

بِسْمِ اللَّهِ الرَّحْمَنِ الرَّحِيمِ



(MBBS, MPhil, Ph.D, CHPE)

Aims and Objectives

At the end of the session the students of 3rd Year MBBS should be able to

1. Describe various phases of bacterial growth curve. # 91
2. Describe medically important members of normal flora and their anatomic location. # 92

Binary fission

- The process of multiplication in which the parent bacterial cell divides to form two progeny cells.

□ exponential (logarithmic) growth (2^n)

Exponential	2^0	2^1	2^2	2^3	2^4	2^5	2^6
# of cells	1	2	4	8	16	32	64

The doubling time (generation time) is the time between bacterial division,

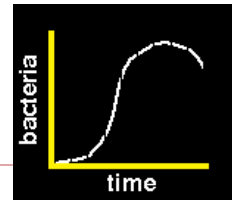
Bacterial Growth

1. Exponential (log) growth □ binary fission,
2. Multiplication rate depends on temperature (max 37°C)
3. It is energy dependent process,
4. varies with bacterial species.
5. depends upon
 - a. amount of nutrition available,
 - b. pH,
 - c. temperature,
 - d. amount of waste products present &
 - e. other environmental factors

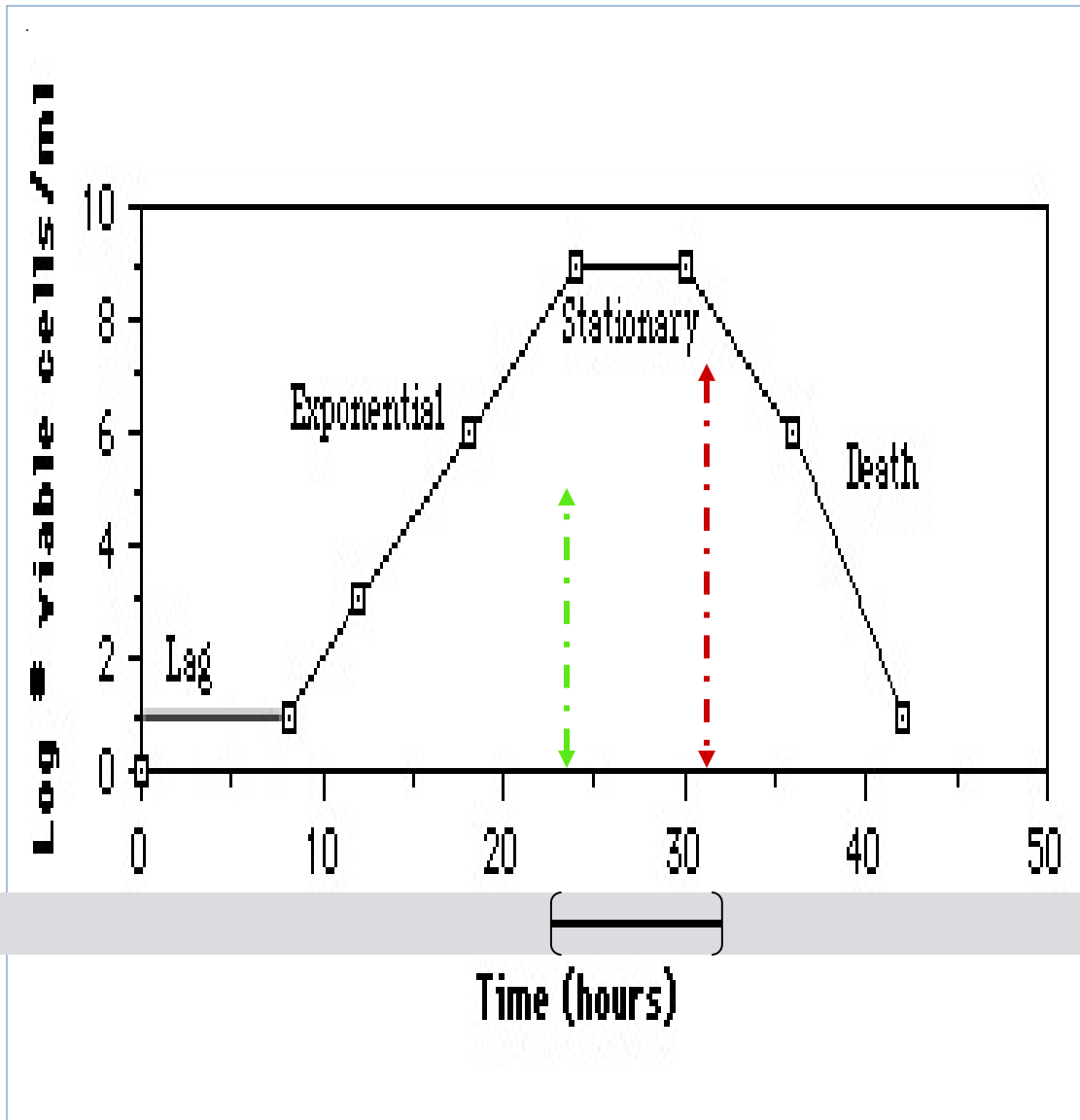
- The doubling time (generation time) ranges from about 20 minutes (most pathogens) to 24 hours (18 hrs for *M. tuberculosis* while 33 hrs for *T. pallidum*).

