

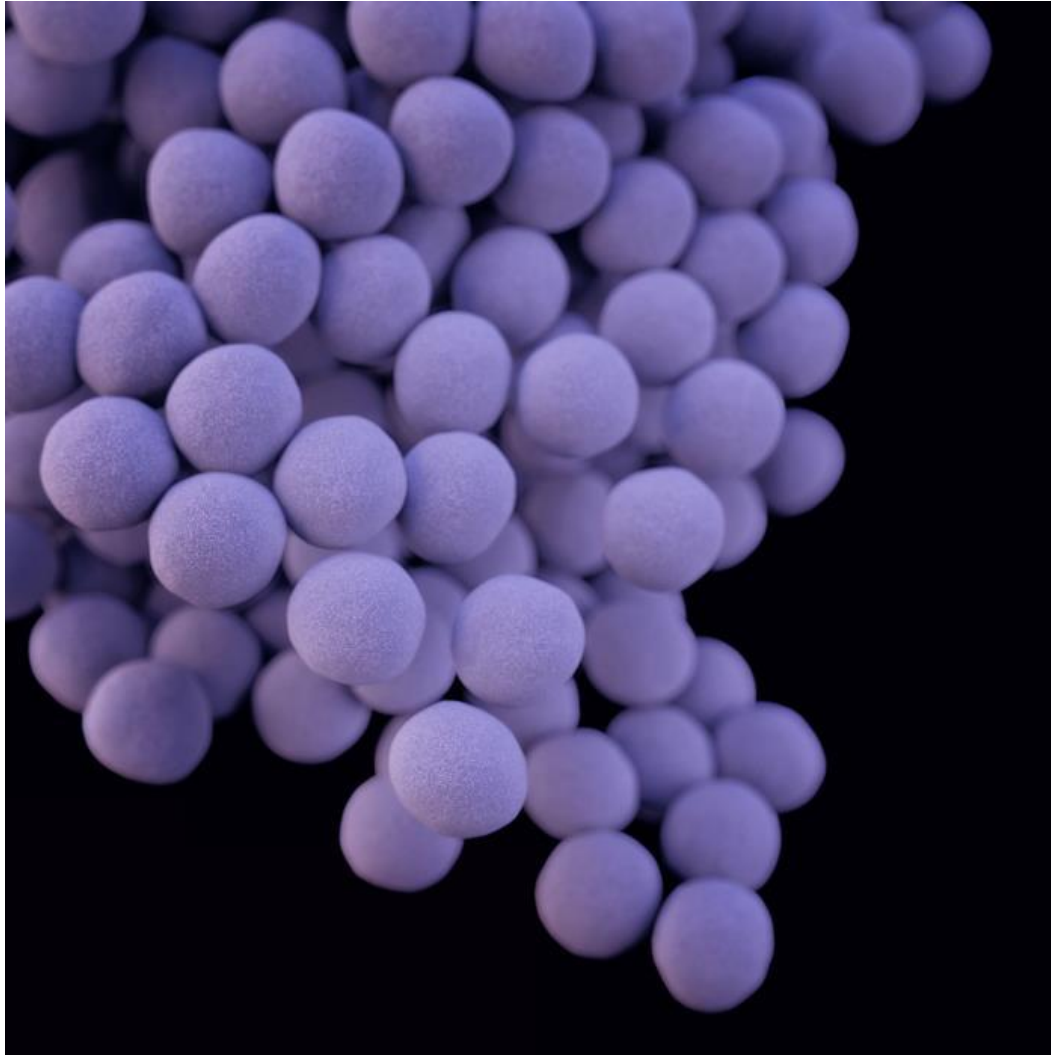
# Staphylococcus & Streptococcus

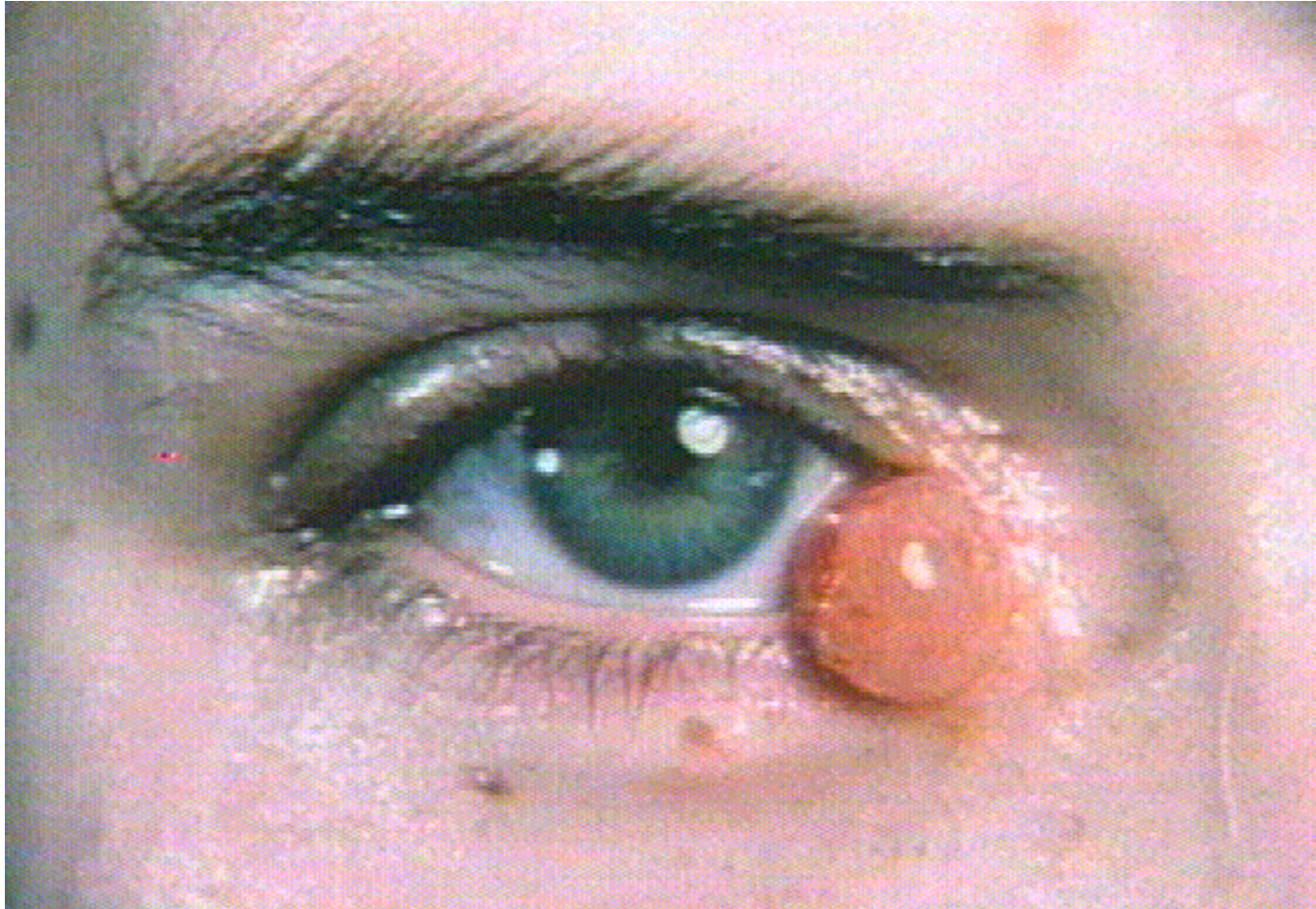
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# Lecture outline

- Classification
- Features
- Sources of infection
- Virulent factors
- Clinical manifestations
- Laboratory diagnosis

