جامعة الملك سعود
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Normal Flora

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Objectives

1. Define the terms: *Normal Flora, Resident flora, Transient flora* and carrier state
2. Know the origin of normal flora.
3. Know the effects and importance of normal flora eg.:
   A. Source of opportunistic infection.
   B. Immunostimulation.
   C. Nutrition: Vitamins production.
   D. Production of Carcinogens.
   E. Protection against external invaders.

Objectives, cont,.

4. Know areas of the body with normal flora (gastrointestinal tract, urogenital tract, and skin) , most common types of organisms and its relation to pathogenicity.
5. Know the sites of the body with no normal flora eg. sterile body sites and the importance of this fact in relation to interpretation of culture results.

Introduction

- **Normal flora** are population of **microorganisms** that are frequently found in the skin , mucous membrane and other particular sites in normal healthy individual.
- Some are found in association with humans and animals. The Majority are bacteria.
- Symbolic relationship (**symbiosis**): close association with the host.
- Subject to constant changes.
- Altered by antimicrobial agents.

Types of Normal Flora

- **Commensals:** Microorganisms that have natural relationship with the host. Found in low number and has no benefit or harm . Mainly associated with the GIT.
- **Residents** : Consist of relatively fixed types of microorganisms . Regularly found in a given area at invariable period. If disturbed promptly re-establish itself .

Types of Normal Flora-cont.

- **Transients** : Consist of **nonpathogenic** or **potential pathogenic** microorganisms that inhabit the skin or mucous membrane for hours or days.
- Transient organisms living in the external environment are attracted to moist and warm body sites.
- Excluded by host defense or competition from resident flora.

Transient flora- cont.,

Exist temporarily for the following reasons:

- They are washed by hand wash or bathing
- Competition by resident flora
- Killed by substances produced by resident flora
- May not survive in acidic or alkaline PH of the body site
- May be flushed away by body secretions like tears, sweat, oil urine,feces.

- **Carrier state:**

Potentially pathogenic bacteria that are carried by the individual without causing disease. However, it is the source of infection to other susceptible (non-immune) individual.

Examples: ***Neisseria meningitides*** and ***Streptococcus pneumoniae*** in the throat of healthy individual .

Origin of Normal Flora

- Newborn is sterile in uterus.
- After birth , newborn exposed to the flora of mother's genital tract, skin, respiratory tract flora of individuals handling him and the organisms in the environment.

Beneficial Effects of Normal Flora

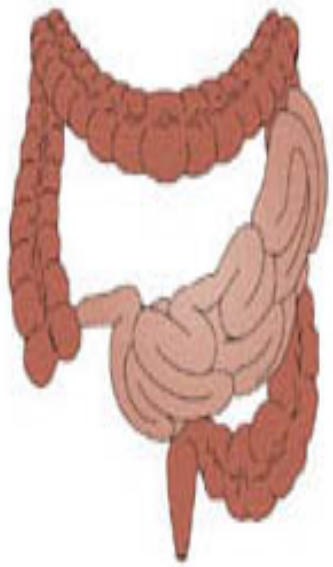
1- **Immunostimulation** (*antibody production*)

2- **Exclusionary effect** (*vacuum effect*) and protection from external invaders.

