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## CHAPTER 10

# Communicable Disease -Health Risk and Prevention

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# Objectives:

- Discuss the impact of infectious disease internationally
  - Define and discuss the implications of immunity
  - Graph and interpret results
  - Discuss types of communicable diseases
  - Discuss methods of transmission
  - Discuss methods of prevention
  - Identify the current immunization schedule for children in the U.S. and what group makes these recommendations.
  - Identify the trends in the resurgence of Tuberculosis.
  - Discuss the primary prevention strategies in the control of select communicable diseases.
  - Describe the natural history of HIV
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# Critical world health problems

- Critical world health problems still exist and include:
    1. Communicable diseases such as tuberculosis, measles, mumps, rubella, and polio.
    2. Maternal and Child Health
    3. Diarrheal diseases
    4. Nutritional deficits
    5. Malaria
    6. AIDS
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# Communicable Diseases

- A disease that spreads from person to person
  - Caused by germs that result in an infection
  - Healthy behaviors can help keep your body healthy
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# Definition of communicable diseases

- A communicable disease is an illness due to a specific infectious (biological) agent or its toxic products capable of being directly or indirectly transmitted from man to man, from animal to man, from animal to animal, or from the environment (through air, water, food, etc..) to man.
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# Epidemiologic triad

- **Demographic characteristics**
- **Biological characteristics**
- **Socioeconomic characteristics**

**Host**

**Agent**

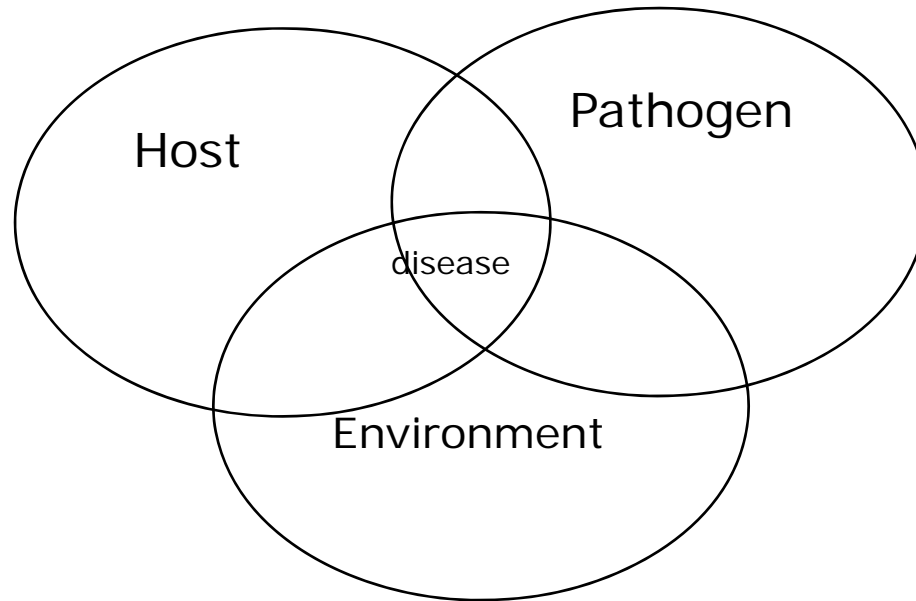
**Environment**

- **Biological agents**
- **Physical agents**
- **Chemical agents**
- **Nutrient agents**
- **Mechanical agents**
- **Social agents**

- **Physical environment**
- **Biological environment**
- **Social environment**

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# Infectious Disease Model



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# Terminology and Definitions

- Infection
  - Contamination
  - Infestation
  - Contagious disease
  - Incidence and prevalence of infectious diseases
  - Epidemic
  - Endemic
  - Hyperendemic
  - holoendemic
  - Pandemic
  - Exotic
  - Sporadic
  - Attack rate
  - Primary/secondary cases
  - Zoonosis, epizootic and enzootic
  - Nosocomial infection
  - Opportunistic infection
  - Eradication
  - Elimination
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# Terminology and Definitions (cont.)

- Virulence
  - Reproductive rate of infection
  - Host
  - Vector (source)
  - Reservoir
  - Incubation period
  - Infectivity period
  - Serial interval
  - Latent period
  - Transmission Probability ratio
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# Infection

- Infection is the entry and development or multiplication of an infectious agent in the body of man or animals. An infection does not always cause illness.
  - There are several levels of infection (Gradients of infection):
    - Colonization (*S. aureus* in skin and normal nasopharynx)
    - Subclinical or inapparent infection (polio)
    - Latent infection (virus of herpes simplex)
    - Manifest or clinical infection
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# contamination

- The presence of an infectious agent on a body surface, on or in clothes, beddings, toys, surgical instruments or dressings, or other articles or substances including water and food
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# Infestation

- It is the lodgment, development and reproduction of arthropods on the surface of the body or in the clothing, e.g. lice, itch mite. This term could be also used to describe the invasion of the gut by parasitic worms, e.g. ascariasis.
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# Contagious disease

