

Bacterial Mechanisms of Pathogenicity

1st Lecture

Introduction

&

Definitions

Infection and Disease

A. Definitions

B. Generalized Stages of Infection

C. Virulence Factors and Toxins

A. Definitions

- Disease and Infectious Disease

- Disease

- Any deviation from a condition of good health and well-being

- Infectious Disease

- A disease condition caused by the presence or growth of infectious microorganisms or parasites

A. Definitions

- Pathogenicity and Virulence
 - Pathogenicity
 - The ability of a microbe to cause disease
 - This term is often used to describe or compare species
 - Virulence
 - The degree of pathogenicity in a microorganism
 - This term is often used to describe or compare strains within a species

Definitions

- Acute infection vs. chronic infection
 - Acute Infection
 - An infection characterized by **sudden onset, rapid progression, and often with severe symptoms**
 - Chronic Infection
 - An infection characterized by **delayed onset and slow progression**

Definitions

- Primary infection vs. secondary infection
 - Primary Infection
 - An infection that develops in **an otherwise healthy individual**
 - Secondary Infection
 - An infection that develops in an **individual who is already infected with a different pathogen**

Definitions

- Localized infection vs. systemic infection
 - Localized Infection
 - An infection that is **restricted to a specific location or region within the body of the host**
 - Systemic Infection
 - An infection that has **spread to several regions or areas in the body of the host**

Definitions

- Clinical infection vs. subclinical infection
 - Clinical Infection
 - An infection with **obvious observable or detectable symptoms**
 - Subclinical Infection
 - An infection **with few or no obvious symptoms**

Definitions

- Opportunistic infection
 - An infection caused by microorganisms that are commonly found in the host's environment. This term is often used to refer to infections caused by organisms in the normal flora.

Definitions

- The suffix “-emia”
 - A suffix meaning “presence of an infectious agent”
 - Bacteremia = Presence of infectious bacteria
 - Viremia = Presence of infectious virus
 - Fungemia = Presence of infectious fungus
 - Septicemia = Presence of an infectious agent in the bloodstream

Definitions

- The suffix “-itis”
 - A suffix meaning “inflammation of”
 - Examples:
 - Pharyngitis = Inflammation of the pharynx
 - Endocarditis = Inflammation of the heart chambers
 - Gastroenteritis = Inflammation of the gastrointestinal tract

Definitions

- Epidemiology
 - The study of the transmission of disease
- Communicable Disease
 - A disease that can be transmitted from one individual to another
- Noncommunicable Disease
 - A disease that is not transmitted from one individual to another

Definitions

- Endemic Disease
 - A disease condition that is normally found in a certain percentage of a population
- Epidemic Disease
 - A disease condition present in a greater than usual percentage of a specific population
- Pandemic Disease
 - An epidemic affecting a large geographical area; often on a global scale

Definitions

- Reservoir of Infection
 - The source of an infectious agent
- Carrier
 - An individual who carries an infectious agent without manifesting symptoms, yet who can transmit the agent to another individual
- Fomites
 - Any inanimate object capable of being an intermediate in the indirect transmission of an infectious agent, such as clothes utensils and furniture

Definitions

- Animal Vectors
- An animal (nonhuman) that can transmit an infectious agent to humans
- Two types: mechanical and biological
- Mechanical animal vectors: The infectious agent is physically transmitted by the animal vector, but the agent does not incubate or grow in the animal; e.g, the transmission of bacteria sticking to the feet of flies
 - Biological animal vectors: The infectious agent must incubate in the animal host as part of the agent's developmental cycle; e.g, the transmission of malaria by infected mosquitoes

Definitions

- Direct Mechanisms of Disease Transmission
 - Directly From Person to Person
 - Examples:
 - Direct Skin Contact
 - Airborne (Aerosols)

Definitions

- Indirect Mechanisms of Disease Transmission

- Examples:

- Food & Waterborne Transmission

- Fomites

- Animal Vectors

Table 19.1 Terms Used in the Study of Infectious Diseases

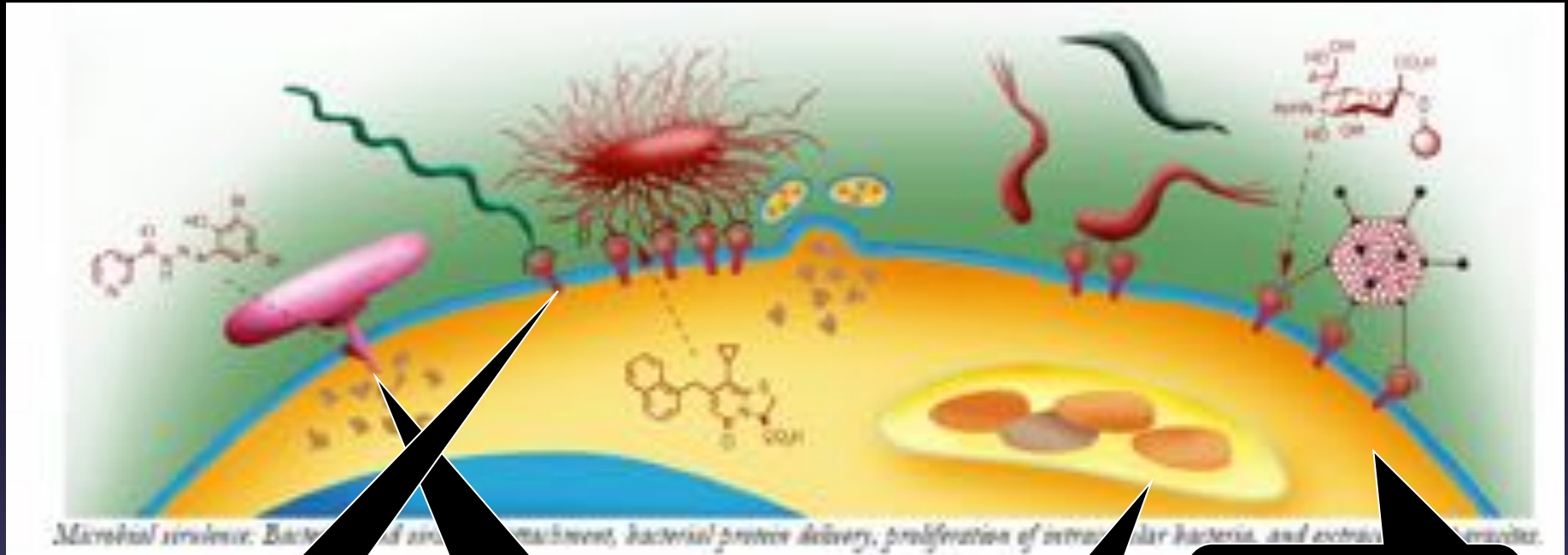
Term	Definition
Bacteremia	Bacteria circulating in the bloodstream
Colonization	Establishment and growth of a microorganism on a body surface
Disease	Noticeable impairment of body function
Immunocompromised	A host with weaknesses or defects in the innate or adaptive defenses
Inapparent infection	Infection with no obvious symptoms
Infectious disease	Disease caused by an infecting microorganism or virus
Latent infection	Infection in which the infectious agent is present but not active
Opportunistic pathogens	Organisms that cause disease only when introduced into an unusual location or into an immunocompromised host
Parasite	An organism that benefits at the expense of another organism, the host
Pathogen	Any disease-causing microorganism or virus
Pathogenic	Disease-causing
Primary infection	Infection in a previously healthy person
Secondary infection	An additional infection that occurs as a result of a primary infection and that occurs during or immediately following the primary infection
Septicemia	Acute illness caused by infectious agents or their products circulating in the bloodstream
Systemic infection	Widespread infection through blood or lymph
Toxemia	Toxin circulating in the bloodstream
Viremia	Viruses circulating in the bloodstream
Virulence determinants	Attributes of a microorganism or virus that promote pathogenicity

Pathogenicity - ability to cause disease

Virulence - degree of pathogenicity

- Many properties that determine a microbe's pathogenicity or virulence are unclear or unknown
- But, when a microbe overpowers the hosts defenses, infectious disease results!