Phases of Growth

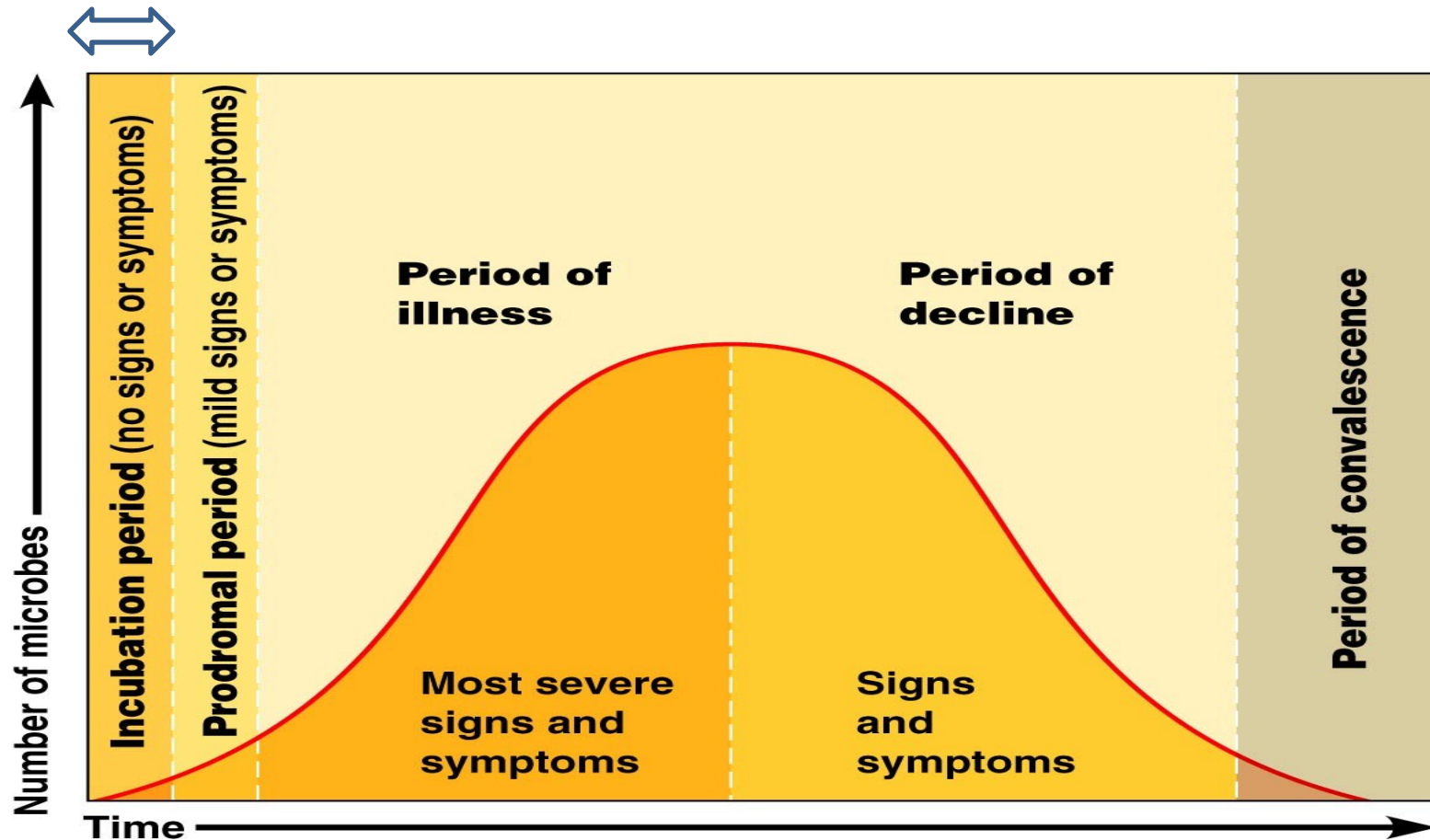
The growth cycle of bacteria has four major phases.



