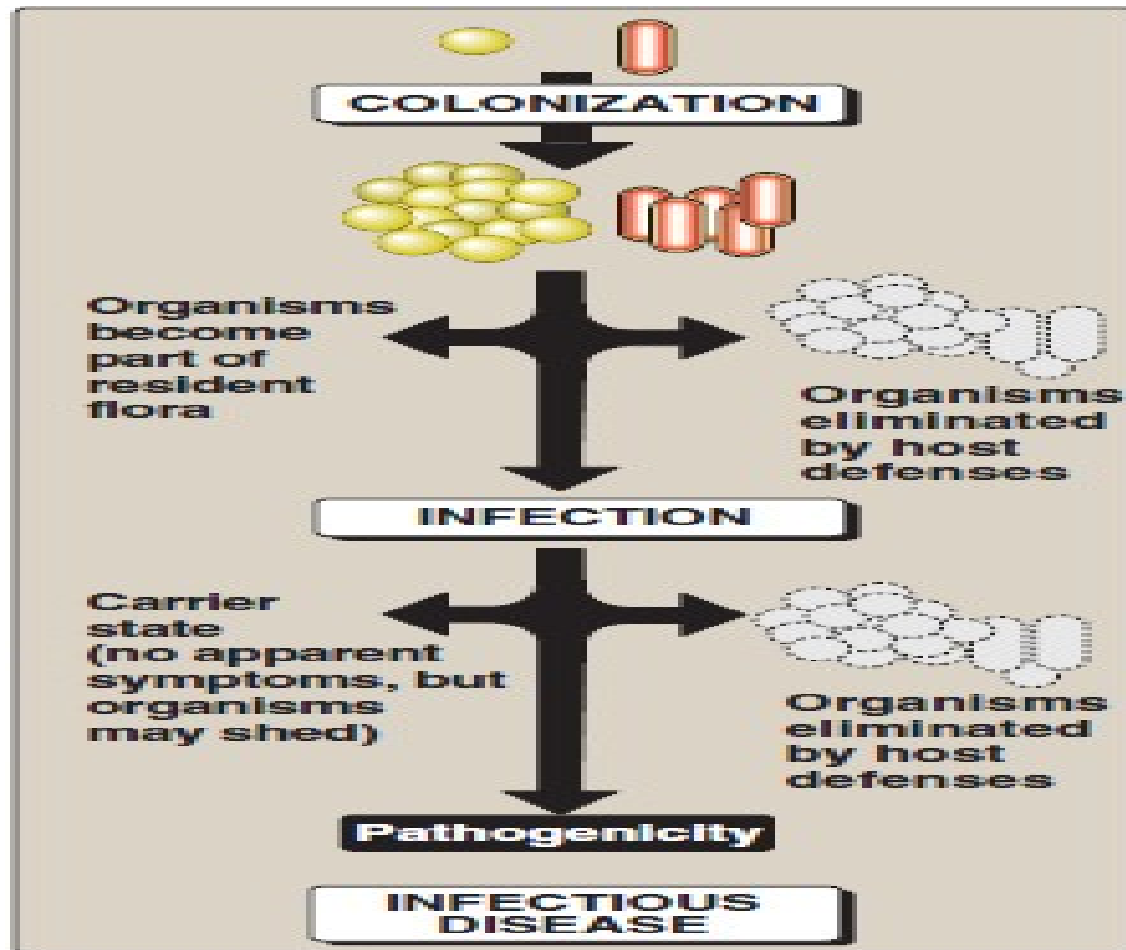


Introduction to microbiology

OVERVIEW

- Microorganisms can be found in every ecosystem and in close association with every type of multicellular organism.
- They populate the healthy human body by the billions as benign passengers (normal flora) and even as participants in bodily functions.
- For example, bacteria play a role in the degradation of intestinal contents.

- In this volume, we primarily consider the role of microorganisms (that is, bacteria, fungi, protozoa, helminths, and viruses) in the initiation and spread of human diseases.
- Those relatively few species of microorganisms that are harmful to humans, either by production of toxic compounds or by direct infection, are characterized as **pathogens**.



PROKARYOTIC PATHOGENS

- All prokaryotic organisms are classified as bacteria, whereas eukaryotic organisms include fungi, protozoa, and helminths as well as humans.
- Prokaryotic organisms are divided into two major groups: the eubacteria, which include all bacteria of medical importance, and the archaeobacteria, a collection of evolutionarily distinct organisms.