Molecular Determinants of Pathogenicity



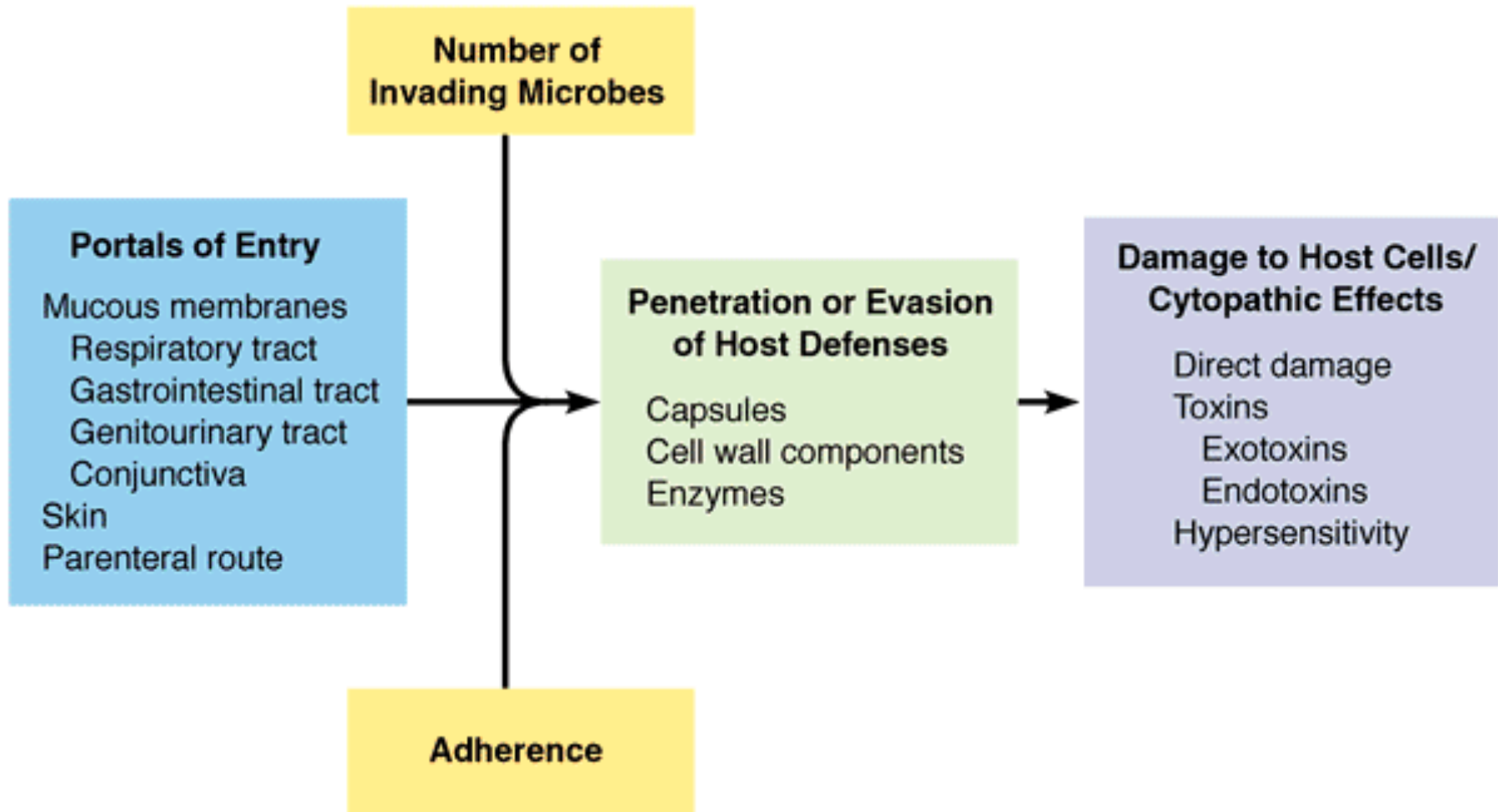
Attachment
to host
tissues

Production
and delivery
of various
factors

Replication
and evasion
of immunity

Damage to
host tissues

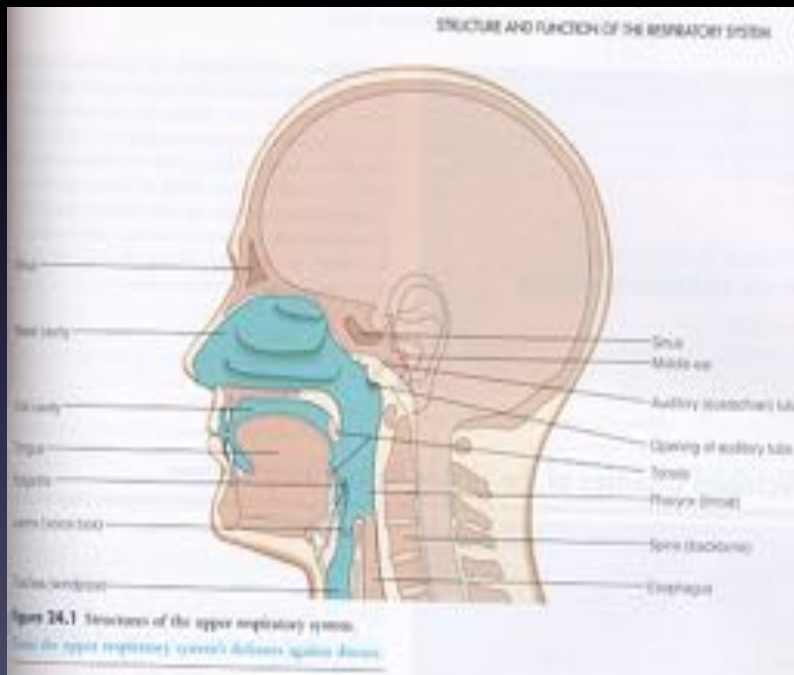
Microbial Mechanisms of Pathogenicity: How Microorganisms Cause Disease