- A contagious disease is the one that is transmitted through contact. Examples include scabies, trachoma, STD and leprosy.
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# Host

- A person or an animal that affords subsistence or lodgement to an infectious agent under natural conditions. Types include: an obligate host, definitive (primary) host, intermediate host and a transport host.
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# Vector of infection

- An insect or any living carrier that transports an infectious agent from an infected individual or its wastes to a susceptible individual or its food or immediate surroundings. Both biological and mechanical transmissions are encountered.
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# Reservoir

- Any person, animal, arthropod, plant, soil, or substance, or a combination of these, in which an infectious agent normally lives and multiplies, on which it depends primarily for survival, and where it reproduces itself in such a manner that it can be transmitted to a susceptible host. It is the natural habitat of the infectious agent.
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# Incidence and prevalence of infectious diseases

- Incidence of an infectious disease: number of new cases in a given time period expressed as percent infected per year (cumulative incidence) or number per person time of observation (incidence density).
  - Prevalence of an infectious disease: number of cases at a given time expressed as a percent at a given time. Prevalence is a product of incidence x duration of disease, and is of little interest if an infectious disease is of short duration (i.e. measles), but may be of interest if an infectious disease is of long duration (i.e. chronic hepatitis B).
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# Epidemic

- “The unusual occurrence in a community of disease, specific health related behavior, or other health related events clearly **in excess of expected occurrence**”
  - (epi= upon; demos= people)
  - Epidemics can occur upon endemic states too.
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# Endemic

- It refers to the constant presence of a disease or infectious agent within a given geographic area or population group. It is **the usual or expected frequency of disease** within a population.
  - (En = in; demos = people)
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# Hyperendemic and holoendemic

- The term “hyperendemic” expresses that the disease is constantly present at high incidence and/or prevalence rate and affects all age groups equally.
  - The term “holoendemic” expresses a high level of infection beginning early in life and affecting most of the child population, leading to a state of equilibrium such that the adult population shows evidence of the disease much less commonly than do the children (e.g. malaria)
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# Pandemic and Exotic

- An epidemic usually affecting a large proportion of the population, occurring over a wide geographic area such as a section of a nation, the entire nation, a continent or the world, e.g. Influenza pandemics.
  - Exotic diseases are those which are imported into a country in which they do not otherwise occur, as for example, rabies in the UK.
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# Sporadic

- The word sporadic means “scattered about”. The cases occur irregularly, haphazardly from time to time, and generally infrequently. The cases are few and separated widely in time and place that they show no or little connection with each other, nor a recognizable common source of infection e.g. polio, meningococcal meningitis, tetanus....
  - However, a sporadic disease could be the starting point of an epidemic when the conditions are favorable for its spread.
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# Attack rates and primary/secondary cases

- Attack rate: proportion of non-immune exposed individuals who become clinically ill.
  - Primary (index)/secondary cases: The person who comes into and infects a population is the primary case. Those who subsequently contract the infection are secondary cases. Further spread is described as "waves" or "generations".
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# Zoonosis, epizootic and enzootic

- Zoonosis is an infection that is transmissible under natural conditions from vertebrate animals to man, e.g. rabies, plague, bovine tuberculosis.....
  - An epizootic is an outbreak (epidemic) of disease in an animal population, e.g. rift valley fever.
  - An Enzotic is an endemic occurring in animals, e.g. bovine TB.
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# Nosocomial infections

- Nosocomial (hospital acquired) infection is an infection originating in a patient while in a hospital or another health care facility. It has to be a new disorder unrelated to the patient's primary condition. Examples include infection of surgical wounds, hepatitis B and urinary tract infections.
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# Opportunistic infection

- This is infection by organisms that take the opportunity provided by a defect in host defense (e.g. immunity) to infect the host and thus cause disease. For example, opportunistic infections are very common in AIDS. Organisms include Herpes simplex, cytomegalovirus,
  - M. tuberculosis.....
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# Eradication and Elimination