Comparison of prokaryotic and eukaryotic cells

CHARACTERISTIC	PROKARYOTIC CELLS	EUKARYOTIC CELLS
Chromosome	Usually single, circular ¹	Multiple
Nucleus	No nuclear envelope or nucleoli	Membrane bound, nucleoli present
Membrane-bound organelles	Not present	Present (examples include mitochondria and endoplasmic reticulum)
Cell wall	Usually present, many contain peptidoglycan	Present in plant cells, no peptidoglycan
Plasma membrane	No carbohydrates, most lack sterols	Sterols and carbohydrates present
Ribosome	70S	80S (70S in organelles)
Average size	0.2–2 mm in diameter	10–100 mm in diameter

Typical bacteria

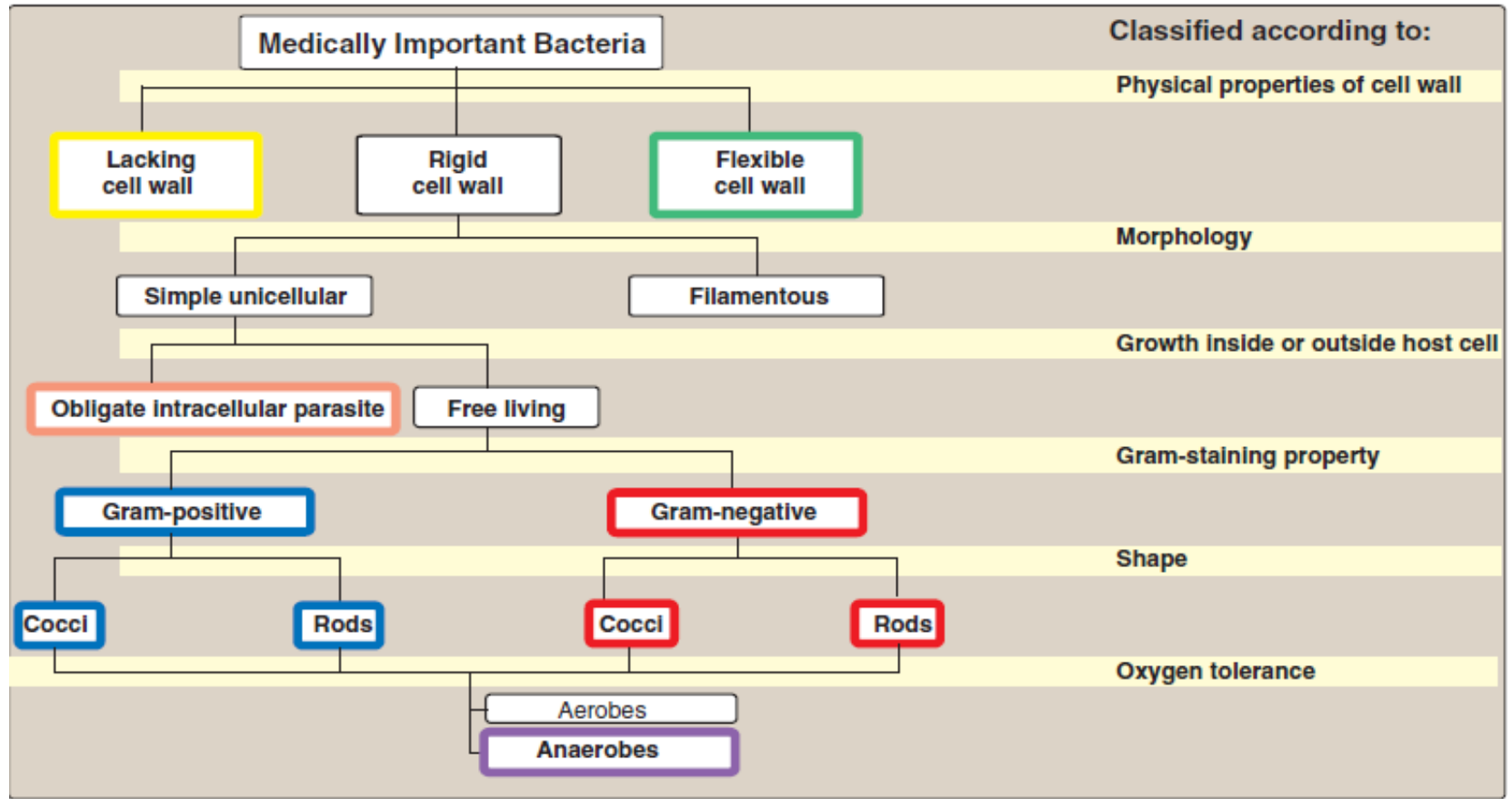
- Most bacteria have shapes that can be described as a rod, sphere, or corkscrew.
- Nearly all bacteria, with the exception of the mycoplasma, have a rigid cell wall surrounding the cell membrane that determines the shape of the organism.