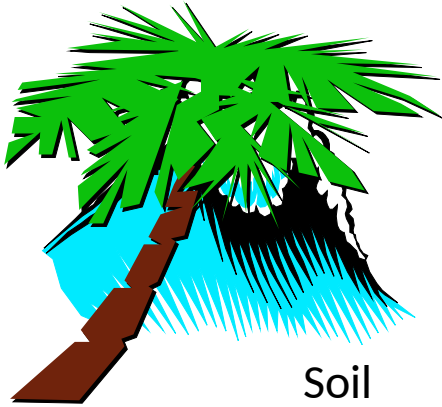
- **Lag Phase:** This is the period when bacteria make adjustment/adaption to the new conditions. There is vigorous metabolic activity but cell does not divide.
- **Exponential or logarithmic Phase.** Very rapid bacterial growth occur during this phase.
- **Stationary phase:** In this phase the nutrients are exhausted or toxic products accumulate in the medium, that cause growth to slow until the number of new cells produced balances the number of cells that die, resulting in a steady state.
- **Phase of decline or death:** Bacterial autolysis and death.



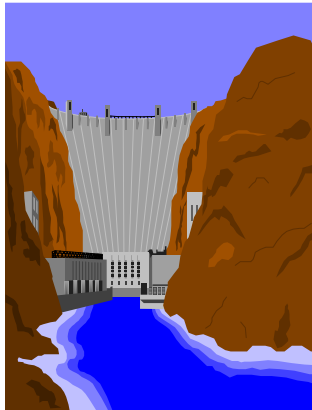
Incubation period- time interval between initial infection and the first appearance of any signs or symptoms



MICROORGANISMES IN THE ENVIRONMENT



Soil
Air
Water
Food



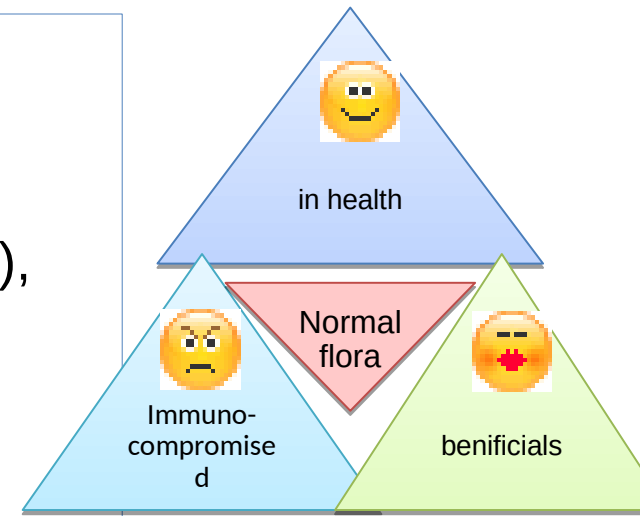
Normal Flora
= Commensal flora

- 10^{13} cells are of human origin.
- 10^{14} are **commensal flora**

Normal flora

- ❑ Normal flora is frequently found in particular anatomic sites in healthy individuals. It is stable in health.
- ❑ This microbial flora is associated with the skin, mucous membrane from shortly after birth until death,
- ❑ Relatively stable; but varies with the body site, age (pH and hormonal changes), physiologic differences , geographic habitat, working circumstances, nutritional status and antimicrobial therapy
- ❑ Under normal circumstances in a healthy person it is harmless & even beneficial but can cause serious infections if they enter sterile body sites (peritonitis if gain access to peritoneal cavity), or if immunity is compromised.