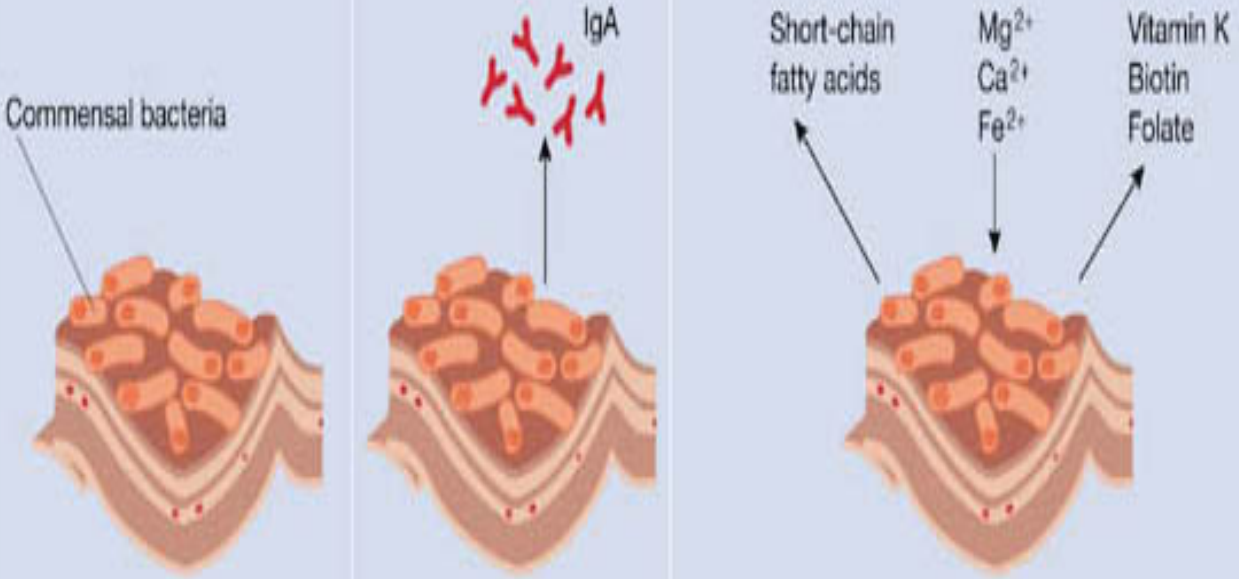
3- **Antagonize** other bacteria through the production of substances (toxin) that inhibit or kill non-indigenous bacteria.

4-**Production of essential nutrients** (Vitamin K & B) by some normal intestinal flora eg. *E.coli*

5-others (see diagram)



Protective functions	Structural functions	Metabolic functions	
Pathogen displacement	Barrier fortification	Control IEC differentiation and proliferation	Ferment non-digestible dietary residue and endogenous epithelial-derived mucus
Nutrient competition	Induction of IgA	Metabolize dietary carcinogens	Ion absorption
Receptor competition	Apical tightening of tight junctions	Synthesize vitamins e.g., biotin, folate	Salvage of energy
Production of anti-microbial factors e.g., bacteriocins, lactic acids	Immune system development		



Facts About Normal Flora

- May be a **source of** **opportunistic infections** in patients with impaired defense mechanisms. eg. *Staphylococcus epidermidis* and *E.coli*.
- Some may **cross react with normal tissue** components ,eg. antibodies to various ABO group arise because of cross reaction between intestinal flora and the antigens of A & B blood substances.

