

# Principles of disease and epidemiology

[Science](#), [Epidemiology](#)



Chapter 14 – Principles of Disease and Epidemiology Pathology Infection and Disease

1. Pathology is the scientific study of disease – concerned with cause (etiology) and manner in which disease develops (pathogenesis) - Also concerned with structural and functional changes brought about by disease and final effects on the body

2. Infection – invasion or colonization of the body by pathogenic microorganisms

3. Disease – when infection results in change in state of health

Normal Microbiota –

1. Free of microbes in utero, at birth gain lactobacilli in intestine from mothers vaginal canal, E. coli taken through food and inhabits intestine thru life

2. Ten times more bacterial cells than human cells in the body

3. Normal flora – normal microbiota

4. Transient microbiota – present for a while but disappear

5. Distribution of normal flora dependent on physical and chemical factors, defenses of the host and mechanical factors

Relationship between Normal Flora and Host

1. Microbial antagonism – aka competitive exclusion – normal microbiota ability to protect the host from overgrowth of harmful microorganisms

2. Normal microbiota and host live in symbiosis – one is dependent on the other

3. The three types of symbiosis – commensalism (one organism benefits, other unaffected), mutualism (both benefit) and parasitism (one harmed and one benefits)

4. Probiotics – live microbial cultures applied to or ingested that are intended to exert a beneficial effect

Opportunistic Microorganisms

1. E. coli – normally harmless but in other parts of the body – cause UTI, pulmonary infections, meningitis or abscesses.

2. AIDS – compromises immune system – increases susceptibility to opportunistic infection e. g. Pneumocystis pneumonia

The Etiology of Infectious Disease –

Koch's Postulates – 1. Koch established that microorganisms cause specific disease 2. Isolated microorganisms from diseased animal, grew in pure culture and identified, injected healthy animal, disease reproduced and identical 3. Experimental requirements – same pathogen must be present in every case of disease, pathogen must be isolated from diseased host and grown in pure culture, pathogen must cause disease when inoculated into healthy animal, pathogen must be isolated from inoculated animal and shown to be original organism Exceptions to Koch's postulates – 1.

Unique culture environments – modified to establish etiologies of those that cannot be grown on artificial media e. g. viruses, syphilis, leprosy 2. Some disease such as tetanus have unequivocal signs and symptoms 3. Some disease may be caused by a number of microbes e. g. pneumonia and nephritis 4. Some pathogens cause several diseases e. g. *S. pyogenes* 5.

Certain pathogens only cause disease in humans e. g. HIV Classifying

Infectious diseases – 1. Every disease alters body structures and functions in particular ways and are indicated by several kinds of evidences 2.

Symptoms – changes in body functions 3. Signs – objective changes the physician can observe or measure e. g. lesions, swelling, fever and paralysis 4. Syndrome – a specific group of signs or symptoms that accompany a disease 5. Communicable disease – any disease that spreads from one host to another e. g. herpes, chickenpox, measles, typhoid fever and TB 6.

Contagious diseases – Spread easily from host to host e. g. chickenpox 7.

Noncommunicable Disease – caused by microorganisms that inhabit body and only occasionally produce disease or live outside the body and produce

disease when introduced e. . tetanus

Occurrence of Disease – 1. Incidence – the number of people in a population who develop a disease during a particular period of time 2. Prevalence – number of people in a population who develop a disease at a specific time, regardless of when it first appeared – old and new 3. Sporadic disease – occurs only occasionally e. g. typhoid fever 4. Endemic disease – constantly present in a population – e. g. common cold 5. Epidemic disease – Many people in a given area develop disease in short time e. g. AIDS, STD's 6.

Pandemic – Epidemic disease that occurs worldwide e. g. avian flu

Severity or Duration of Disease – 1. Acute disease – develops rapidly but only lasts a short time e. g. influenza 2. Chronic Disease – develops more slowly and body's reactions may be less severe but continues or recurs for long periods of time e. g. Mono, TB & HepB 3. Subacute – Intermediate between Acute and Chronic e. g. Sclerosing panencephalitis 4. Latent Disease – causative agent remains inactive for some time but then becomes active to produce symptoms e. . shingles 5. Herd Immunity – Immunity to disease in most of population

Extent of Host Involvement – 1. Local infection – microorganisms limited to relatively small area e. g. boils 2. Systemic infection – Spread throughout the body by blood or lymph e. g. measles 3. Focal infection – local infection enters blood or lymph and spread to other specific body parts where they are confined – arise f/ teeth, tonsils, sinus 4. Sepsis - toxic inflammatory condition arising from spread of microbes from a focus of infection 5.

Septicemia – blood poisoning systemic infection arising from multiplication of pathogens in blood 6. Bacteremia – presence of bacteria in blood, Toxemia – presence of toxins in blood and viremia – presence of virus in blood 7.

Primary infection – acute infection that causes initial illness 8. Secondary infection – caused by an opportunistic pathogen after primary weakens defenses 9. Subclinical (inapparent) infection is one that does not cause any noticeable illness e. g. Polio & HepA can be carried but never developed

Patterns of Disease . Sequence – must be reservoir of infection as a source pathogen transmitted to susceptible host by contact or vectors transmission followed by invasion (enters host, multiplies) injures host through pathogenesis 2. Despite these effects, occurrence of disease generally depends on resistance Predisposing factors – makes body more susceptible and may alter course of disease 1. Gender – Females more UTI, Men more meningitis 2. Genetic background – sickle cell against malaria 3. Climate and weather – respiratory disease increase in winter 4.