# Staphylococcus





**Stye**



**Folliculitis**



**Boils**





**Conjunctivitis**

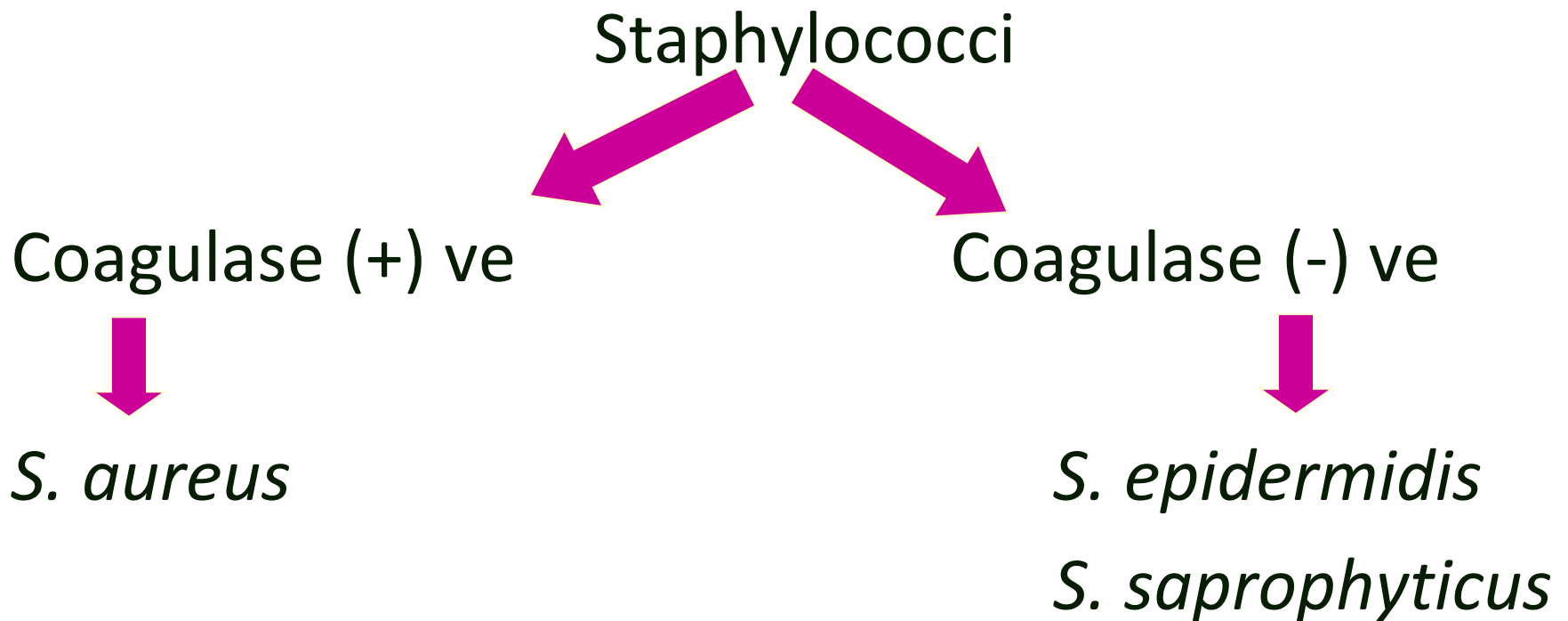


**Impetigo**



# Staphylococci

- Family – Micrococcaceae
- Genus – Staphylococci
- Species – 36 defined species. 16 in humans



# Coagulase

## Bound

- (clumping factor)
- Surface protein
- Binds to fibrinogen
- Causes organisms to aggregate
- Form clumps in plasma