- These microorganisms may
 - Produce bacteriocins (antimicrobial substances),
 - Reduce pH at the site (*Lactobacillus* in female genital tract)



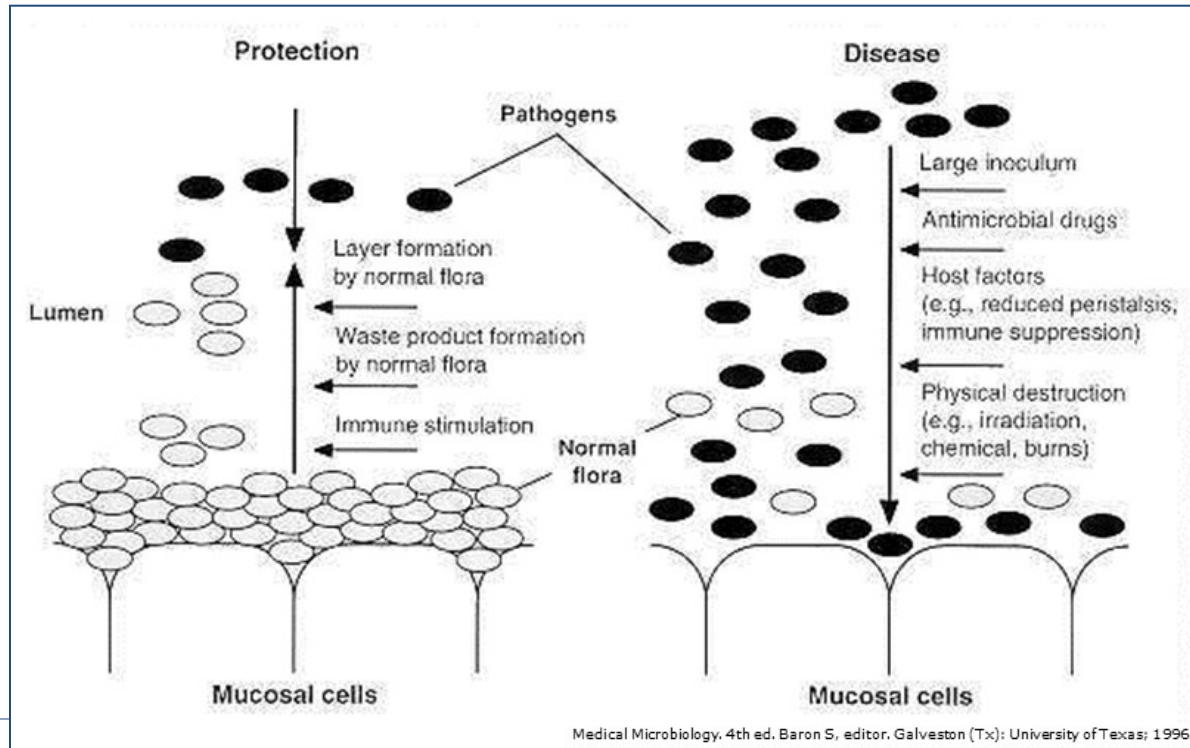
☐ gut flora aid the host in

- fermenting unused energy substrates,
- training the immune system,
- preventing growth of harmful, pathogenic bacteria,
- producing vitamins for the host (such as biotin and vitamin K), and producing hormones to direct the host to store fats.



Medical Microbiology. 4th ed. Baron S, editor. Galveston (Tx): University of Texas; 1996.