Others – nutrition, ageenvironment, lifestyle, habitat, illness, chemo, emotions. Development of Disease – 1. Incubation Period – interval between initial infection and first mild signs and symptoms, time depends on virulence, number of microorganisms, and resistance 2. Prodromal period – characterized by appearance of the first mild signs and symptoms 3. Period of illness – disease at its height and all signs and symptoms apparent, PT dies during this period if not overcome 4. Period of Decline – signs and symptoms subside- vulnerable to secondary infection 5.

Period of convalescence – body returns to its pre-diseased state and health is restored

The Spread of Infection Reservoirs of Infection – 1. Reservoir of Infection – A continual source of infection- may be human animal or nonliving

2. Human reservoirs – Many people harbor pathogens and transmit them – Carriers are living reservoirs and harbor the disease with or without signs or symptoms – Can carry disease during latent phases such as incubation or convalescent – play important role in spread of AIDS, typhoid fever, diphtheria, hep, gonorrhoea, and streptococcal infections 3.

Animal Reservoirs – Wild or domestic – Zoonosis are diseases that occur in wild but can be transmitted to humans e. g. Rabies, Lyme disease – Can occur through contact of animal, its waste, consumption or contamination. 4.

Nonliving Reservoirs – Soil and Water – Soil e. g. Ringworm, Botulism and Tetanus, Water e. g. – usually contamination related, cholera , typhoid fever

Transmission of Disease 1. Contact – spread of an agent of disease by direct contact, indirect contact or droplet transmission a. Direct Contact – touching kissing, intercourse, - Any close physical contact e. . STDs, AIDS, cold, influenza, staph, Hep A, measles etc. b. Indirect Contact – occurs when agent of disease is transmitted from reservoir to host by means of nonliving object – Fomite is a object involved in spread of infection e. g. tissues, bedding, syringes etc. c. Droplet Transmission – microbes are spread in droplet nuclei that travel short distance – Sneezing, coughing, talking – not considered airborne e. g. flu, pneumonia and pertussis 2. Vehicle Transmission – transmission of disease by a medium, such as water food or air and drugs blood IV and body fluids d.

Waterborne – contaminated water, cholera leptospirosis e. Foodborne – transported through undercooked, poorly kept or unsanitary food such as tapeworm f. Airborne – droplet nuclei in dust that travels more than 1 meter – measles virus and TB bacteria as well as some spores can be carried in dust and cause disease coccidioidomycosis 3. Vectors – animals that carry disease from one host to another – g. Mechanical Transmission – passive transport on insects feet or body part – houseflies transfer from feces to food h.

Biological transmission – active process and more complex – arthropod bites infected person pathogens reproduce in vector increase causes more possibility of transmit. If arthropod vomits or defecates while biting host, can transfer from gut. Often parasites, also includes – Lyme disease, plague, Malaria etc. Nosocomial (Hospital Acquired) Infections 1. A nosocomial infection is any infection that is acquired during the course of stay in a hospital, nursinghome or other healthcare facility 2. About 5 – 15% of all hospitalized patients will acquire this 3.

Result from combination of weakened host, chain of transmission in hospital and availability of microorganisms in hospital. Microorganisms in the Hospital 1. Often normal flora are a problem when introduced to body in catheters and surgical procedures 2. Major problems include coagulase negative staph, S. aureus, E. coli, Enterococcus, P. aeruginosa, Enterobacter, K. pneumoniae, Candida albicans 3. Most frequent are opportunistic gram negative, drug resistant Compromised Host 1. Resistance impaired by disease, therapy and burns. 2. Two principals – Broken skin/Mucous membranes and suppressed

immunity . Broken skin and mucous membranes – disable first line of defense 4. Invasive devices also cause problems 5. Adverse effects to B and T Cells compromise host Chain of Transmission – 1. Direct transmission from staff member to patient and among patients 2. Fomites such as catheters, syringes and respiratory devices Control of Nosocomial Infections – 1. Aseptic techniques can prevent – Hand washing most important 2. Hospital infection control staff members are responsible for overseeing proper cleaning, storage and handling of equipment and supplies Emerging Infectious Diseases . EID's are new or changing, increasing recently and showing future increase. 2. Number of factors contribute to emergence including new strains which may result from genetic recombination (E. coli), a new serovar resulting from changes or evolution (Vibrio cholerae) , use of antibiotics and pesticide to cause resistance, changes in weather patterns (Hantavirus), modern transportation (West Nile), Ecological changes from natural disasters construction or wars, animal control measures (kill deer predators, more deer, more Lyme disease and failures in public health measures. . CDC priorities (1) Detect investigate and monitor pathogens and disease (2) Expand basic and applied research on ecological and environmental factors microbial changes and host interaction (3) Enhance public information (4) Establish plans to monitor and control worldwide Epidemiology 1. The science of epidemiology is the study of transmission incidence and frequency of disease 2.

Modern epidemiology began in mid-1800s with the works of Snow, Semmelweis and Nightingale 3. Descriptive Epidemiology – data about infected people is collected and analyzed – includes info about person place



and period 4. Analytical epidemiology – analyzes disease to determine probable cause – (case control method) a group of infected people is compared with an uninfected group or (Cohort Method) people in contact with an agent vs. those not in contact with the same agent 5. Experimental Epidemiology – controlled experiments designed to test hypothesis are performed e. g. placebo studying 6. Case reporting provides data on incidence and prevalence to local, state and national health officials 7. The CDC is the main source of epidemiologic information in the US 8. The CDC publishes the Morbidity and Mortality weekly report to provide info on incidence and deaths.