# MEDICAL MICROBIOLOGY

## Lec. 6
## Gram-positive cocci
## Streptococcus

*By:*

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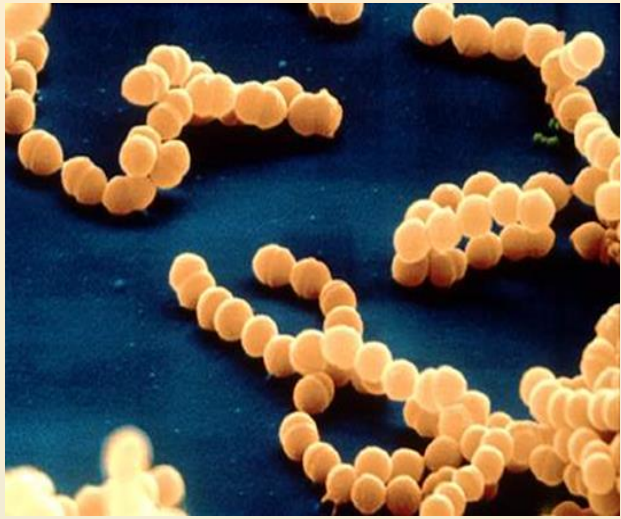
# Streptococci

## ❑ Important properties:

- Large group of bacteria belonging to the family Streptococcaceae
- $G^+$ spherical, 0.5-1 μm bacterial cells
- Arranged in chains or pairs
- Catalase negative.
- Non-spore forming.
- Some are members of the normal human flora. Others are associated with important human diseases.



## ❑ Culture characteristics:

- Most streptococci grow on solid media as descoid colonies, usually 1-2 mm in diameter.
- Strains that produce capsule give rise to mucoid colonies.
- Most strptococci are facultative anaerobes. Growth and hemolysis is aided by incubation at 10% $CO_2$.
- Most pathogenic streptococci grow at 37 ˚C. Group D enterococci grow well at 15-45 ˚C. Enterococci also can grow at 6.5% Nacl.

# Colony morphology of streptococci, alpha & beta hemolysis

# Classification of streptococci

Classification of streptococci based on many features including:

- **Hemolysis:**

**1. Alpha-hemolytic:** partial or incomplete hemolysis of RBCs (e.g. *St. viridance,* pneumococci)

**2. Beta-hemolytic:** complete hemolysis of RBCs (e.g. *St. pyogenes*).

**3. Non-hemolytic**: No hemolysis of RBCs (e.g. Enterococci).

- **Group-specific substance (Lancefield grouping):**

It depend on serologic grouping of surface group-specific carbohydrate in cell wall. Arranged in groups from A-H and K-U (human pathogenic streptococci are in groups (A,B,C,D,F & G)

- **Capsular polysaccharide:** used in classification of pneumococci (84 types) and *S. agalactiae.*
- **Biochemical reactions:** including sugar fermentation, presence of certain enzymes, susceptibility or resistant to certain chemical agents. It used for classification of viridans streptococci

# Streptococci of medical interest

## A- Beta- hemolytic streptococci:

❖ ***Streptococcus pyogenes*: (group A)**

- **Morphology:**

- G+ve, cocci, arranged in chains, capsulated.
- B- hemolytic, 1-2 mm discoid colonies, growth and hemolysis are aided by 10% $CO_2$.
- Bacitracin sensitive
- Variants show different colony forms: matte or glossy colonies.

- **Antigenic structure:**

- **M protein:** hair-like projections of streptococcal cell wall, major virulence factor resist phagocytosis, 150 types of M protein present, have an important role in pathogenesis of rheumatic fever.
- T substances
- R protein

- **Toxins and enzymes:**

* **Streptokinase (Fibrinolysin):** Activates plasminogen to form plasmin that digest fibrin & other proteins.

* **Dnase** (**Streptodornase):** mixture of DNase and Streptokinase liquefy purulent exudates & facilitate removal of pus **(enzymatic debridement).**

* **Hyalurondase (spreading factor):** It split hyaluronic acid which is an important component of the connective tissues, thus it aid in spread of bacteria.