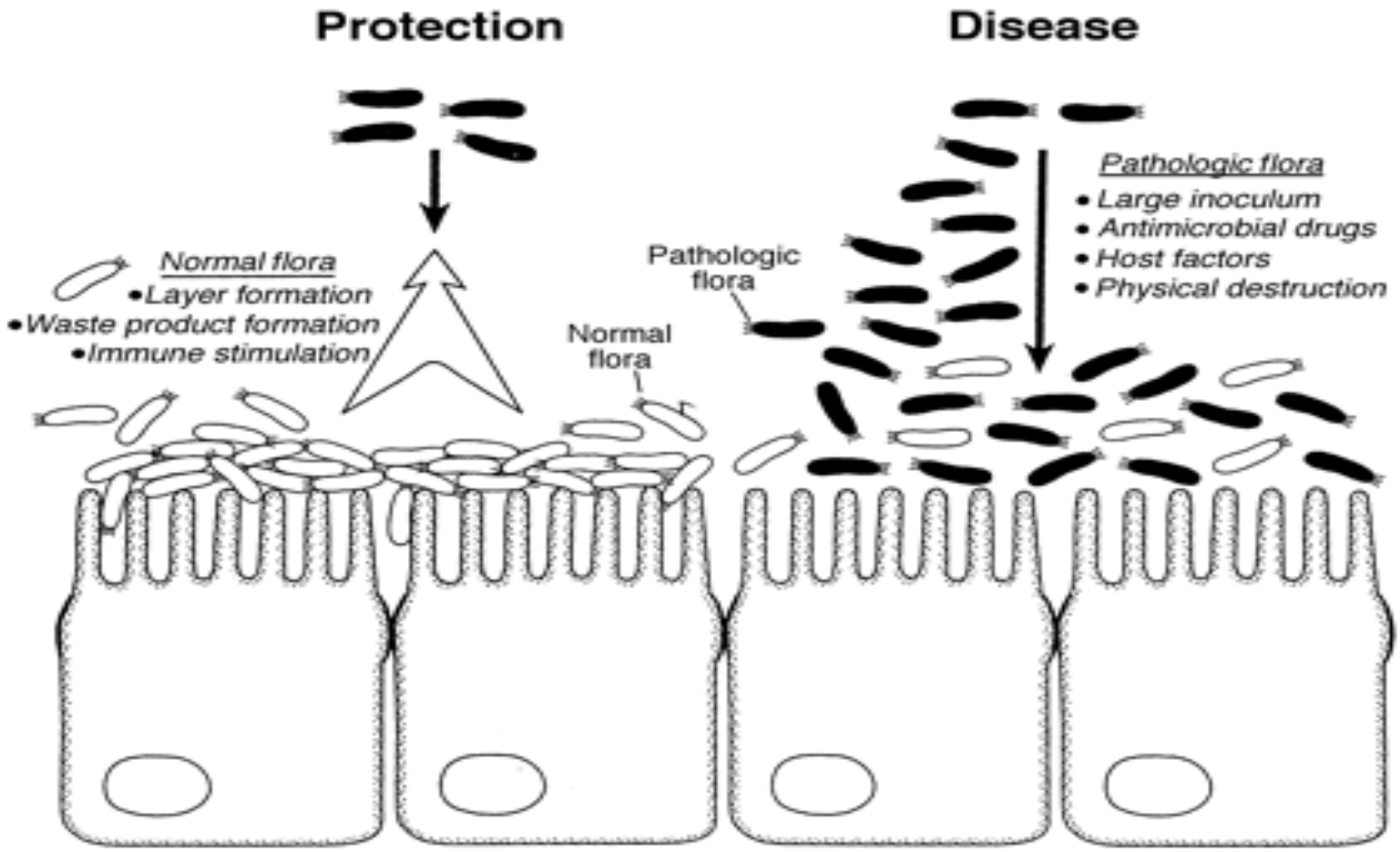
Facts About Normal Flora

- **Production of Carcinogens:**

  Some normal flora may modify through their enzymes chemicals in our diets into carcinogens. eg. artificial sweeteners may be enzymatically modified into bladder carcinogens.

- **Normal flora affected by :** antibiotics, tissue damage, mechanical procedures and diet change.

Normal Flora *vs* Pathogenic Flora



True vs. Opportunistic Pathogen

True pathogen

- Causes disease in healthy individuals
- Associated with a specific and recognizable disease

Opportunistic pathogen

- Causes disease in immune compromised host
- Gain access (injury) to sterile regions

