



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. The 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 bodily secretions like tears, sweat, oil urine, feces, ..etc.

- **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.

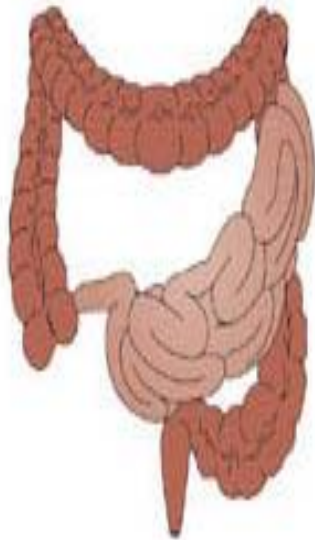
Examples: *Neisseria meningitides* and *Streptococcus pneumoniae* in the throat of healthy individual .

Origin of Normal Flora

- **Newborn is sterile in uterus.**
- **After birth , newborn is exposed to 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. *Eschericia coli (E.coli)*.



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		

Commensal bacteria

IgA

Short-chain fatty acids

Mg²⁺
Ca²⁺
Fe²⁺

Vitamin K
Biotin
Folate

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.

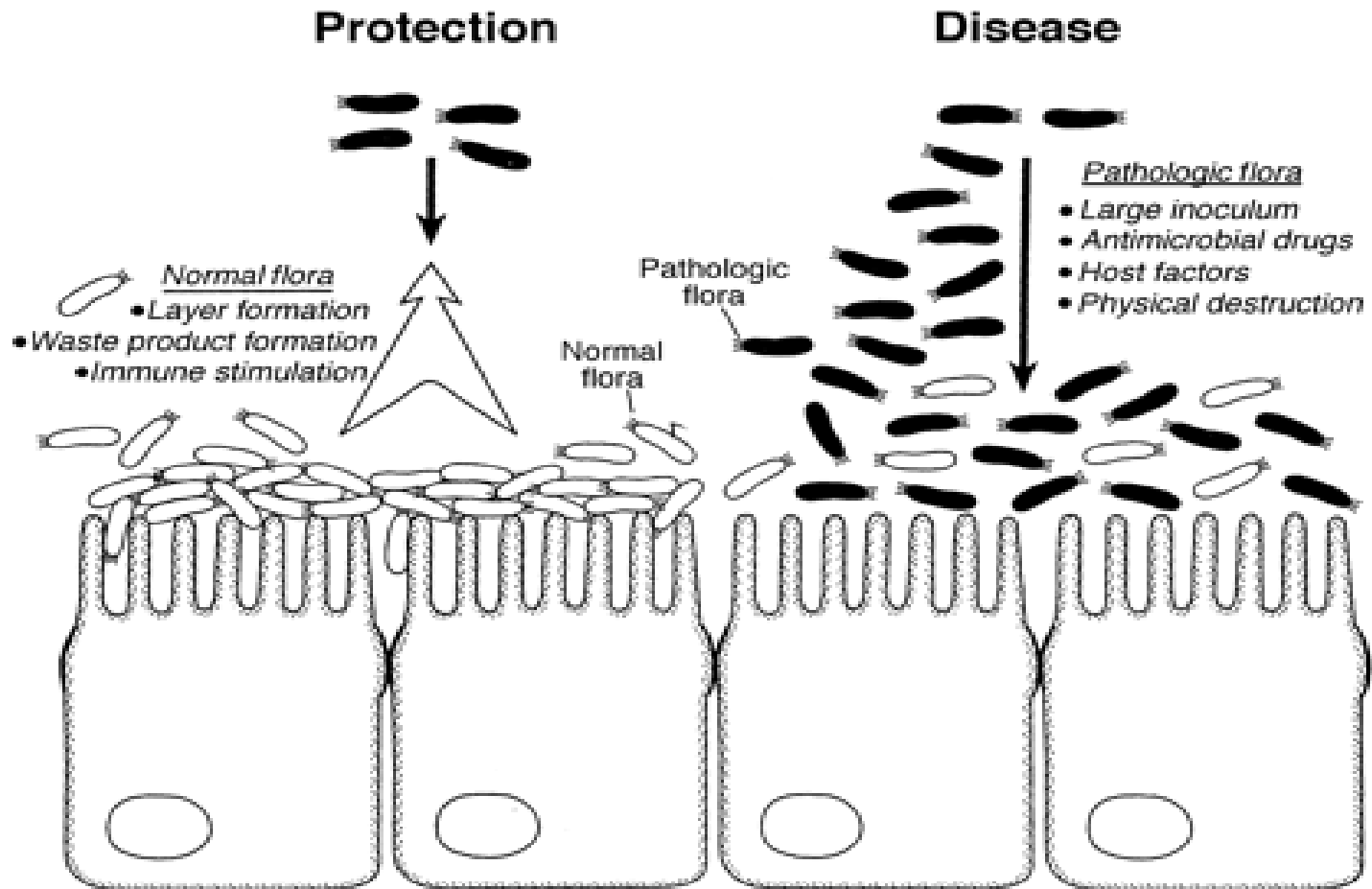
Facts About Normal Flora-cont.,

- **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.

- **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

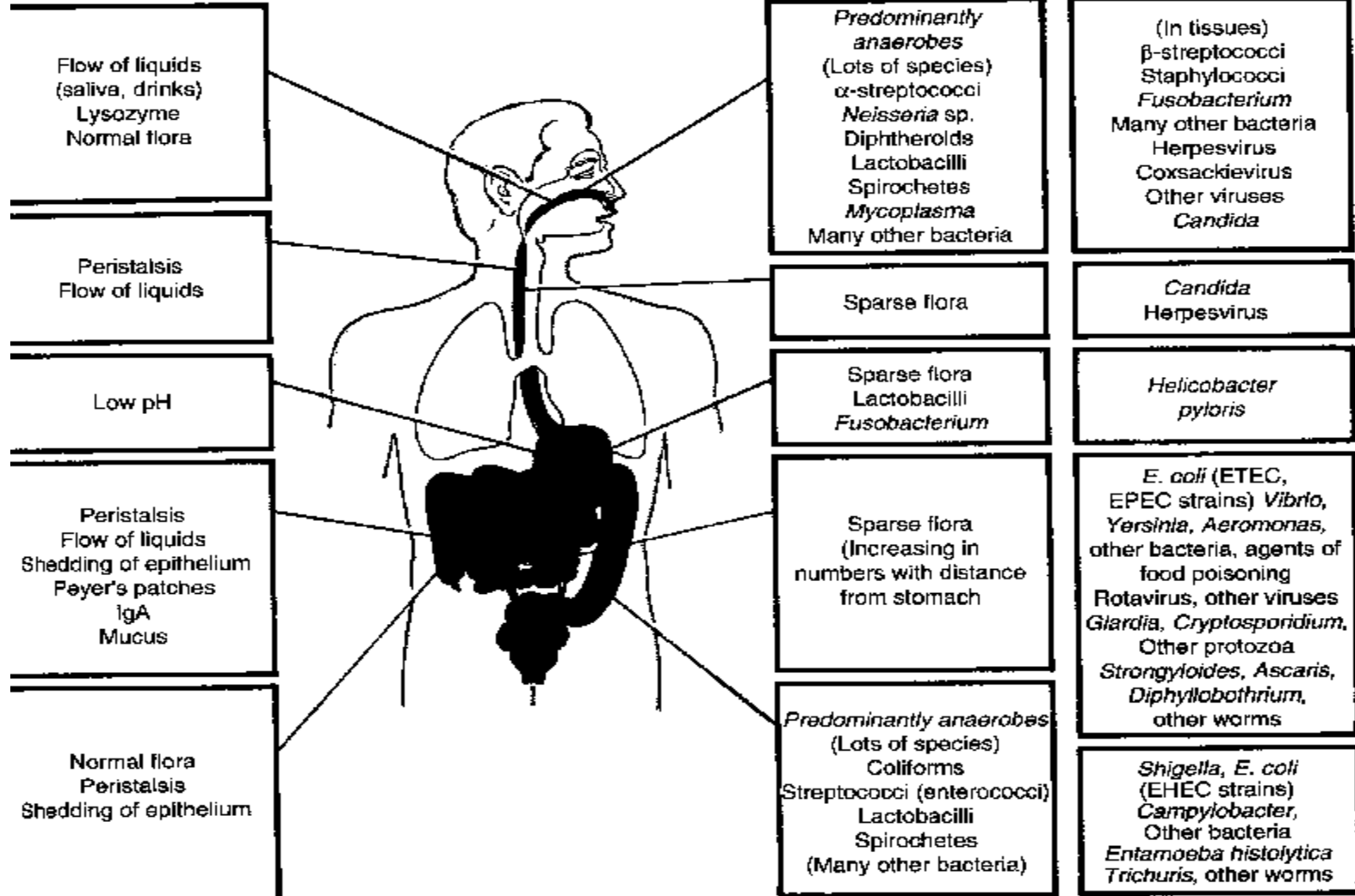
- Normal flora found on external body sites
- Internal organs are sterile at health (*except the Gastrointestinal tract*).
- Sterility of internal organs maintained by :
 - Local defense mechanisms
 - Chemical substances in serum & tissues eg. Complement and antibodies.
 - Phagocytic activity of Polymorphnuclear Monocytes.