* **Erythrogenic toxin (Pyrogenic exotoxin):** Three antigenic types A,B, and C. The streptococcal pyrogenic exotoxin are associated with streptococcal toxic shock syndrome and scarlet fever. They are superantigen.

* **Hemolysins:** Hemolyze RBCs in vitro in varying degree. Group A *S. pyogenes* produce two type of hemolysins:

- **Streptolysin O** (antigenic, oxygen-labile) and **Streptolysin S** (not antigenic, oxygen stable).

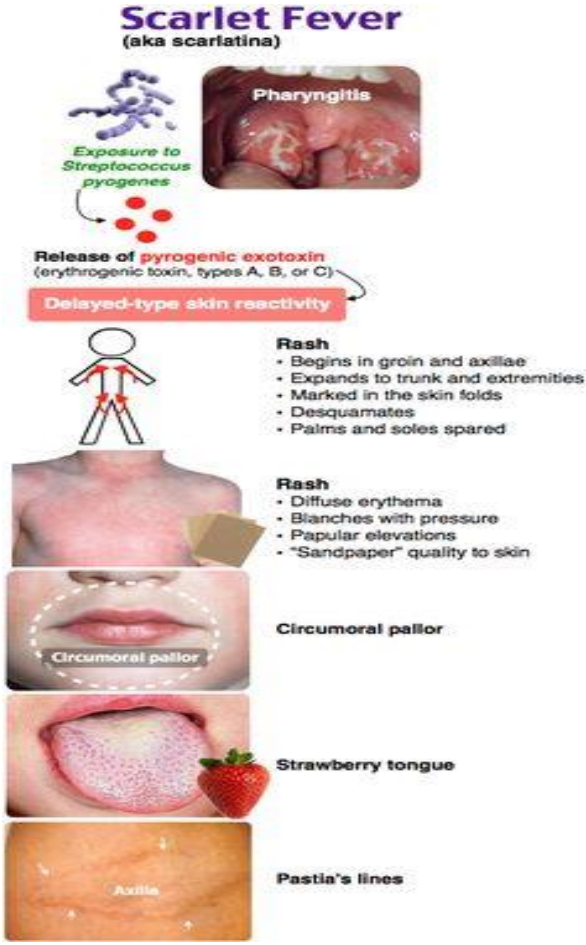
- **Pathogenesis and clinical findings:**

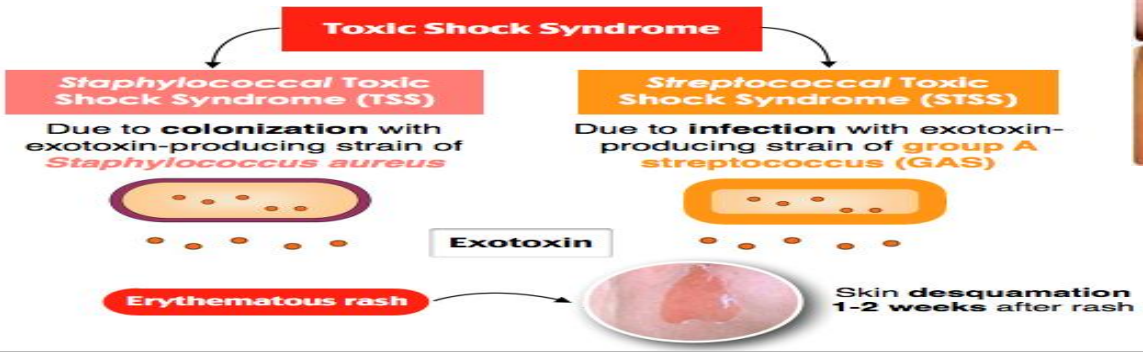
- **Pyogenic infection:** The portal of entry determines the principal clinical picture, including: erysipelas, cellulitis, necrotizing fasciitis (flesh-eating), puerperal fever, sepsis, streptococcal sore throat **(*s. pyogenes* is the most common bacterial cause of sore throat),** streptococcal pyoderma (impetigo),