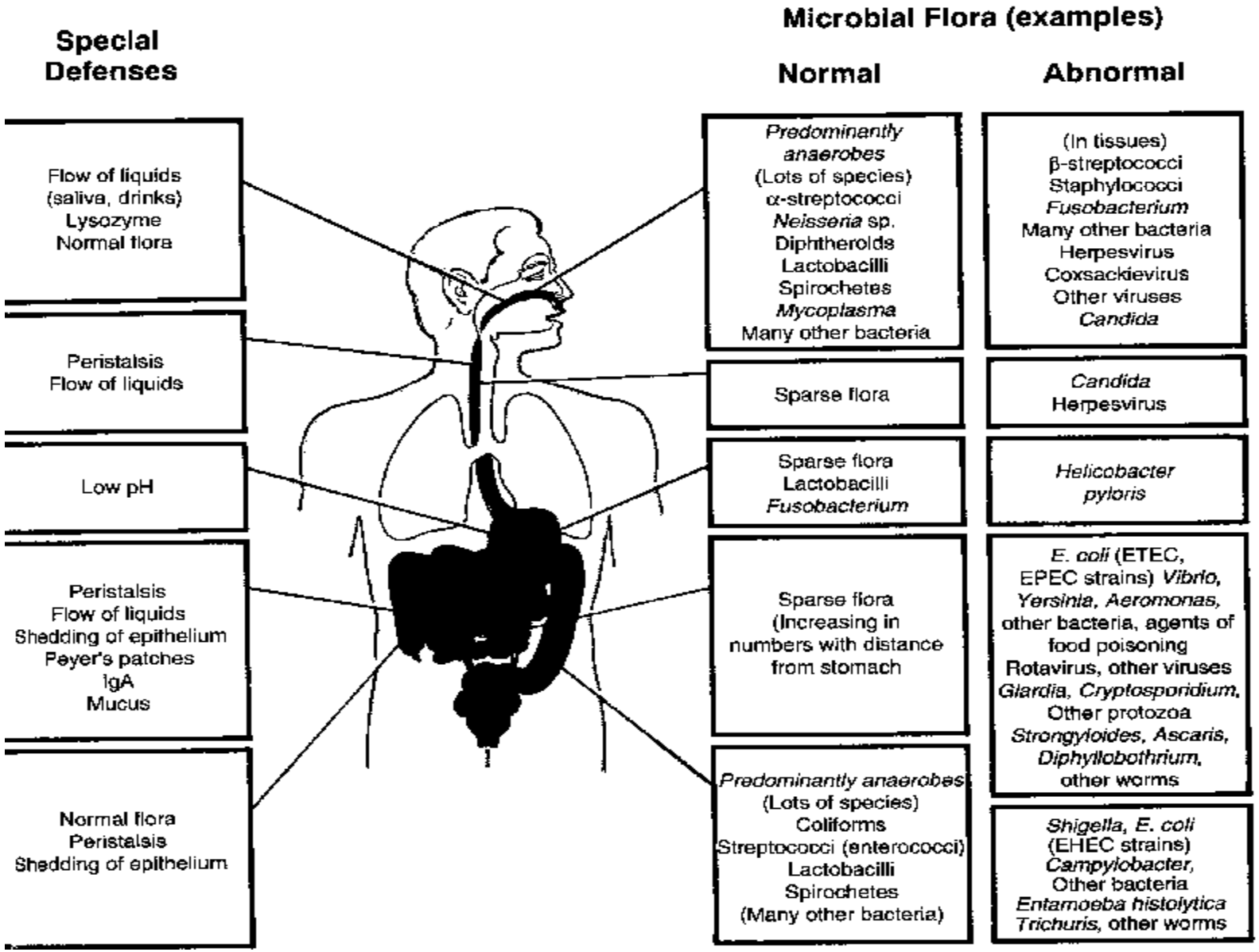
Distribution of Normal Flora

- **Normal flora found on external body sites**
- **Internal organs are sterile at health (*except the gastrointestinal tract*) .**
- **Sterility of internal organs maintained by :**

~ Local defense mechanisms

~ Chemical substances in serum & tissues eg. complement and antibodies.

~Phagocytic activity of Polymorphonuclear monocytes.