Portals of Entry

- 1. Mucus Membranes
- 2. Skin
- 3. Parenteral (eg; injection)

1. Mucus Membranes



- A. Respiratory Tract
 - microbes inhaled into mouth or nose in droplets of moisture or dust particles
 - Easiest and most frequently traveled portal of entry

Common Diseases contracted via the Respiratory Tract



- Common cold
- Flu
- Tuberculosis
- Whooping cough
- Pneumonia
- Measles
- Diphtheria

Mucus Membranes



- B. Gastrointestinal Tract
 - microbes gain entrance thru contaminated food & water or fingers & hands
 - most microbes that enter the G.I. Tract are destroyed by **HCL & enzymes of stomach** or **bile & enzymes of small intestine**

Common diseases contracted via the G.I. Tract



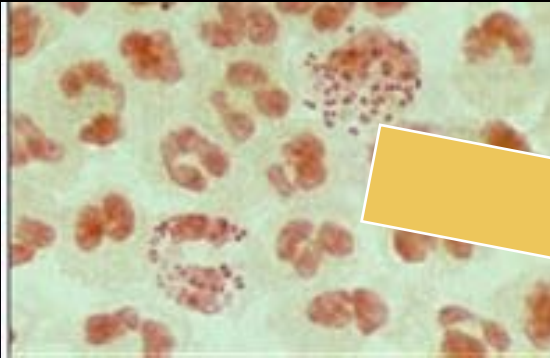
Clostridium botulinum

- Salmonellosis
 - *Salmonella sp.*
- Shigellosis
 - *Shigella sp.*
- Cholera
 - *Vibrio cholorea*
- Ulcers
 - *Helicobacter pylori*
- Botulism
 - *Clostridium botulinum*

Fecal - Oral Diseases

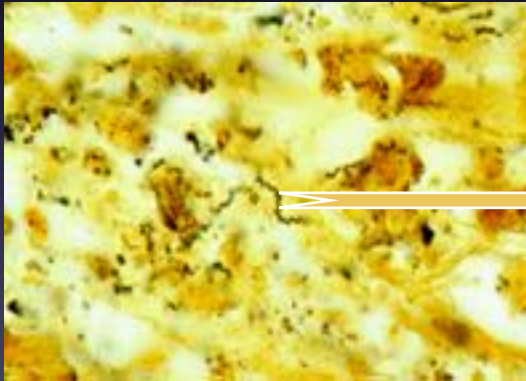
- These pathogens enter the G.I. Tract at one end and exit at the other end.
- Spread by contaminated hands & fingers or contaminated food & water
- Poor personal hygiene.