- **Toxin- mediated streptococcal infections:**

- **Streptococcal toxic shock syndrome:** Following minor trauma, characterized by fever, bacteremia, rapidly progressive shock, and multi-organ failure**.( blood culture are often positive)**

- **Scarlet fever:** it can develop in people who have strep throat. It's characterized by a bright red rash usually on trunk and extremities, fever and sore throat.




| CDC Criteria for the Diagnosis of Toxic Shock Syndrome | |
|---|---|
| *Staphylococcal* Toxic Shock Syndrome (TSS) | *Streptococcal* Toxic Shock Syndrome (TSS) |
| Fever > 38.9°C (102°F) | Isolation of group A *streptococcus* (CSF, surgical wound, throat, blood) |
| Rash (Diffuse, blanching, erythematous w/desquamation occurring 1-2 wks later) | Hypotension (SBP < 90 mm Hg) |
| Hypotension (SBP < 90 mm Hg) | Evidence of involvement of ≥ 2 organ systems |
| Evidence of involvement of ≥ 3 organ systems | |
| Absence of serologic evidence of: Rocky Mountain spotted fever, Leptospirosis, Measles, Hepatitis B, Antinuclear antibody, Positive VDRL, Monospot | |

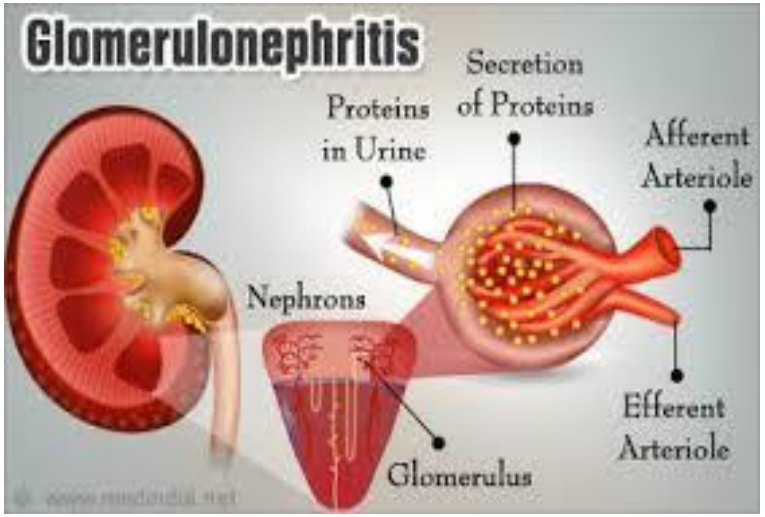
The following table summarizes key distinctions between staphylococcal and streptococcal TSS.

| Findings | Staphylococcal Toxic Shock Syndrome | Streptococcal Toxic Shock Syndrome |
|---|---|---|
| Age | 15-35 y | 20-50 y |
| Sex | More common in females | Males and females |
| Local invasive disease | Absent | Present |
| Generalized erythroderma | Present | Absent |
| Nausea, vomiting, or diarrhea | >90% of patients | Uncommon |
| Bacteremia | Uncommon | 60% of patients |
| Toxins implicated | TSST-1; enterotoxins B and C | Streptococcal pyrogenic exotoxins A and B |
| Mortality rate | 3.3% | 30% |

- **Post-streptococcal diseases:**

**- Rheumatic fever:**

* Is more common following *st. pyogenes* respiratory infection (Due to an immunologic reaction between cross-reacting antibodies to certain streptococcal M proteins and antigens of joint, heart, and brain tissues).
* **Acute glomerulonephritis:**
* Is more commonly following *st. pyogenes* skin infection (initiated by deposition of Ag-Ab complexes on the glomerular membrane).




- **Immunity:**

  Humoral immune response (IgG) against M protein (type-specific), they considered as opsonin.

