Gram Positive Cocci
(Staphylococci)
Staphylococci

- **Staphyle**: Derived from Greek “stapyle” which means bunch of grapes.
- **Cocci**: Spherical

**Morphology:**
Gram positive, cocci in groups
Staphylococci spp.

The most important spp. are:

*Staphylococcus aureus* (The most virulent one)

*S. epidermidis*

*S. saprophyticus*
Characteristics of Staphylococci

1. Morphology>>
   • Gram positive cocci.
   • Arranged in grape like clusters.

2. Habitat>>
   • They are ubiquitous in nature (found on any inanimate surface).
   • About a dozen species occurring as part of human flora on the skin, in the nose, throat, and in the stool.

3. Culture>>
   They are Facultative anaerobic (Can live with or without Oxygen).
4. Biochemical Reactions>>
  Produce Catalase enzyme (give positive catalase test in the lab).

5. Non-sporulating.

6. Resistant to heat, drying and high salt concentration.

7. Staphlyococcus can easily spread from person to person via hand to hand contact.
Note: areas at highest risk for severe staphylococcal infections:

• New born nursery
• ICU
• Operating rooms and
• Cancer chemotherapy wards
Staphylococci are Calcified into:

- **Coagulase Positive Staphylococci:**
  - Can produce Coagulase enzyme.
  - The most virulent
  *Staphylococcus aureus*

- **Coagulase Negative Staphylococci:**
  - Do not produce Coagulase enzyme.
  - Occasionally cause disease.
  - Mainly:
    *Staphylococcus epidermidis*
    *Staphylococcus sparophyticus*
**S. aureus**

*S. aureus* Virulence factors:

1. **Cell wall Virulence factors:**
   - **Capsule:** very thin, resist phagocytosis.
   - **Protein A:** anti-phagocytic (bind to Fc region of IgG).
   - **Fibronectin-binding protein (FnBP):** promote binding to mucosal cells.
   - **Clumping factor:** enhance clumping of the organisms in the presence of plasma.

2. **Cytolytic toxine (hemolysins):** attack mammalian cell membranes and leads to lysis.

3. **Panton-Valentine leukocidin:** it lyses PMNs. Predominantly produced by MRSA.

4. **Enterotoxins:** produced by ½ of *S. aureus*, it’s toxin to the intestine. Ingestion of enterotoxin in contaminated food cause food poisoning.
**S. aureus Infections:**

- **Localized skin infections:** the most common *S. aureus* infections, small superficial abscesses involving hair follicles or sweat or sebaceous glands. Example of it is Blepharitis.

- **Deep, localized infections:** these are usually metastatic from superficial infections. The most common is chronic infection of bone marrow and septic joint in children.

- **Acute endocarditis:** generally associated with intravenous drug abuse.

- **Septicemia:** blood poisoning.

- **Pneumonia:** it cause severe necrotizing pneumonia.

- **Nosocomial infections:** often related to wound infection or bacteremia associated with catheters.

- **Toxinosis:** Toxic shock syndrome, Staphylococcal gastroenteritis, Scalded skin syndrome.
How do *Staphylococcus aureus* cause the infection??

- Penetrate the deep tissues of skin damaged by:
  - burns, cuts, insect bites, skin diseases.
  - Insertion of a foreign body.
  - Obstructed hair follicle.
  - Compromised immune system.
Treatment of S.aureus infections in general

• Usually require incision & drainage of localized lesions, as well as systemic antibiotic.

• Nowadays all community and hospital acquired S. aureus infection are resistant to penicillin G.

• Currently the drug in serious infections is β-lactamase-resistant penicillin such as methicillin or oxacillin.

• The increased use of these antibiotics resulted in the evolving of a S.aureus that is resistant to a number of β-lactam antibiotics such as methicillin, oxacillin and amoxicillin. Those strains are called Methicillin Resistant Staphylococcus aureus (MRSA).

• Vancomycins resistance: vancomycin has been the agent of choice for empiric treatment of life-threatening MRSA. Since 1997 low level resistance to vancomycin has been observed and it has been in the rise since then.
Blepharitis: Inflammation of the base of the eyelid.

**Ulcerative Blepharitis:**
- Characterized by the deposition of yellow crusts at the roots of eyelashes.
- Presence of ulcer under the crusts.
- Bleeding on crust removal
- Swelling of the lid margins and falling of the eyelashes.
Etiologic Agent of Ulcerative Blepharitis

- Most common is *Staphylococcus aureus* (Coagulase Positive Staphylococci).
General Signs & Symptoms

• Foreign-body sensation.
• Dryness.
• Tearing.
• Itching.
• Burning.
• Crusting around the eyes.
• Eyelid swelling.
• Mild discharge.
• Sticking of eyelids mostly upon waking.
Diagnosis

• The clinical appearance of the eyelids is virtually diagnostic.
• Scraping or swabbing can be sent for culture in severe or recurrent cases.
Treatment

- Lid hygiene
- Warm compresses for 20 minutes 2 to 4 times a day on the eyes.
- Mechanical removal of crusts by scrubbing.
- Scrub the eyelid margins with mild shampoo (Johnson’s baby shampoo).
- Artificial tears 4 to 6 times a day.
- Application of antibiotic eye ointment e.g. Erythromycin ointment at bedtime.
Other eye infections that can be caused by S.aureus

- **Conjunctivitis>>** mostly acute purulent conjunctivitis
  - Conjunctiva becomes red.
  - Lids are slightly edematous.
  - Mucopurulent discharge.
  - Glueing of the eyelashes after night sleep.
  - Photophobia.
  - Commonly seen in children but can affect any age group.
  - Short incubation period.
  - Bacterial conjunctivitis is bilateral.
  - May manifest either in mild or severe form.

- **Bacterial corneal ulcer (=bacterial keratitis)***
MRSA

• MRSA is a type of Staphylococcus, sometimes called “superbug” that is resistant to most of the antibiotics.

• It is hard to treat.

• They are resistant to most other drugs including tetracyclines, erythromycins, aminoglycosides.

• Vancomycin has been the drug of choice for MRSA infections.

• 1997 several MRSA’s were isolated that had also acquired low-level vacomycin resistance.
Methicillin-resistant *Staphylococcus aureus* is one of the most common causes of postoperative ophthalmic infections. Hence infectious blepharitis, if present, should be treated prior to surgery.
Coagulase Negative Staphylococci

• Around 12 different coagulase negative staphylococci species have been recovered as normal flora of human skin and anterior nares.

• The most abundant and important species are:
  ✓ *Staphylococcus epidermidis*.
  ✓ *Staphylococcus saprophyticus*.

• Coagulase negative staphylococci are important agents of hospital-acquired infections associated with the use of implanted prosthetic devices and catheters.
The Difference

<table>
<thead>
<tr>
<th>Staphylococcus aureus</th>
<th>Coagulase Negative Staphylococci</th>
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<tbody>
<tr>
<td>• Gram positive cocci in clusters</td>
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<tr>
<td>• Catalase +ve.</td>
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</tr>
<tr>
<td>• Coagulase +ve.</td>
<td>• Coagulase –ve.</td>
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<tr>
<td>• Blood agar&gt;&gt; βhemolysis , creamy yellowish colonies.</td>
<td>• Blood agar&gt;&gt; No hemolysis , gray colonies.</td>
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<tr>
<td>• Mannitol salt agar&gt;&gt; ferment mannitol and give yellow colonies</td>
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Staphylococcus aureus

Coagulase Negative Staphylococci

Blood Agar plate

Mannitol Salt Agar plate