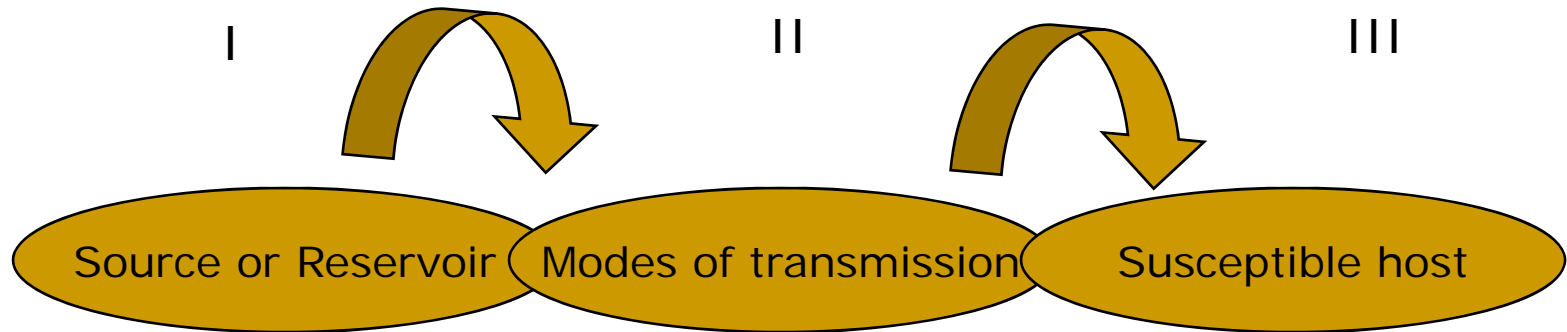
- Termination of all transmission of infection by the extermination of the **infectious agent** through surveillance and containment. Eradication is an absolute process, an “all or none” phenomenon, restricted to termination of infection from the whole world.
  - The term elimination is sometimes used to describe eradication of a disease from a large geographic region. Disease which are amenable to elimination in the meantime are polio, measles and diphtheria.
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# Reproductive rate of infection:

- Reproductive rate of infection: potential for an infectious disease to spread. Influential factors include the probability of transmission between an infected and a susceptible individual; frequency of population contact; duration of infection; virulence of the organism and population immune proportion .
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# Dynamics of disease Transmission (Chain of Infection)