- The cell wall also determines whether the bacterium is classified as gram positive or gram negative.
- External to the cell wall may be flagella, pili, and/or a capsule.
- Bacterial cells divide by binary fission.

- However, many bacteria exchange genetic information carried on plasmids including the information necessary for establishment of antibiotic resistance.

Atypical bacteria

- Atypical bacteria include groups of organisms such as Mycoplasma, Chlamydia, and Rickettsia that, although prokaryotic, lack significant characteristic structural components or metabolic capabilities that separate them from the larger group of typical bacteria.



Normal flora

- The human body is continuously inhabited by many different micro - organisms (mostly bacteria, but also fungi and other microorganisms), which, under normal circumstances in a healthy individual, are harmless and may even be beneficial.
- These microorganisms are termed “**normal flora.**”

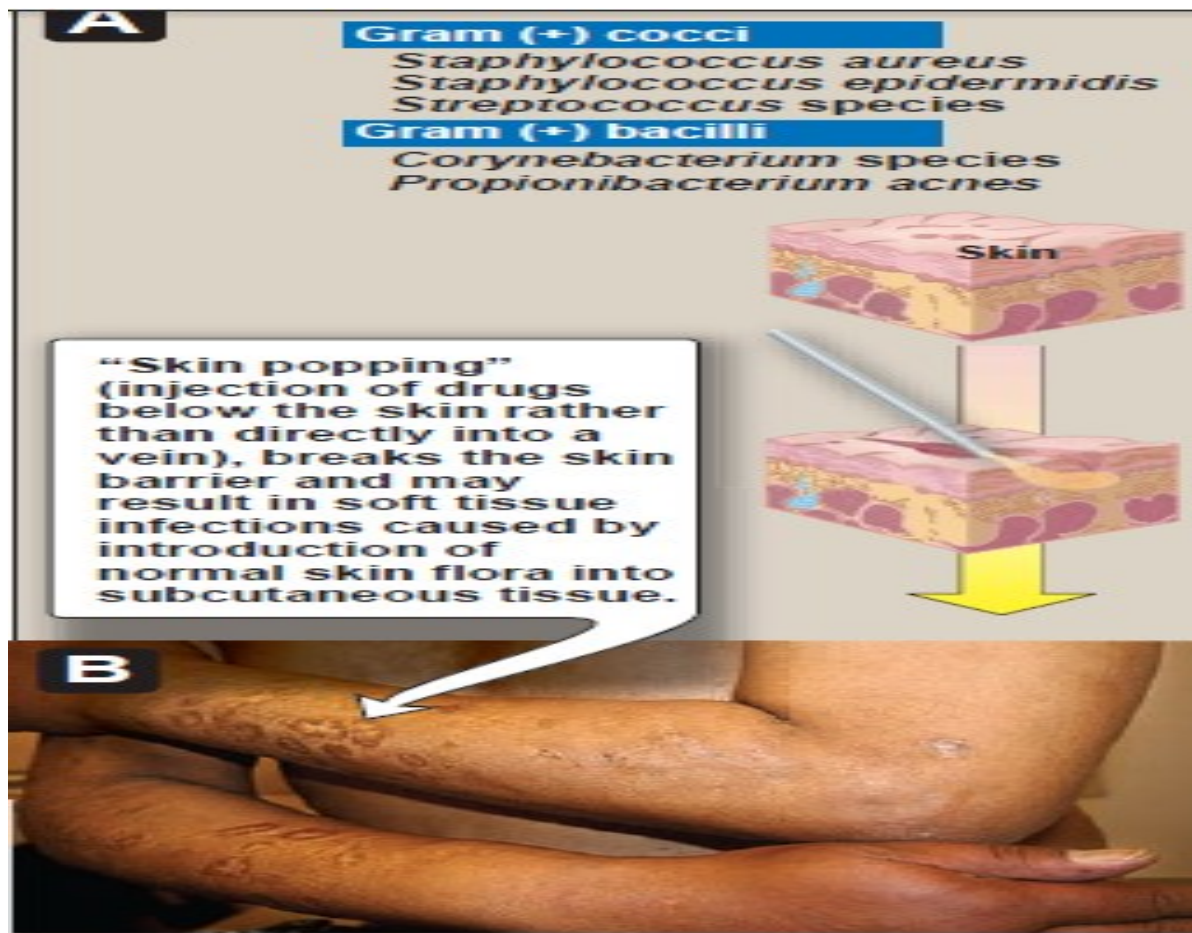
- A healthy newborn enters the world in essentially sterile condition, but, after birth, it rapidly acquires normal flora from food and the environment, including from other humans.