Special Defenses
Microbial Flora (examples)
Normal
Abnormal
Flow of liquids (saliva, drinks) Lysozyme Normal flora
Predominantly anaerobes (Lots of species) α-streptococci Neisseria sp. Diphtheroids Lactobacilli Spirochetes Mycoplasma Many other bacteria
(In tissues) β-streptococci Staphylococci Fusobacterium Many other bacteria Herpesvirus Coxsackievirus Other viruses Candida
Peristalsis Flow of liquids
Sparse flora
Candida Herpesvirus
Low pH
Sparse flora Lactobacilli Fusobacterium
Helicobacter pyloris
Peristalsis Flow of liquids Shedding of epithelium Peyer's patches IgA Mucus
Sparse flora (Increasing in numbers with distance from stomach
E. coli (ETEC, EPEC strains) Vibrio, Yersinia, Aeromonas, other bacteria, agents of food poisoning Rotavirus, other viruses Giardia, Cryptosporidium, Other protozoa Strongyloides, Ascaris, Diphyllobothrium, other worms
Normal flora Peristalsis Shedding of epithelium
Predominantly anaerobes (Lots of species) Coliforms Streptococci (enterococci) Lactobacilli Spirochetes (Many other bacteria)
Shigella, E. coli (EHEC strains) Campylobacter, Other bacteria Entamoeba histolytica Trichuris, other worms