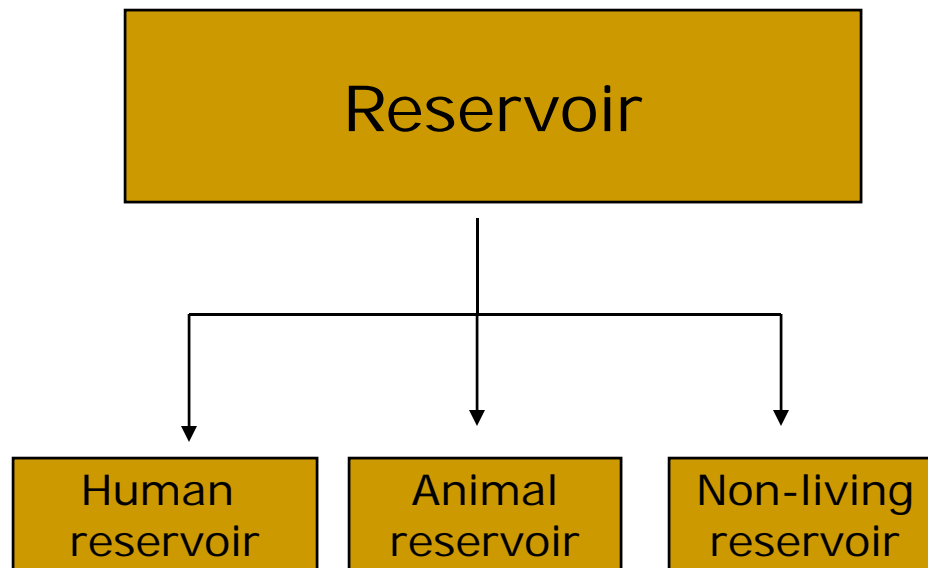


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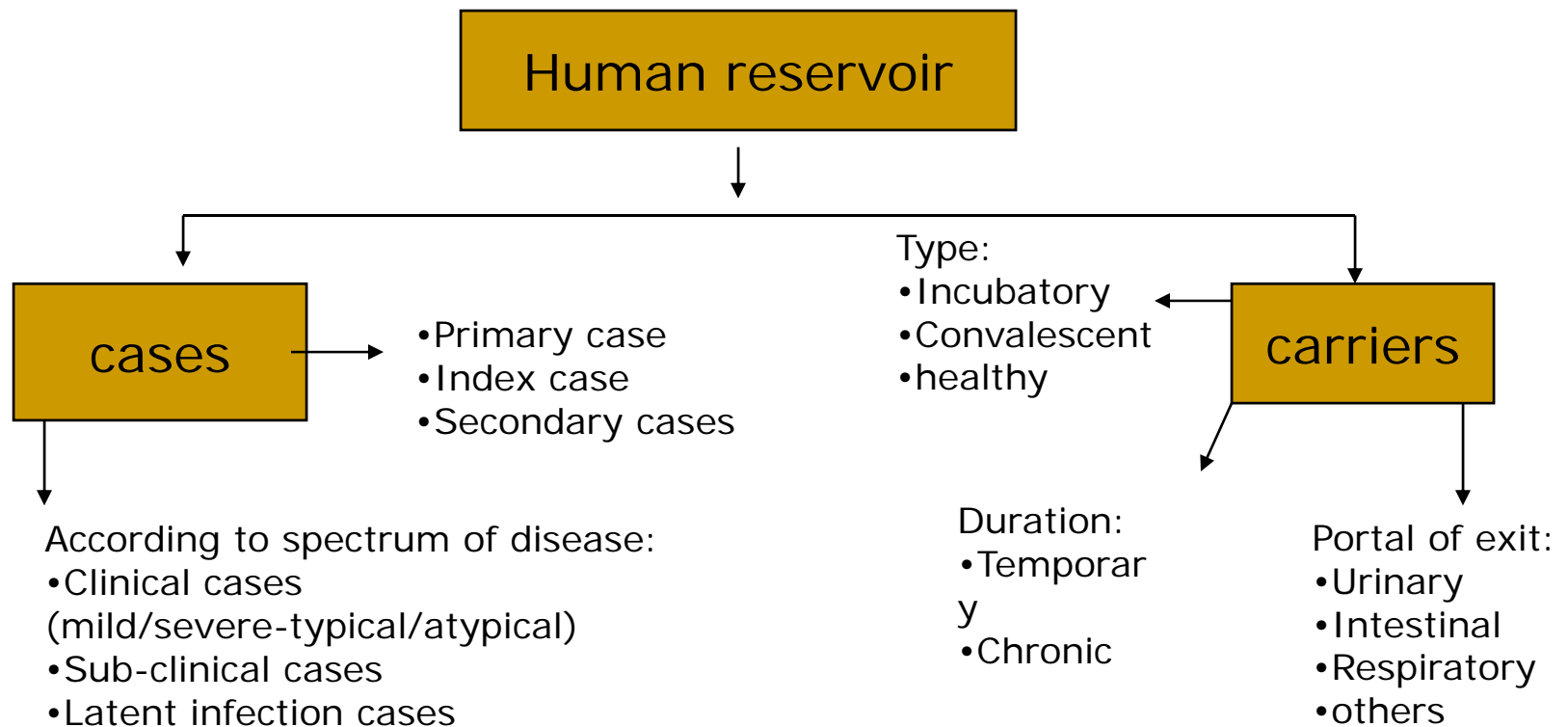
# (I): Source or Reservoir

- The starting point for the occurrence of a communicable disease is the existence of a reservoir or source of infection.
  - The source of infection is defined as “the person, animal, object or substance from which an infectious agent passes or is disseminated to the host (immediate source). The reservoir is “any person, animal, arthropod, plant, soil, or substance, or a combination of these, in which an infectious agent normally lives and multiplies, on which it depends primarily for survival, and where it reproduces itself in such a manner that it can be transmitted to a susceptible host. It is the natural habitat of the infectious agent.”
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# Types of reservoirs



# Human reservoir





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# Cases

- A case is defined as “a person in the population or study group identified as having the particular disease, health disorder, or condition under investigation”
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# Carriers

- It occurs either due to inadequate treatment or immune response, the disease agent is not completely eliminated, leading to a carrier state.
  - It is “an infected person or animal that harbors a specific infectious agent in the absence of discernible (visible) clinical disease and serves as a potential source of infection to others.
  - Three elements have to occur to form a carrier state:
    1. The presence in the body of the disease agent.
    2. The absence of recognizable symptoms and signs of disease.
    3. The shedding of disease agent in the discharge or excretions.
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# Animal reservoirs