NF protects individuals from pathogens by competing for microenvironment or nutrients

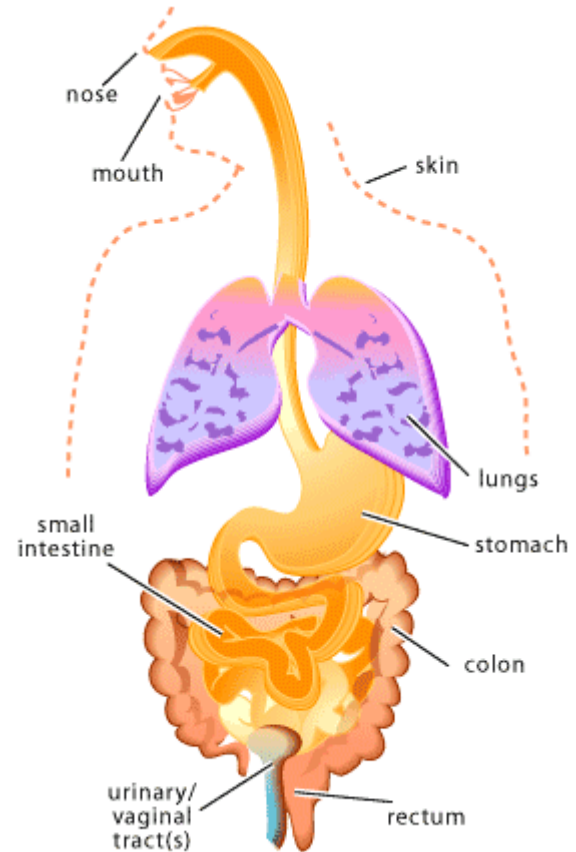


- ❑ Normally, about 10^6 organisms are needed to establish an infection of *Salmonella*, but in streptomycin-treated animals whose flora is altered, and then fewer than 10 organisms cause infection.
- ❑ Moreover fermentation products of the normal flora (acetic and butyric acids) inhibit the growth of *Salmonella* in the gastrointestinal tract.

Normal flora of oral cavity:

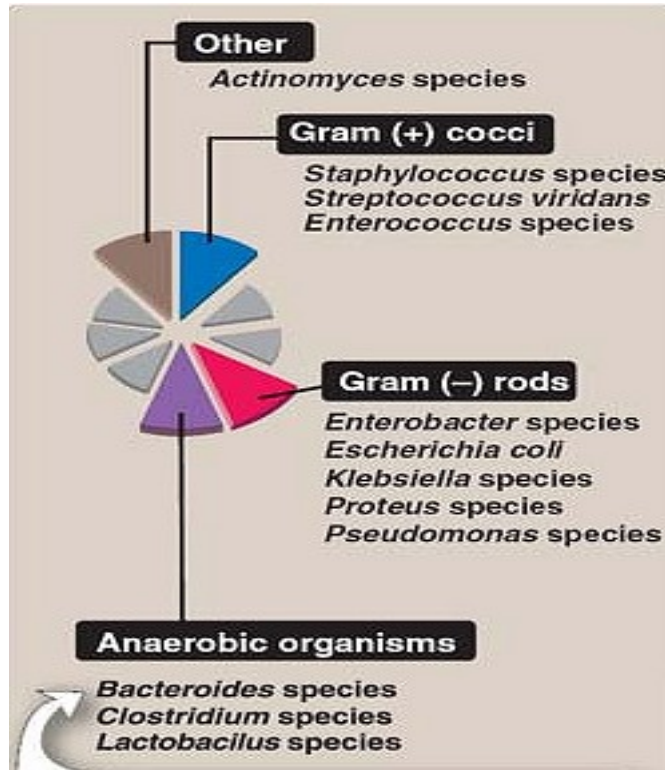
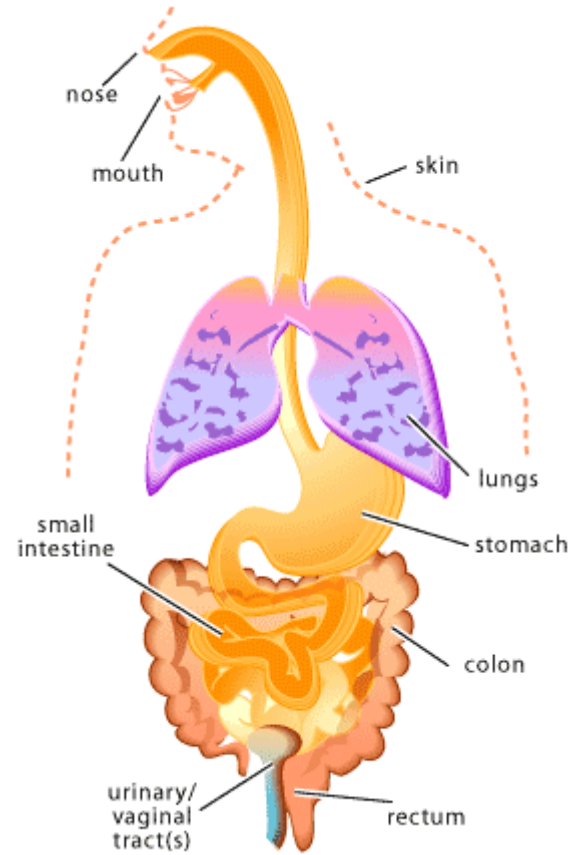
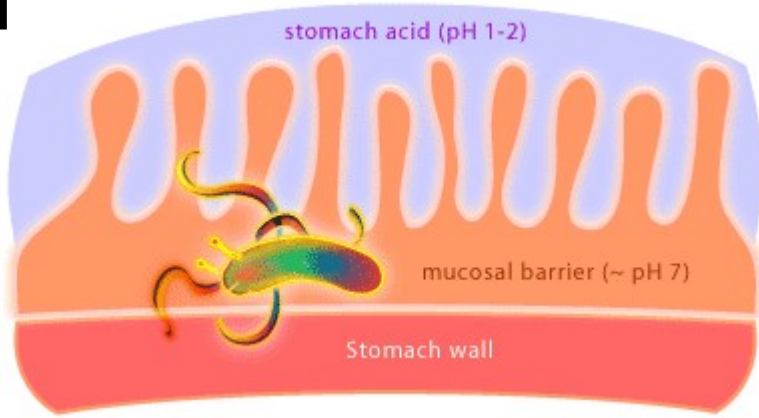
- *Streptococci viridans*, *S. mutans*
- *Lactobacilli*,
- *Staphylococci aureus / epidermidis*,
- *Corynebacteria*, and *Neisseria spp.*
- various anaerobes in particular bacteroides.
- *Actinomyces*