Mucus Membranes of the Genitourinary System - STD's



Gonorrhoea

Neisseria gonorrhoeae



Syphilis

Treponema pallidum

Chlamydia

Chlamydia trachomatis

HIV

Herpes Simplex II

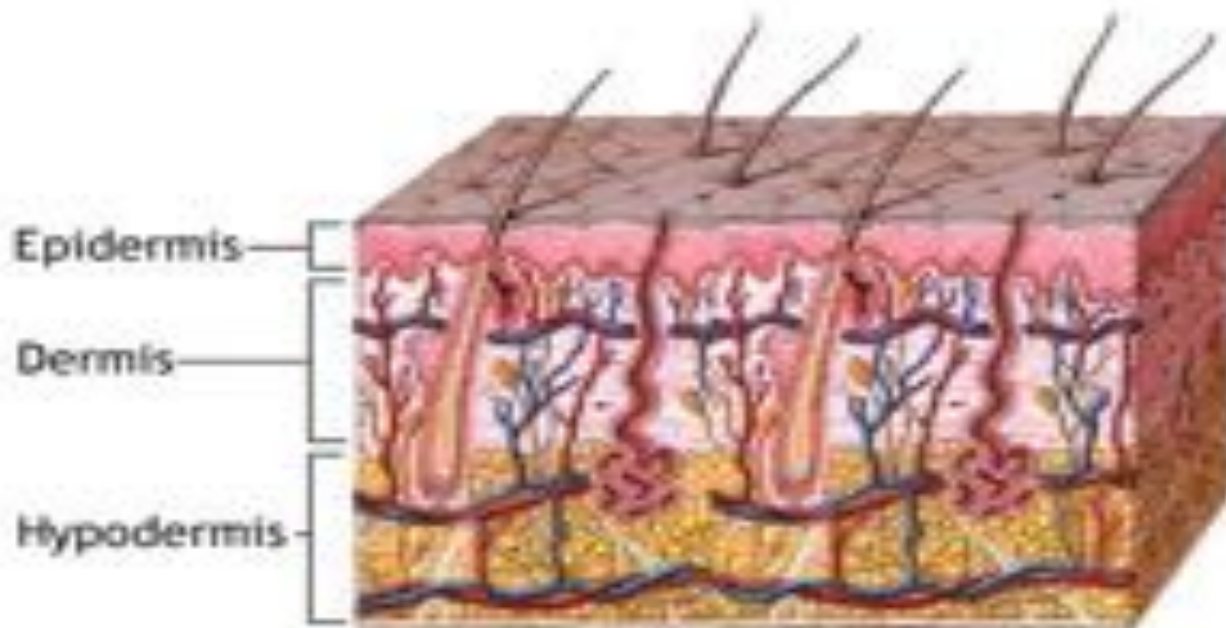
Mucus Membranes



- D. Conjunctiva –
 - mucus membranes that cover the eyeball and lines the eyelid
- Trachoma
 - *Chlamydia trachomatis*

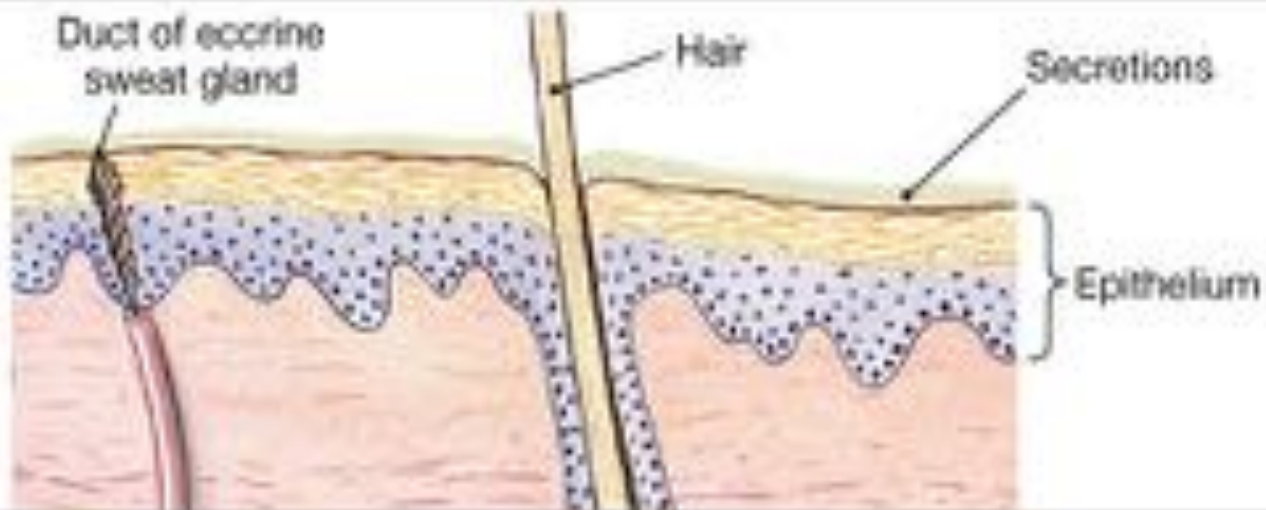
2nd Portal of Entry: Skin

- **Skin - the largest organ of the body.** When unbroken is an effective barrier for most microorganisms.
- Some microbes can gain entrance through openings in the skin: hair follicles and sweat glands, wound ...etc



PHYSICAL BARRIERS

Prevent approach of and deny access to pathogens



3rd Portal of Entry: Parentarel

- Microorganisms are **deposited** into the tissues **below the skin or mucus membranes**
- Punctures and scratches
- injections
- bites
- surgery