Special Defenses

Microbial Flora (examples)

Normal

Abnormal

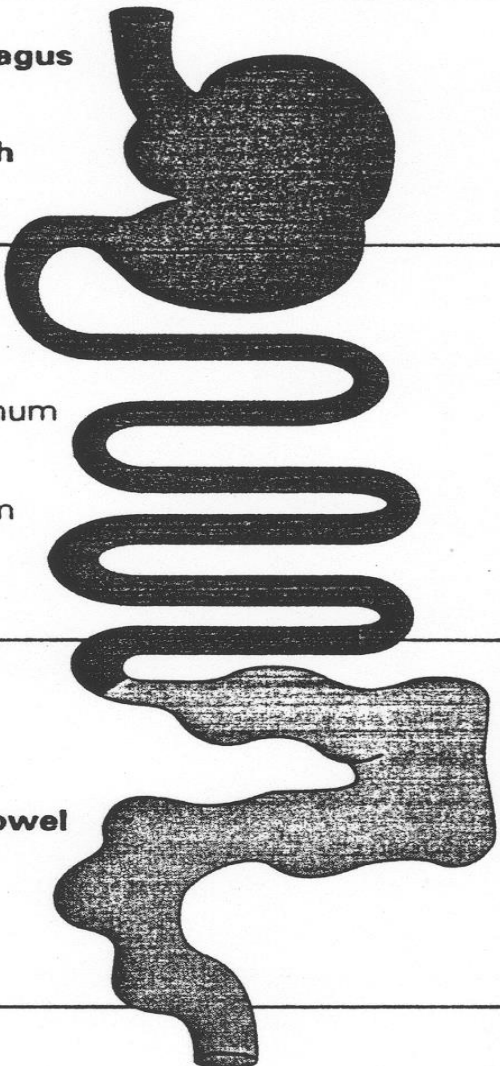


Body Sites With Normal Flora

All external body sites contain normal flora:

- **Gastro intestinal tract (GIT):** 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