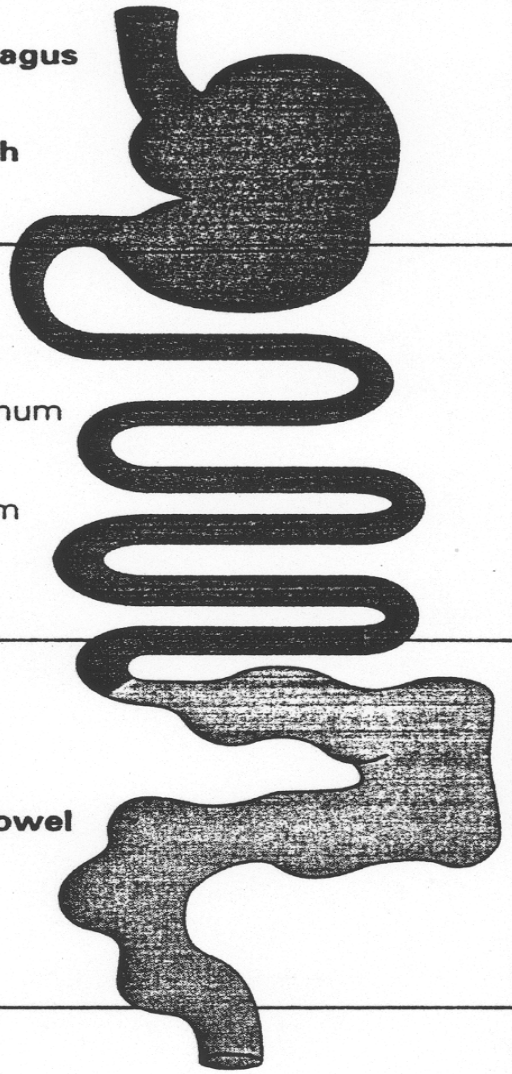
Body sites with normal flora

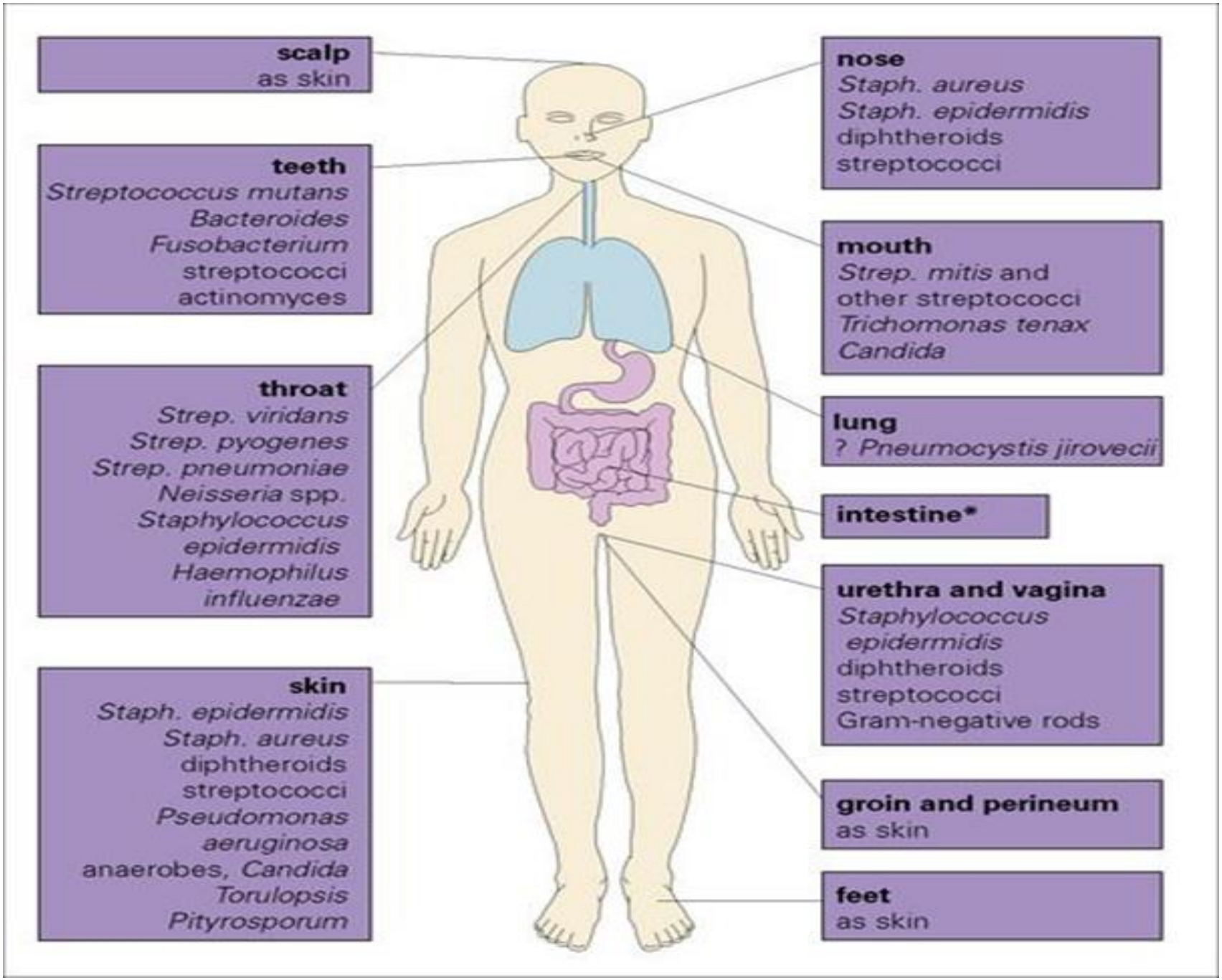
All external body sites contain normal flora:

- Gastro intestinal tract : mouth & large colon
- Urogenital tract: vagina & distal one third of the urethra.
- Skin (including external ear & conjunctiva)

DISTRIBUTION AND FREQUENCY OF BACTERIA IN THE INTESTINE

density	frequency of occurrence in population
oesophagus **stomach**	lactobacilli
small bowel duodenum	lactobacilli streptococci
jejunum ileum	Enterobacteria *Bacteroides* spp.
large bowel	*Bacteroides* spp. *Fusobacterium* spp. *E. faecalis* *Escherichia coli* Enterobacteria *Klebsiella* spp. Eubacteria Bifidobacteria
	Lactobacillus *Staph. aureus* *Clostridium* spp Streptococci *Pseudomonas* *Salmonella*
faecal material	*Bacteroides* spp. Bifidobacteria Eubacteria Coliforms *E. faecalis*




scalp
as skin
teeth
Streptococcus mutans
Bacteroides
Fusobacterium
streptococci
actinomyces
throat
Strep. viridans
Strep. pyogenes
Strep. pneumoniae
Neisseria spp.
Staphylococcus epidermidis
Haemophilus influenzae
skin
Staph. epidermidis
Staph. aureus
diphtheroids
streptococci
Pseudomonas aeruginosa
anaerobes, Candida
Torulopsis
Pityrosporum
nose
Staph. aureus
Staph. epidermidis
diphtheroids
streptococci
mouth
Strep. mitis and other streptococci
Trichomonas tenax
Candida
lung
? Pneumocystis jirovecii
intestine*
urethra and vagina
Staphylococcus epidermidis
diphtheroids
streptococci
Gram-negative rods
groin and perineum
as skin
feet
as skin