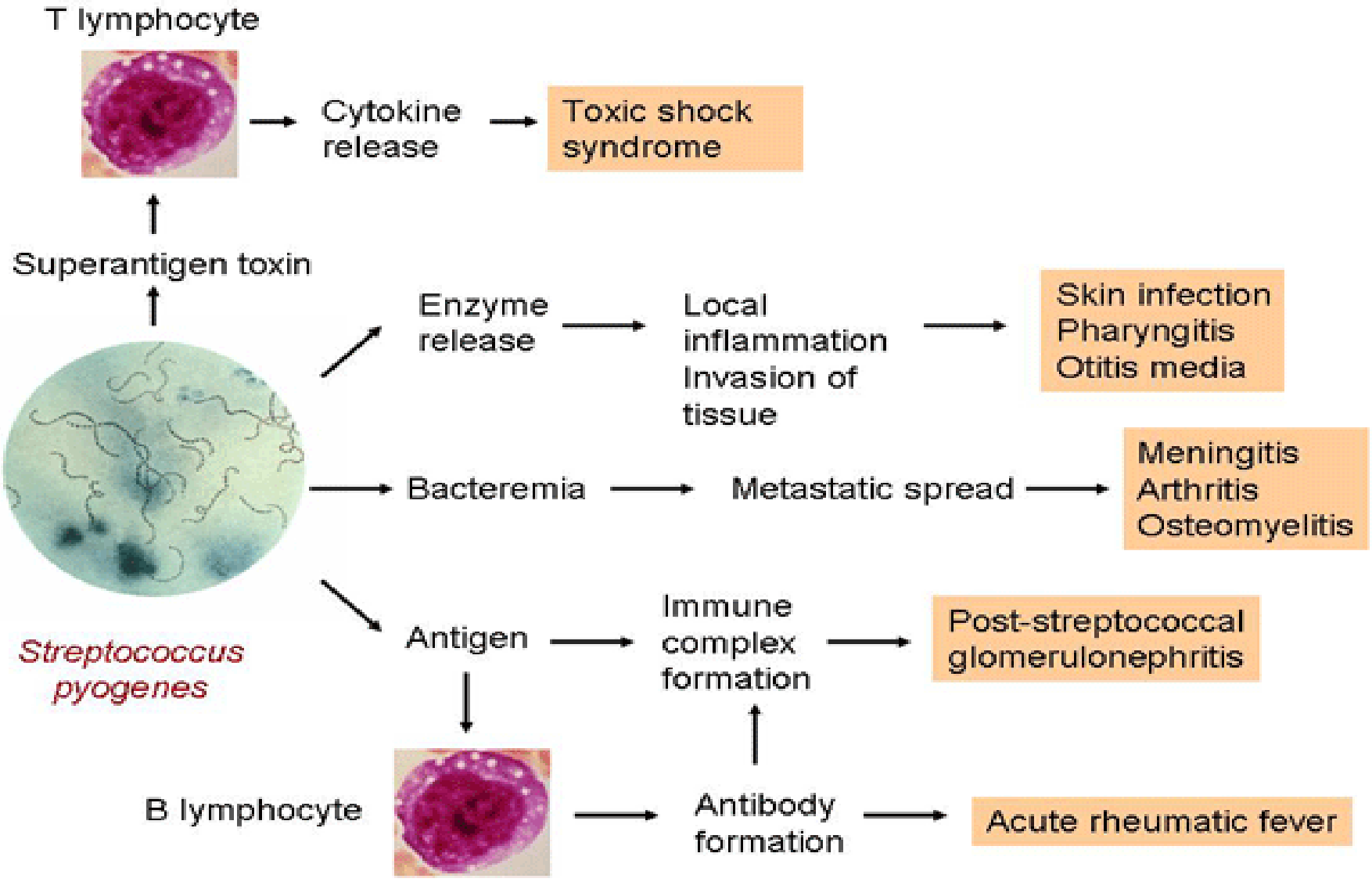
  Anti- streptolysin-O develops following infection and are present in rheumatic individuals

- **Treatment:**

  All *S. pyogenes* are susceptible to Penicillin-G and most to eythromycin.