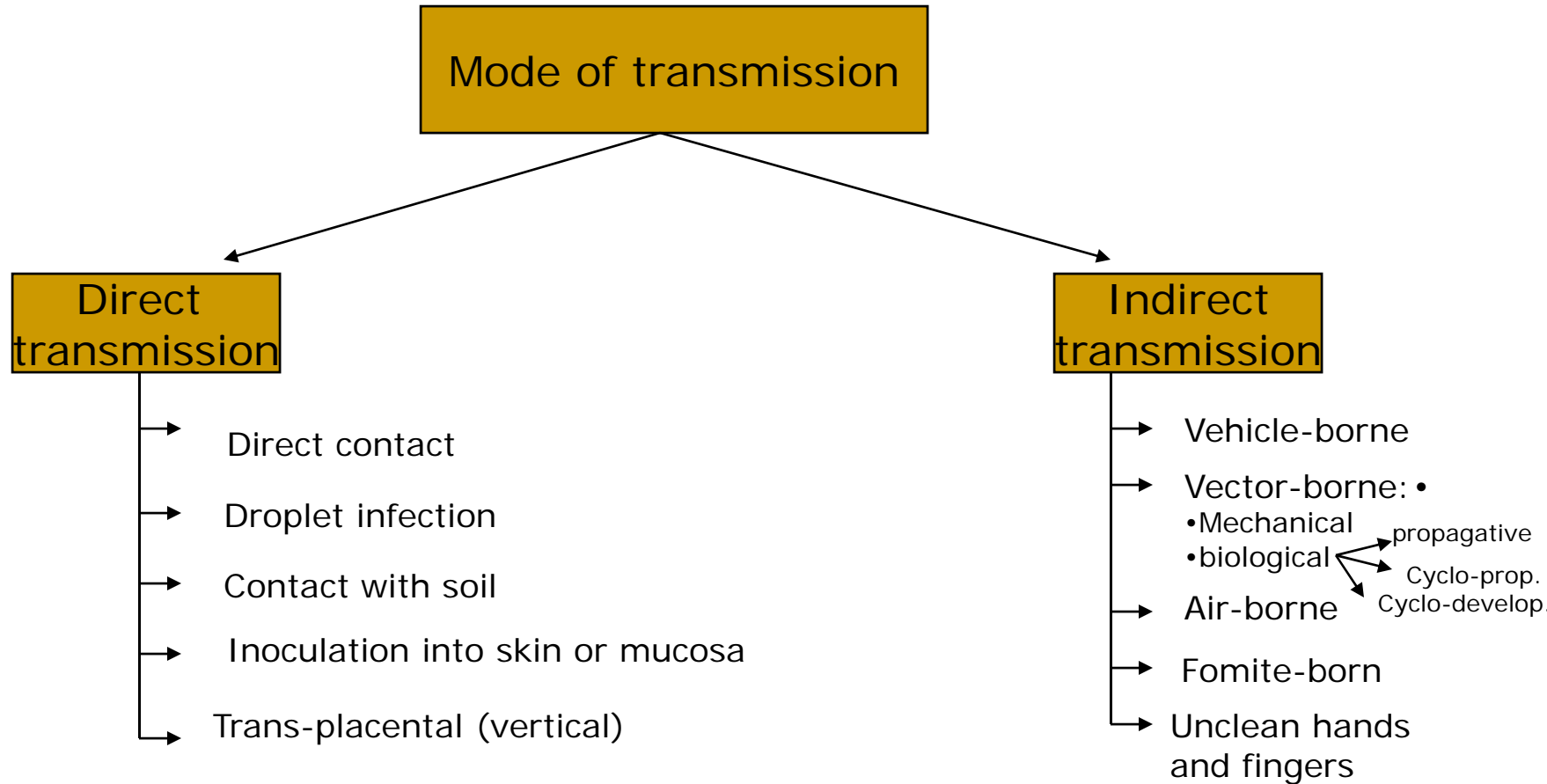
- Zoonosis is an infection that is transmissible under natural conditions from vertebrate animals to man, e.g. rabies, plague, bovine tuberculosis.....
  - There are over a 100 zoonotic diseases that can be conveyed from animal to man.
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# Reservoir in non-living things

- Soil and inanimate matter can also act as reservoir of infection.
  - For example, soil may harbor agents that causes tetanus, anthrax and coccidioidomycosis.
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# (II): Modes of transmission



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## (III): Susceptible host

- An infectious agent seeks a susceptible host aiming “successful parasitism”.
  - Four stages are required for successful parasitism:
    1. Portal of entry
    2. Site of election inside the body
    3. Portal of exit
    4. Survival in external environment
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# Virulence and Case Fatality Rate

- **Virulence:** is the degree of pathogenicity; the disease evoking power of a micro-organism in a given host. Numerically expressed as the ratio of the number of cases of overt infection to the total number infected, as determined by immunoassay. When death is the only criterion of severity, this is the case fatality rate.
  - **Case fatality rate for infectious diseases:** is the proportion of infected individuals who die of the infection. This is a function of the severity of the infection and is heavily influenced by how many mild cases are not diagnosed.
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# Serial interval and Infectious period

- Serial interval: (the gap in time between the onset of the primary and the secondary cases) the interval between receipt of infection and maximal infectivity of the host (also called generation time).
  - Infectious (communicable) period: length of time a person can transmit disease (sheds the infectious agent).
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# Incubation and Latent periods

- Incubation period: time from exposure to development of disease. In other words, the time interval between invasion by an infectious agent and the appearance of the first sign or symptom of the disease in question.
  - Latent period: the period between exposure and the onset of infectiousness (this may be shorter or longer than the incubation period).
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# Transmission Probability Ratio (TPR)

TPR is a measure of risk transmission from infected to susceptible individuals during a contact.

TPR of differing types of contacts, infectious agents, infection routes and strains can be calculated.

There are 4 types of transmission probabilities.

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# TPR (cont.)

Transmission probabilities:

- $p_{00}$ : tp from unvaccinated infective to unvaccinated susceptible
  - $p_{01}$ : tp from vaccinated infective to unvaccinated susceptible
  - $p_{10}$ : tp from unvaccinated infective to vaccinated susceptible
  - $p_{11}$ : tp from vaccinated infective to vaccinated susceptible
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## TPR (cont.)