DISTRIBUTION OF NORMAL FLORA IN THE BODY

- The most common sites of the body inhabited by normal flora are, as might be expected, those in contact or communication with the outside world, namely,
 1. the skin,
 2. eye,
 3. and mouth as well as the upper respiratory, gastrointestinal, and urogenital tracts

A. Skin

- Skin can acquire any bacteria that happen to be in the immediate environment, but this transient flora either dies or is removable by washing.
- Nevertheless, the skin supports a permanent bacterial population (resident flora), residing in multiple layers of the skin



- The resident flora regenerate even after vigorous scrubbing

B. Eye

- The conjunctiva of the eye is colonized primarily by *S. epidermidis*, followed by *S. aureus*, aerobic corynebacteria (diphtheroids), and *Streptococcus pneumoniae*.
- Other organisms that normally inhabit the skin are also present but at a lower frequency.
- Tears, which contain the antimicrobial enzyme lysozyme, help limit the bacterial population of the conjunctiva.

C. Mouth and nose

- The mouth and nose harbor many microorganisms, both aerobic and anaerobic.
- Among the most common are
- diphtheroids (aerobic *Corynebacterium* species),
- *S. aureus*, and
- *S. epidermidis*.

D. Intestinal tract

- In an adult, the density of microorganisms in the stomach is relatively low due to gastric enzymes and acidic pH.
- The density of organisms increases along the alimentary canal.
- Bacteroides species constitute a significant percentage of bacteria in the large intestine.

- Escherichia coli, a facultatively anaerobic organism, constitutes less than 0.1 percent of the total population of bacteria in the intestinal tract.
- However, this endogenous E. coli is a major cause of urinary tract infections.

E. Urogenital tract

- The low pH of the adult vagina is maintained by the presence of *Lactobacillus* species, which are the primary components of normal flora.
- If the *Lactobacillus* population in the vagina is decreased (for example, by antibiotic therapy), the pH rises, and potential pathogens can overgrow.

- The most common example of such overgrowth is the yeast-like fungus, *Candida albicans*, which itself is a minor member of the normal flora of the vagina, mouth, and small intestine.

- The urine in the kidney and bladder is sterile but can become contaminated in the lower urethra by the same organisms that inhabit the outer layer of the skin and perineum.

BENEFICIAL FUNCTIONS OF NORMAL FLORA

- Normal flora can provide some definite benefits to the host.
 1. First, the sheer number of harmless bacteria in the lower bowel and mouth make it unlikely that, in a healthy person, an invading pathogen could compete for nutrients and receptor sites.

2. Second, some bacteria of the bowel produce antimicrobial substances to which the producers themselves are not susceptible.
3. Third, bacterial colonization of a newborn infant acts as a powerful stimulus for the development of the immune system.
4. Fourth, bacteria of the gut provide important nutrients, such as vitamin K, and aid in digestion and absorption of nutrients.

HARMFUL EFFECTS OF NORMAL FLORA

- Clinical problems caused by normal flora arise in the following ways:
 - 1) The organisms are displaced from their normal site in the body to an abnormal site.
 - 2) Potential pathogens gain a competitive advantage due to diminished populations of harmless competitors.

3) When individuals are immunocompromised, normal flora can overgrow and become pathogenic.