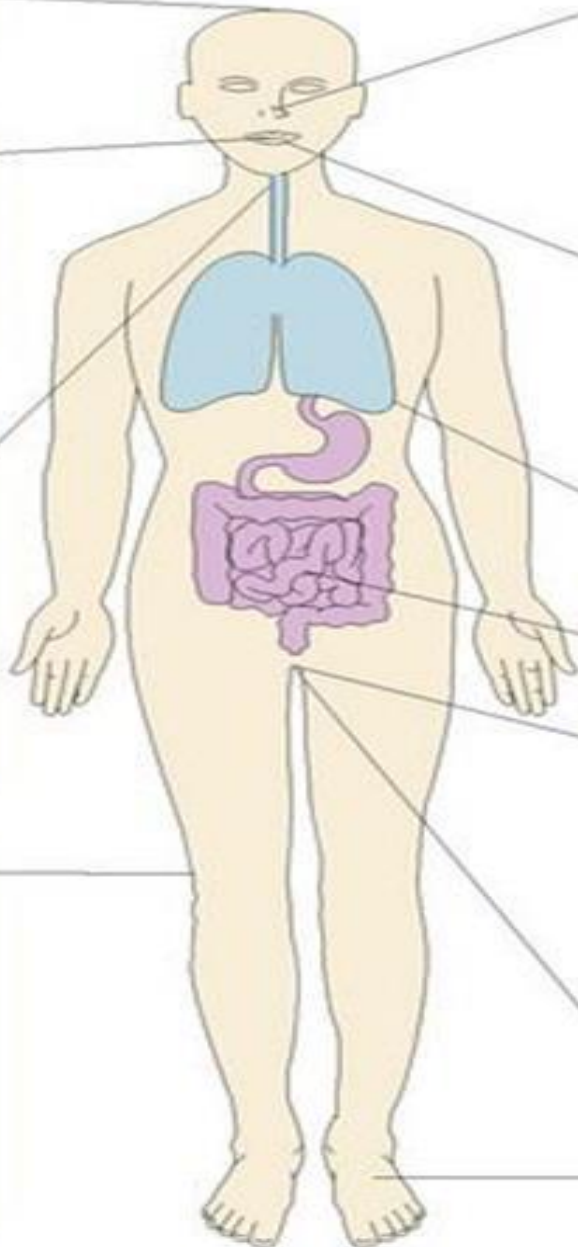
density	frequency of occurrence in population	
<p>oesophagus</p> <p>stomach</p> 	<div style="border: 1px solid black; padding: 5px; width: fit-content; margin: 0 auto;">lactobacilli</div>	
<p>small bowel</p> <p>duodenum</p> <p>jejunum</p> <p>ileum</p>	<div style="border: 1px solid black; padding: 5px; width: fit-content; margin: 0 auto;">lactobacilli streptococci</div> <div style="border: 1px solid black; padding: 5px; width: fit-content; margin: 0 auto;">Enterobacteria <i>Bacteroides</i> spp.</div>	
<p>large bowel</p>	<div style="border: 1px solid black; padding: 5px; width: fit-content; margin: 0 auto;"> <i>Bacteroides</i> spp. <i>Fusobacterium</i> spp. <i>E. faecalis</i> <i>Escherichia coli</i> </div>	<div style="border: 1px solid black; padding: 5px; width: fit-content; margin: 0 auto;"> Enterobacteria <i>Klebsiella</i> spp. Eubacteria Bifidobacteria </div>
<p>faecal material</p>	<div style="border: 1px solid black; padding: 5px; width: fit-content; margin: 0 auto;"> <i>Bacteroides</i> spp. Bifidobacteria Eubacteria </div>	<div style="border: 1px solid black; padding: 5px; width: fit-content; margin: 0 auto;"> Coliforms <i>E. faecalis</i> </div>

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 mouth & nasopharynx
- **Lower respiratory tract is sterile**
- **Nose Flora :**
 - *Staphylococcus epidermidis*
 - *Staphylococcus aureus*
 - *Corynebacterium species*

Normal Flora Of The Oropharynx

- Viridans streptococci
- Commensal neisseriae
- Corynebacteria
- Bacteroides
- Fusobacteria , Veillonella, Actinomyces, Spirochaetes.
- ***Haemophilus influenzae & Pneumococcus* 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 has normal flora similar to pharyngeal flora.
- **Empty stomach sterile due to gastric acid.**
- Duodenum, jejunum & upper ileum have 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 /misdiagnosis.**
- Male & Female distal urethra:
 - *S.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($10^4/\text{cm}^2$).
- 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.