- To estimate the effect of a vaccine in reducing susceptibility, compare the ratio of  $p_{10}$  to  $p_{00}$ .
  - To estimate the effect of a vaccine in reducing infectiousness, compare the ratio of  $p_{01}$  to  $p_{00}$ .
  - To estimate the combined effect of a vaccine, compare the ratio of  $p_{11}$  to  $p_{00}$ .
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# Concepts of Prevention and Control

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- The goals of medicine are to promote health, to preserve health, to restore health when it is impaired, and to minimize suffering and distress.
  - These goals are embodied in the word "prevention"
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# Prevention; Definition and Concept

- Actions aimed at eradicating, eliminating or minimizing the impact of disease and disability, or if none of these are feasible, retarding the progress of the disease and disability.
  - The concept of prevention is best defined in the context of levels, traditionally called primary, secondary and tertiary prevention. A fourth level, called primordial prevention, was later added.
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# Determinants of Prevention

- Successful prevention depends upon:
    - a knowledge of causation,
    - dynamics of transmission,
    - identification of risk factors and risk groups,
    - availability of prophylactic or early detection and treatment measures,
    - an organization for applying these measures to appropriate persons or groups, and
    - continuous evaluation of and development of procedures applied
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# Preventable Causes of Disease

## BEINGS

- Biological factors and Behavioral Factors
- Environmental factors
- Immunologic factors
- Nutritional factors
- Genetic factors
- Services, Social factors, and Spiritual factors

[JF Jekel, Epidemiology, Biostatistics, and Preventive Medicine, 1996]

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# Levels of prevention

Primordial prevention

Primary prevention

Secondary prevention

Tertiary prevention

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# Primordial prevention

- Primordial prevention consists of actions and measures that inhibit the emergence of risk factors in the form of environmental, economic, social, and behavioral conditions and cultural patterns of living etc.
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# Primordial prevention (cont.)

- It is the prevention of the emergence or development of risk factors in countries or population groups in which they have not yet appeared
  - For example, many adult health problems (e.g., obesity, hypertension) have their early origins in childhood, because this is the time when lifestyles are formed (for example, smoking, eating patterns, physical exercise).
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# Primordial prevention (cont.)

- In primordial prevention, efforts are directed towards discouraging children from adopting harmful lifestyles
  - The main intervention in primordial prevention is through individual and mass education
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# Primary prevention

- Primary prevention can be defined as the action taken prior to the onset of disease, which removes the possibility that the disease will ever occur.
  - It signifies intervention in the pre-pathogenesis phase of a disease or health problem.
  - Primary prevention may be accomplished by measures of “Health promotion” and “specific protection”
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# Primary prevention (cont.)

- It includes the concept of "positive health", a concept that encourages achievement and maintenance of "an acceptable level of health that will enable every individual to lead a socially and economically productive life".
  - Primary prevention may be accomplished by measures designed to promote general health and well-being, and quality of life of people or by specific protective measures.
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# Primary prevention

Achieved by

## Health promotion

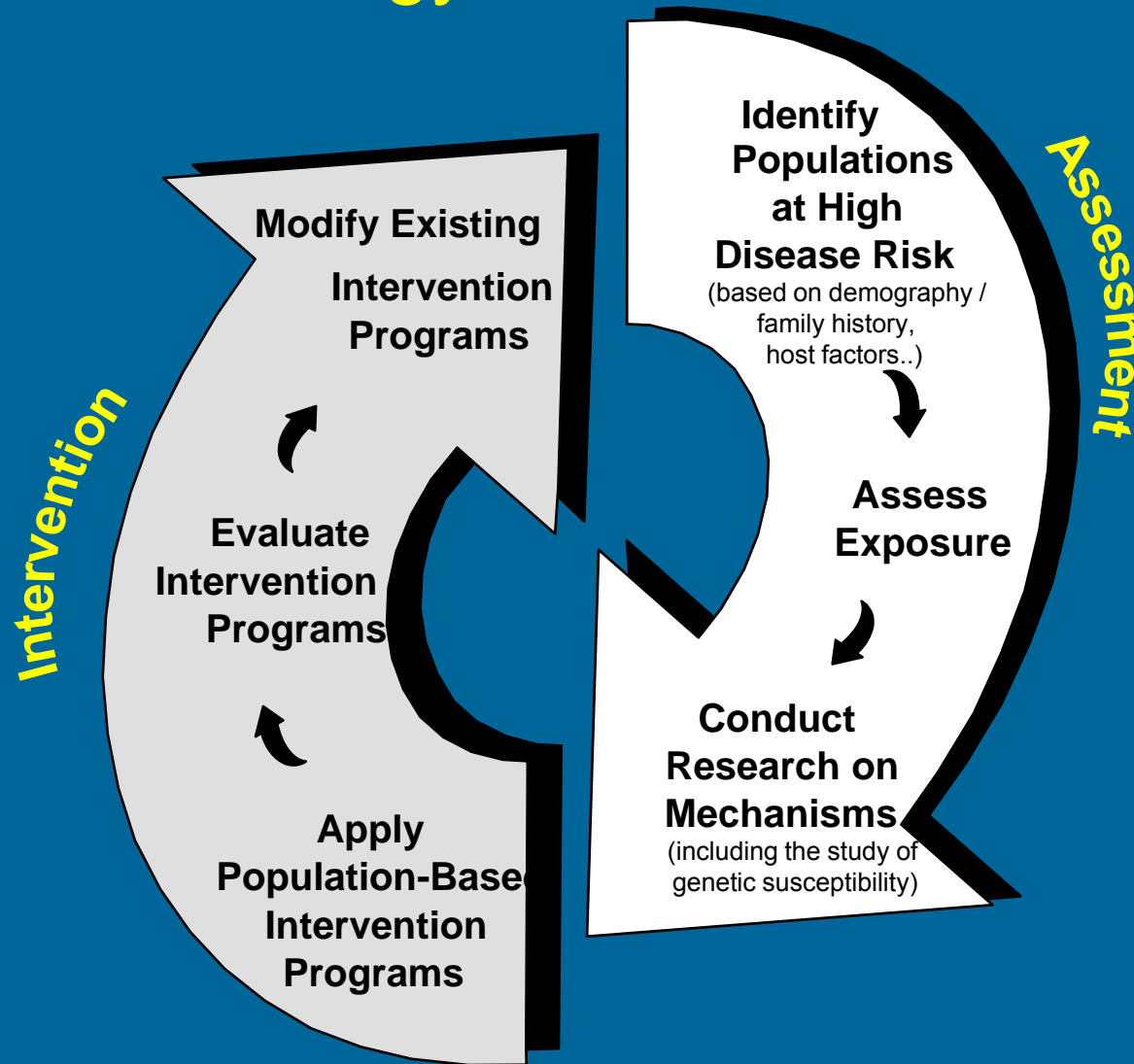
- Health education
- Environmental modifications
- Nutritional interventions
- Life style and behavioral changes

