Spores

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Maternity Hospital

- Cases of maternity hospital & obstetric department of general hospital are exposed to varied genitourinary infections especially puerperal sepsis & sequelae
- **Causative agents:**
  - Staphylococcus aureus & streptcoccus haemolyicus
  - Anaerobic streptococci of vagina
  - E.coli
  - Clostridia of tetanus & gas gangrene rarely

Premature & LBW Units

- ARIs
- Neonatal diarrhea
- Skin infection

Outpatient Clinics

- Attendants may be exposed to potenial risk of infection through:
  association of cases with reservoir of infection
  using contaminated or improperly sterilized instruments, dressing, syringes
- Potential risk increased in : pediatric, DM, chest

Mass-inoculation Clinics

- There are **clinics where protective inoculations of active immunization are given or blood sample taken** e.g. pediatric immunization center, STS
- **Unless strict preventive precautions** are taken as disposable syringes & needles and gloves are available attendants are exposed to injection infection

INFECTIOUS DISEASES HOSPITAL

- Hospitalized cases may acquire another infection on the top of that they have. It is known as "hospital cross-infection" .

Particulars of hospital cross-infection

Together with the same general characteristics of hospital infection, cross-infection has the following particulars :

- **Personnel going in-between wards** of different infectious diseases may transmit infection from ward to the other through third-person role, when preventive precautions are not followed .
- **Undiagnosed cases** may be admitted to ward of suspected disease, and who then prove to have some other disease, with the risk of exposing other cases of the ward to infection, and they acquire another disease .
- **More than one infectious disease may be admitted to one ward** where vacant beds are available.

Prevention of Hospital Infection

- **Hospital Infection control committees**
- **Sanitation of Environment**
- **Medical Care Providers**
- **Sterilization and Asepsis**
- **Chemoprophylaxis**
- **Administrative Regulations**
- **Measures of Infection Control**
- **Surveillance of Hospital acquired infections**

1- Hospital Infection control committees

- Hospital infection control committees should be developed in any health care facilities that has inpatient departments of more than 30 beds.
- The ICC should be made up of key personnel from various health facility departments.
- It should act as a liaison between departments that are responsible for patient care and departments that are responsible for support (Nursing, Medicine, Pharmacy, Central store, Engineering, etc.)
- The Chairman of ICC is director of the Hospital or his Deputy.

2-Sanitation of Environment

- **Sanitary, clean, hospital environment**, including :
  - Sanitary collection and incineration of particular forms of hospital refuse .
  - Disinfection of air of operating theaters, premature units, and certain laboratories and wards, when necessary : by ultraviolet radiation .
- **Sanitation of surrounding area** : a suitable area, all around hospital or medical center must be clean, and free of breeding places of insects .

3-Medical Care Providers

- **Free of infection**: pre employment and periodic examination, medical, investigations, and bacteriologic (nose and throat swabbing are particularly important).
- **Proper health behavior** and clean habits.
- When infectious case is suspected: **segregated until proves to be free of infection.**

4-STERILIZATION AND ASEPSIS

- Must be strictly followed throughout all processes that may be associated with the risk of infection : efficient sterilization system.

5- CHEMOPROPHYLAXIS

- Asepsis is the **basic preventive measure of infection.**
- Chemoprophylaxis, however, is valuable under certain circumstances of unsatisfactory fulfillment of asepsis, and unavoidable risk of infection.

6- Administrative Regulations

- **Precise organization** and performance of work.
- Processes of **sterilization and asepsis**.
- **Supervision** of personnel.
- **Control** of hospital visits.

7-Measures of Infection Control

- Early case-finding, on regular health appraisal and supervision of hospitalized cases : to screen and diagnose any who has acquired infection.
- Isolation of infected cases in specially prepared rooms, and properly managed, to prevent spread of infection.

8- Surveillance of Hospital acquired infections

- The same principles of surveillance used can be applied to the health care facilities (HCF)

Prevention of Hospital Cross-infection

- General preventive measures
- Special Preventive Measures

Special Preventive Measures

- Special hospital **design**, to prevent spread of infection inbetween wards.
- Special **isolation ward(s**) for each infectious disease. It is not allowed to admit cases of any other disease.
- Availability of a **suitable number of "isolation cubicles**", for separate (individual) isolation of undiagnosed cases.

Precautions for Personnel

- Must have basic knowledge of infection: how acquired, and how to be prevented.
- *Specific protection of personnel :*
  - Immunization: mainly active, and occasionally seroprophylaxis .
    - Active: according to potentially expected exposure .
    - Seroprophylaxis : when exposed to certain infections
  - Chemoprophylaxis.

Precautions for Personnel

- Providing facilities for **personal cleanliness**.
- **Nursing and serving personnel:** to be responsible for cases of one infectious disease only, and not to go to other wards and units.
- **On daily round of personnel in hospital**. it is necessary to use clean gown and shoes (and also sterile mask and gloves when necessary), to be changed and hands thoroughly washed in between wards and units, to prevent third-person transfer of infection.

EXPOSURE OF HEALTH TEAM TO PROFESSIONAL INFECTION

- **Medical care providers** (medical, paramedical, and other personnel) may be exposed to (at-risk of) varied health hazards, including different forms of infection, according to nature of work.
- **Professional infection** may be acquired in infectious diseases clinics and hospitals, chest clinics and hospitals, laboratories and other centers and units.

- Personnel are **exposed to** influenza, pulmonary tuberculosis, blood-transmitted infection, on exposure to blood, as B hepatitis, C hepatitis, AIDS and syphilis, and other infections.
- **Preventive measures** and precautions for personnel must be applied