- The pharynx and trachea contain primarily
 - α -and β -hemolytic streptococci;
 - anaerobes,
 - *Staphylococci aureus / epidermidis*,
 - *Neisseria sp*,
 - diphtheroids,
- In contrast, the lower respiratory tract is usually sterile,

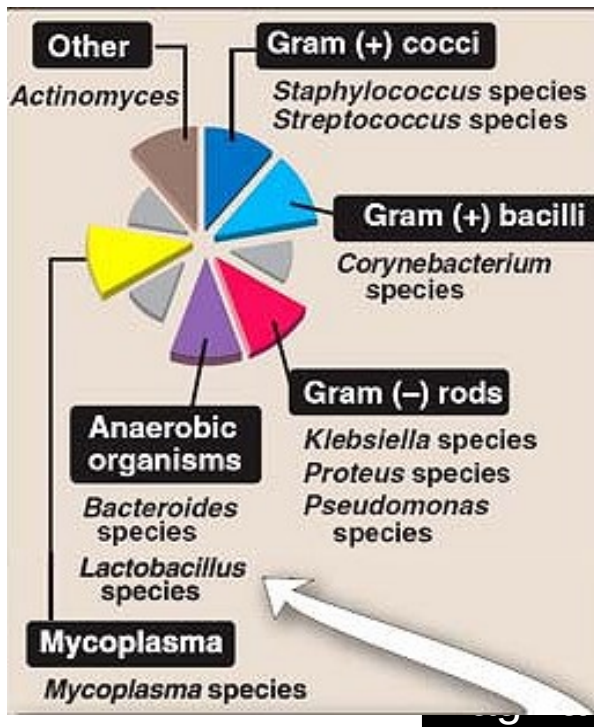
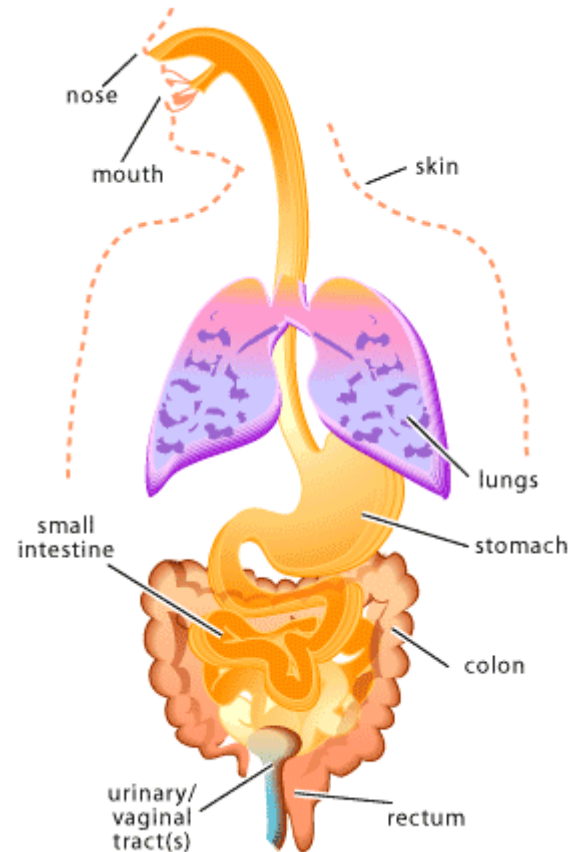