## Specific protection

- Immunization and seroprophylaxis
- chemoprophylaxis
- Use of specific nutrients or supplementations
- Protection against occupational hazards
- Safety of drugs and foods
- Control of environmental hazards, e.g. air pollution



# Strategy for Prevention



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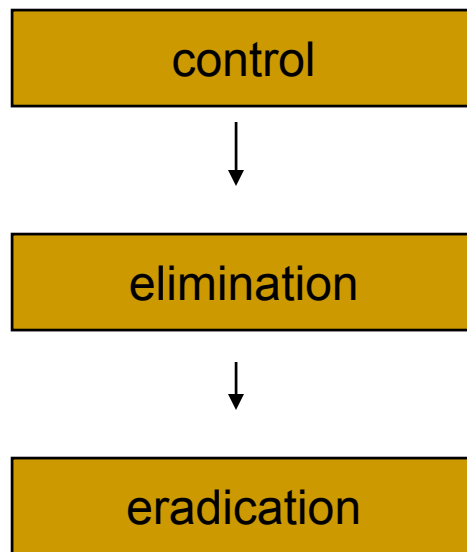
# Control

- Concept of control:

The term disease control describes ongoing operations aimed at reducing:

- The incidence of disease
  - The duration of disease and consequently the risk of transmission
  - The effects of infection, including both the physical and psychosocial complications
  - The financial burden to the community.
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- Control activities focus on primary prevention or secondary prevention, but most programs combine both.



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# Disease Elimination

- Between control and eradication, an intermediate goal has been described, called "regional elimination"
  - The term "elimination" is used to describe interruption of transmission of disease, as for example, elimination of measles, polio and diphtheria from large geographic regions or areas
  - Regional elimination is now seen as an important precursor of eradication
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# Disease Eradication

- Eradication literally means to "tear out by roots".
  - It is the process of "Termination of all transmission of infection by extermination of the infectious agent through surveillance and containment".
  - Eradication is an absolute process, an "all or none" phenomenon, restricted to termination of an infection from the whole world. It implies that disease will no longer occur in a population.
  - To-date, only one disease has been eradicated, that is smallpox.
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# Monitoring

- Monitoring is "the performance and analysis of routine measurements aimed at detecting changes in the environment or health status of population" (Thus we have monitoring of air pollution, water quality, growth and nutritional status, etc).
  - It also refers to on -going measurement of performance of a health service or a health professional, or of the extent to which patients comply with or adhere to advice from health professionals.
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# Surveillance

- surveillance means to watch over with great attention, authority and often with suspicion
  - According to another, surveillance is defined as "the continuous scrutiny (inspection) of the factors that determine the occurrence and distribution of disease and other conditions of ill-health"
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# Common Communicable Diseases

The common cold is a respiratory infection caused by over 200 different viruses.

Symptoms include congestion, sore throat and cough. It can be spread through direct and indirect contact. Treatment includes rest, liquids and over the counter medications.

Prevention techniques include handwashing and avoiding contact with infected persons.

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# Common Communicable Diseases

Influenza, more commonly called “flu”, is a respiratory infection caused by several groups of viruses.

Symptoms include high fever, fatigue, muscle and joint aches. It is spread through direct contact with infected people and water droplets in the air from coughs and sneezes.

Treatment includes rest, liquids, and over the counter medications. Prevention includes avoiding contact with infected persons and vaccines.