- **Epidemiology:** although humans can be asymptomatic nasopharyngeal or perineal carriers of *S. pyogenes*, the organism should be considered abnormal if it is detected by culture or other means. The ultimate source of group A streptococci is a person harboring these organisms and distributing streptococci directly to other persons via droplets from the respiratory tract. Nasal discharges of a person harboring *S. pyogenes* are the most dangerous source for spread of these organisms.

# Strep pyogenes infections



## Other B- hemolytic streptococci:

❖ ***Streptococcus agalactiae*: (group B)**

- Produce zone of hemolysis are slightly larger than the colonies.
- Present as normal vaginal flora in 5-25% of women
- Causes **neonatal sepsis** and **meningitis.**
- Bacitracin resistant.
- CAMP +ve
- IV penicillin given to mother harboring this organism and are in labor.

❖ ***Streptococcus bovis*: (non-enterococcal group D)**

- Enteric normal flora
- Associated with UTI, occasionally cause endocarditis, and bacteremia in colon carcinoma patients
- Nonhemolytic, PYR –ve, bile-esculin +ve, but do not grow in 6.5% NaCl.

## B- Alph- hemolytic streptococci:

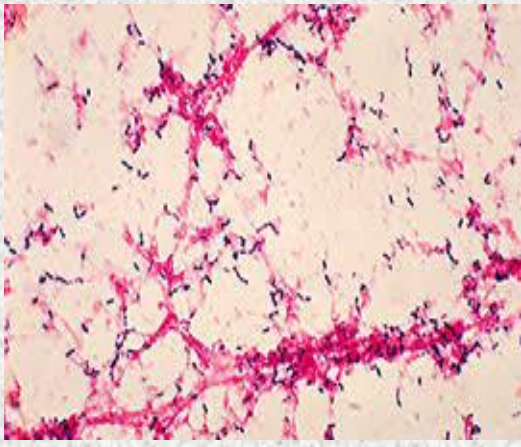
### ❖ *Streptococcus pneumonia:*

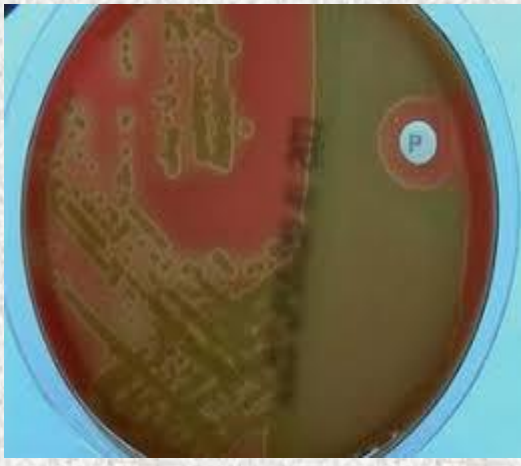
- **General features:**

- G + lancet-shape diplococci, capsulated.
- On culture, a small round **alpha hemolytic** colonies at first dome-shape and later develop a central plateau with an elevated rim.
- Optochin sensitive
- More than 80 antigenic types according to capsular polysaccharide.

- **Virulence factors:**

- produce no significant toxin
- polysccharide capsule which prevent phagocytosis by interfering with complement binding & mediating complement inactivation.