GIT

H pylori



- In the anterior urethra,
 - *Acinetobacter*
 - *Mycob smegmatis*
 - *Mycoplasma*
 - *Candida*



Skin Flora

- *Micrococci* ,
- *S. epidermidis*
- Non-hemolytic *Streptococci*,
- *Enterococci*,
- *diphtheroids (Corynebacteria)* &
- *Propionibacterium acne*
- **Yeast and fungi**

Nose

Staphylococcus aureus
Staphylococcus epidermidis
Corynebacterium species

Throat

Streptococcus species
Branhamella catarrhalis
Corynebacterium species
Haemophilus species
Neisseria species
Mycoplasma species

Large intestine

Bacteroides fragilis
Escherichia coli
Proteus mirabilis
Klebsiella species
Lactobacillus species
Streptococcus species
Candida albicans
Clostridium species
Pseudomonas species
Enterococcus species

Mouth

Streptococcus species
Fusobacterium species
Actinomyces species
Leptotrichia species
Veillonella species

Skin

Staphylococcus epidermidis
Propionibacterium acnes
Pityrosporum ovale

Vagina

Lactobacillus species
Streptococcus species
Candida albicans
Gardnerella vaginalis

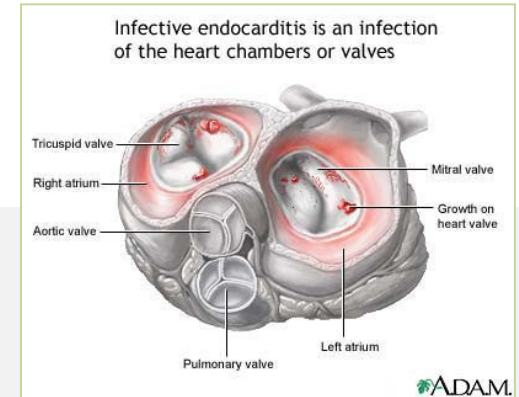
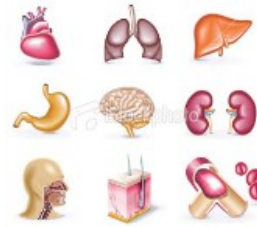
Urethra

Streptococcus species
Mycobacterium species
Escherichia coli
Bacteroides species

Harmful effect of Normal flora

Internal organs & systems: □ sterile

(spleen, pancreas, liver, bladder, CNS, & blood).



1. When organisms are displaced from their normal site □ pathogenic,

- *S. epidermidis* (Skin) → blood → colonizes catheters & heart valves
→ bacterial endocarditic

2. When potential pathogen gains competitive advantage due to diminished population of harmless competitors of NF

- by antibiotic therapy → promotes overgrowth of resistant *Clostridium difficile* □ severe colitis.

3. When harmless food substances are converted into carcinogen by the gut flora in colon

- conversion of the sweetener cyclamate into the bladder carcinogen-cyclohexamine by bacterial enzymes .

4. In immuno-compromised □ normal flora overgrows □ and becomes pathogenic (opportunists).

Thank
you