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# Common Communicable Diseases

- Mononucleosis is a viral infection common among teens and young adults. Symptoms include tiredness, loss of appetite, sore throat and fever. It is caused by direct contact with an infected person's saliva through kissing, sharing utensils and water droplets in the air from coughs and sneezes. Treat symptoms with pain relievers, rest and liquids. Prevention includes avoiding contact with infected persons and not eating or drinking after anyone else.

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# Sexually Transmitted Diseases

- Chlamydia
  - Gonorrhea
  - Genital Herpes
  - Syphilis
  - HIV/AIDS
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# Chlamydia

- A group of infections that attack the reproductive system
  - Most common type of STD in the US
  - Symptoms : often there are no symptoms, however, sometimes there will be pain and an unusual liquid coming from the penis or vagina
  - If detected, it can be cured with antibiotics
  - If undetected, it can lead to damage to the reproductive organs
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# Gonorrhea

- An STD caused by bacteria that live in warm, moist body areas
  - Symptoms include a burning feeling during urination and an unusual liquid coming from the penis or vagina
  - If treated, it can be cured with the use of antibiotics
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# Genital Herpes

- An STD caused by the herpes simplex type II virus
  - Symptoms include fever and painful, itchy sores where the disease entered the body
  - There is no cure
-

# Case 1

- Brief History
- Summary: A man in his forties with extremity and groin lesions.
- A man in his forties was well until seven months prior to admission when he noticed several painless, purplish lesions on his lower extremities. These lesions gradually increased in size and number. One month before admission, a right groin lesion developed and grew rapidly. Three days prior to admission, scrotal and penile edema occurred. There were no systemic symptoms such as fever, chills, night sweats, weight loss, anorexia, shortness of breath, abdominal pain or diarrhea.
- Past medical history /Allergies
- The past history included syphilis and gonorrhea 10 years ago, which had been treated.
- Epidemiological History
- He was a homosexual male, whose HIV status eight years earlier was negative. He denied tobacco, alcohol or intravenous drug use.

# Case 1

- Physical Examination
- The patient appeared well. The temperature was 98.4°F (36.9°C); other vital signs were stable. There were no oral lesions, no cervical or axillary lymphadenopathy. The lungs were clear, and cardiac examination revealed a regular rate and rhythm, with a 1/6 SEM at the apex. The abdomen was soft and non-tender, and the spleen was not palpable.
- Skin exam revealed scattered violaceous lesions on the lower extremities, toes, sacral area, chest and arms. (See Figure 1.) His right groin revealed a nodular, indurated lesion with some necrosis and yellow exudate, and matted lymph nodes bilaterally. (See Figure 2.) He had 2+ scrotal and penile edema.



# Case 1



■ Figure 1.



Figure 2.

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# Case 1

## ■ Studies

- The white blood cell count (WBC) was 3,300 cells/mmi, (65% polymorphonuclear leukocytes, 25% lymphocytes, 8% monocytes, 2% eosinophils), hematocrit 39%, and platelet count 266,000/mmi. Serum laboratory testing for electrolytes, liver function tests and extended chemistries were normal except for a globulin fraction of 4.4g/dL.

## ■ Final Diagnosis

- AIDS-related Kaposi's Sarcoma.
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# Syphilis

- An STD that attacks many parts of the body
- It is fatal without treatment
- Early symptoms include a reddish, painless sore at the place where the disease entered the body
- It can be cured with antibiotics

- Syphilitic chancre



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# HIV/AIDS

- HIV is the virus that causes AIDS, it attacks the immune system
  - Early symptoms may include a rash, a sore throat, fever and tiredness
  - It is spread through contact with bodily fluids, mainly through sexual activity and sharing needles during intravenous drug use
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# HIV/AIDS

- Nearly everyone infected with HIV develops AIDS
  - People with AIDS cannot fight off diseases that healthy people could easily resist
  - Aids has no cure, so people eventually die from one of the diseases
  - Prevention techniques include practicing abstinence and never sharing with anyone else a needle or any object that breaks the skin
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# HIV/AIDS

- HIV is not spread through
  - the air
  - sweat or tears
  - mosquitos
  - donating blood
  - touching, such as shaking hands or hugging
  - contact with objects, such as eating utensils
-

# Why does your child need to know?

- We all want our children to stay healthy.
- STDs are very prevalent in today's society.
- Our children need to be informed as early as possible.
- Schools and parents must work together cooperatively to provide children with education before they put themselves at risk.



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# Current Immunization Schedule for Children in the U.S.

- Review the following links and identify the current immunization schedule for children in the U.S.
  - <http://www.immunofacts.com>
  - <http://www.cdc.gov/>
  - <http://www.cdc.gov/inpho/inpho.htm>
  - <http://odphp.osophs.fhhs-gov/>
  - <http://www.hhs.gov/progorg/pharmacy/overview.html>
  - <http://www.who.ch/>
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**THANK YOU**