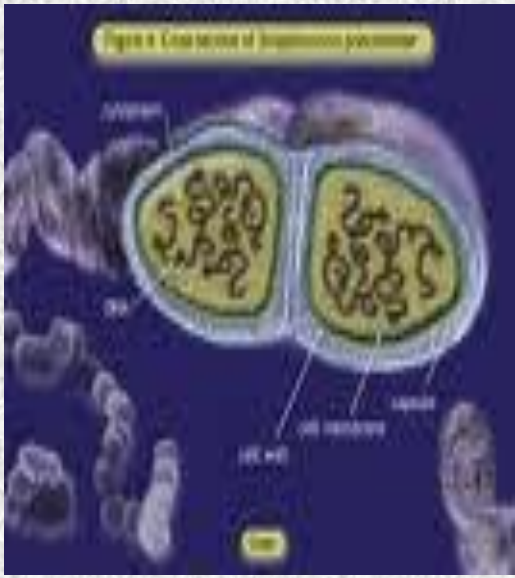




- **Clinical findings:**

Pneumonia (60-70% of bacterial pneumonia), sinusitis, otitis media, septic arthritis and meningitis.

The onset of pneumococcal pneumonia is usually sudden with fever, chills & sharp pleural pain, and rusty sputum. Early in the disease bacteremia is present in 10-20% of cases. The mortality rate may reach up to 30% depending on age and underlying illness.



- **Immunity:**

depend on anti-capsular antibodies and intact phagocytic function.

- **Treatment:**

drug of choice is Penicillin G

## B- Alph- hemolytic streptococci:

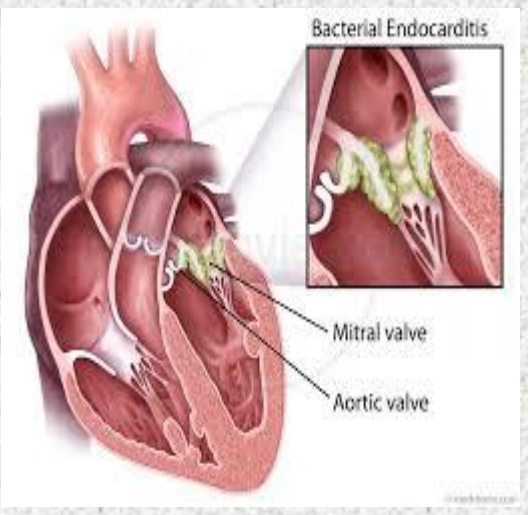
### ❖ Viridans streptococci:

- Including: *S. mitis, S. mutans, S. salvaris, S. sanguis* and others.
- Commensal flora of oral cavity.
- It produce alpha-hemolysis on blood agar.

- **Clinical findings:**

They can cause a Varity of infections such as dental caries, subacute bacterial endocaditis, and intra-abdominal suppurative infections

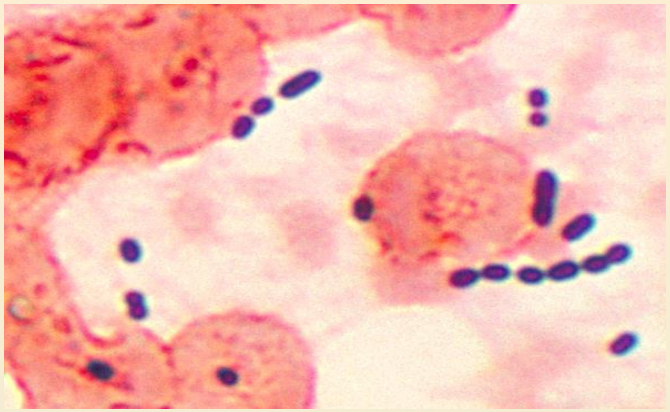




**Enterococci:**

- G+ cocci usually arranged in pair, or short chains.
- Non motile, non capsulated
- There are at least 12 species: *St.fecalis* is the most common and causes 85-90% of enterococcal infections.
- Grow at 10-45°C , pH 9.6, in broth containing 6.5 % NaCl, survive heating t0 60°C for 30 min.
- It is known to cause nosocomial infections particularly among immunocompromised patients.
- Enterococcal infections include UTI, wound infections, biliary tract and blood.
- Enterococci are known to develop a wide range of antibiotic resistance including vancomycin, aminoglycosides and beta-lactams due to production of beta-lactamase enzyme.

**Enterococci**




Thank You