Normal flora of the respiratory tract

- Upper respiratory tract colonized by normal flora as in the mouth & nasopharynx
- Lower respiratory tract is sterile
- Common nose flora :

~ *Staphylococcus epidermidis*

~ *Staphylococcus aureus*

~*Corynebacterium species*

Normal flora of the oropharynx

- **Viridans streptococci**
- Commensal Neisseriae
- Corynebacteria
- Bacteroides
- Fusobacteria , Veillonella, Actinomyces, Spirochaetes.
- ***Heamophilus inflenzea & Pneumcoccus*** **are potential pathogens.**
- **Less common potential pathogens :** ***Streptococcus pyogenes and Neisseria meningitidis***

Normal flora of the GIT

- Saliva contains 10^8 bacteria/ml
- Gingival margin debris & dental Plaque continually colonized by bacteria.
- Oesophagus normal flora similar to pharyngeal flora.
- **Empty stomach sterile due to gastric acid.**
- **Duodenum, jejunum& upper ileium contain scanty flora**
- **Large intestine heavily colonized by bacteria.**

Feces (Stool)

- 1/3 of feces weight is bacteria , mainly dead.
- Living bacteria about 10^{10}/gm
- **99% anaerobes**
- Anaerobic environment maintained by aerobic bacteria utilizing free O2.
- ***Bacteroides fragilis*** group is the dominant anaerobes, Bifidobacteria , Lactobacilli…etc.
- **Less common aerobics: *E.coli*** ,*Proteus*,….etc.

Normal flora of the genital tract

- Female genital tract heavily colonized , why ?
- 10^8/ml flora in normal vaginal secretion.
- **In both sexes *Mycobacterium smegmatis* in secretions which contaminate urine and leads to confusion and misdiagnosis of tuberculosis.**
- Male & Female distal urethra:
  - *Staphylococcus epidermidis*
  - Corynebacteria
  - *Mycoplasma species*

Normal flora of the female Genital tract

- **Vulva** : *S. epidermidis , Corynebacteria, E.coli* and other coliforms & *Enterococcus faecalis*.
- **Vagina :**

~Lactobacillus (Doderlein's bacilli)

~ *Bacteroides melaninogenicus*

~*Enterococcus faecalis*

~ Corynebacteria

~*Mycoplasma*

~ Yeasts.

Normal flora of the skin

- Skin has rich resident bacterial flora($10^4/cm^2$).
- Exist as microcolonies.
- Anaerobic organisms predominate in areas with sebaceous glands.
- Moist skin often colonized by coliforms (Gram negative bacteria).

Skin Flora

Resident organisms

- In deeper layers of skin
- Permanent flora
- If disturbed reestablish themselves
- Not removed by routine hand wash
- Usually not associated with transmission of infection

Transient organisms

- In superficial layers of skin
- Temporary flora
- Usually do not reestablish themselves
- Easily removed by routine hand wash
- Usually associated with transmission of infection

Main skin flora:

- *Staphylococcus epidermidis*
- *Propionibacterium acnes*
- Anaerobic cocci
- Corynebacteria
- *Staphylococcus aureus* (potential pathogen)
- Coliforms

Normal flora of the external auditory meatus

External ear has the following normal flora:

- *S. epidermidis*
- Corynebacteria
- Acid fast bacilli (AFB) (occasionally in wax).

Middle and inner ear are sterile.

Normal flora of the conjunctival sac

Conjunctiva has normal flora eg.

- *Corynebacterium xerosis*
- *Staphylococcus epidermidis*

Internal eye is sterile.

Reference book

- ***Sherris*** **medical microbiology** , an introduction to infectious diseases.

Kenneth Ryan/George Ray. Latest edition .
Publisher : McGrew Hill.