## Free

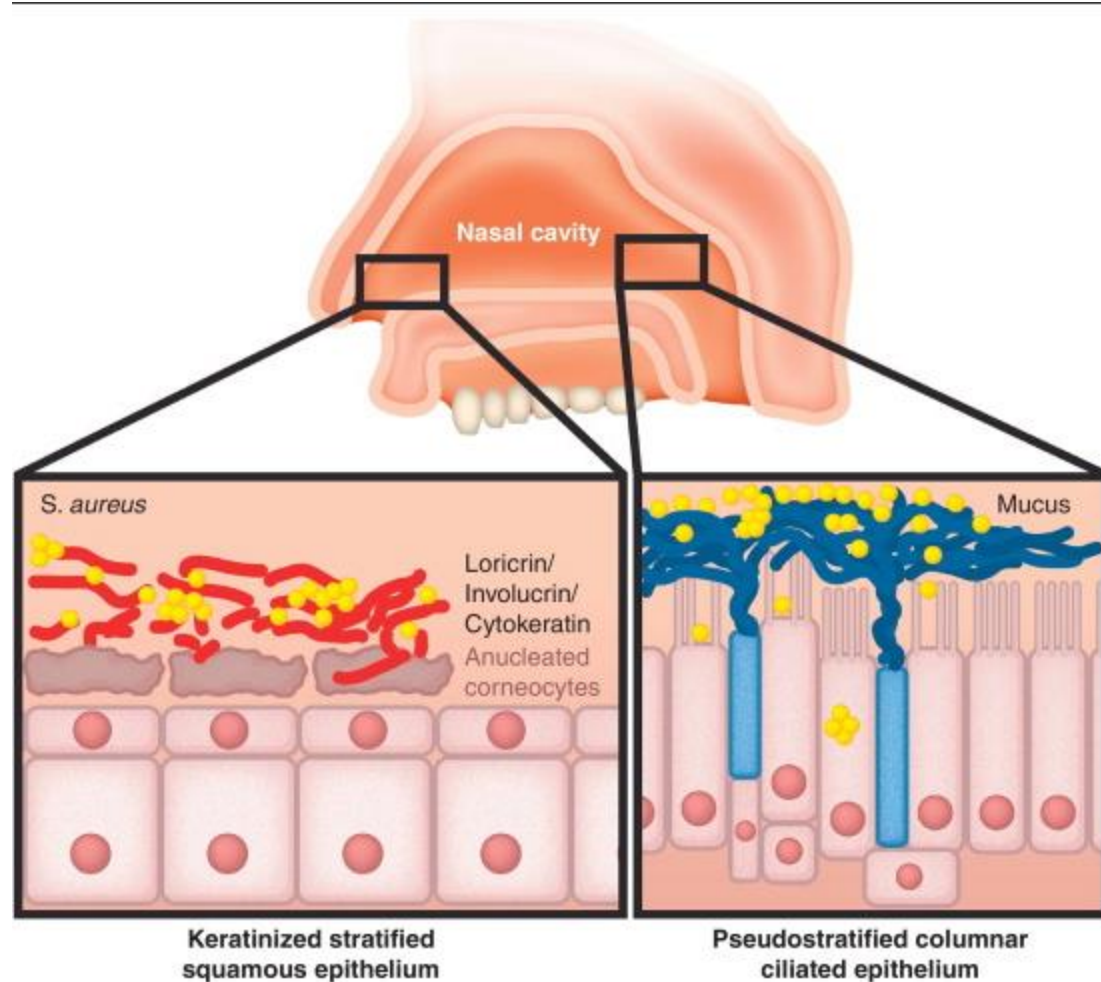
- Extracellular enzyme
- Convert Fibrinogen → fibrin
- Clot formation

- Most virulent spp in humans

***S. aureus***

# Normal habitat of staphylococcus

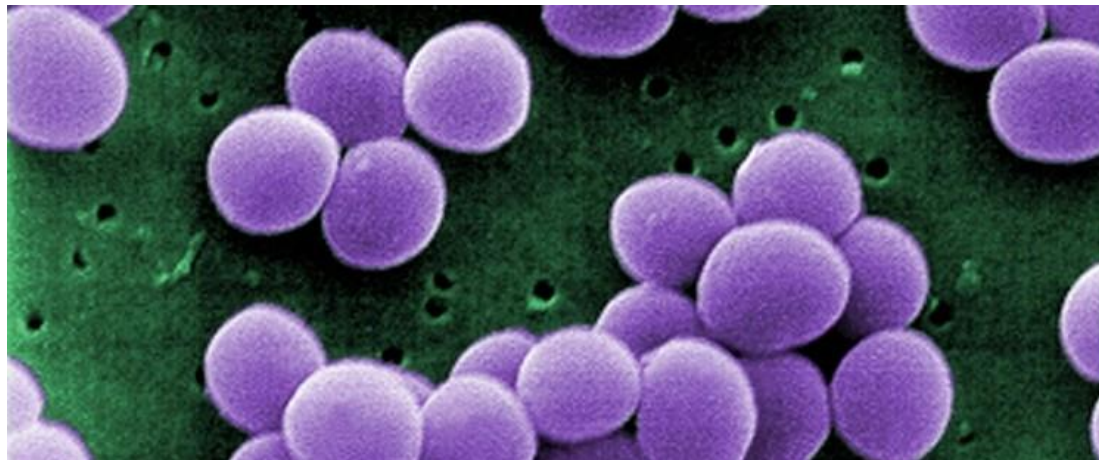
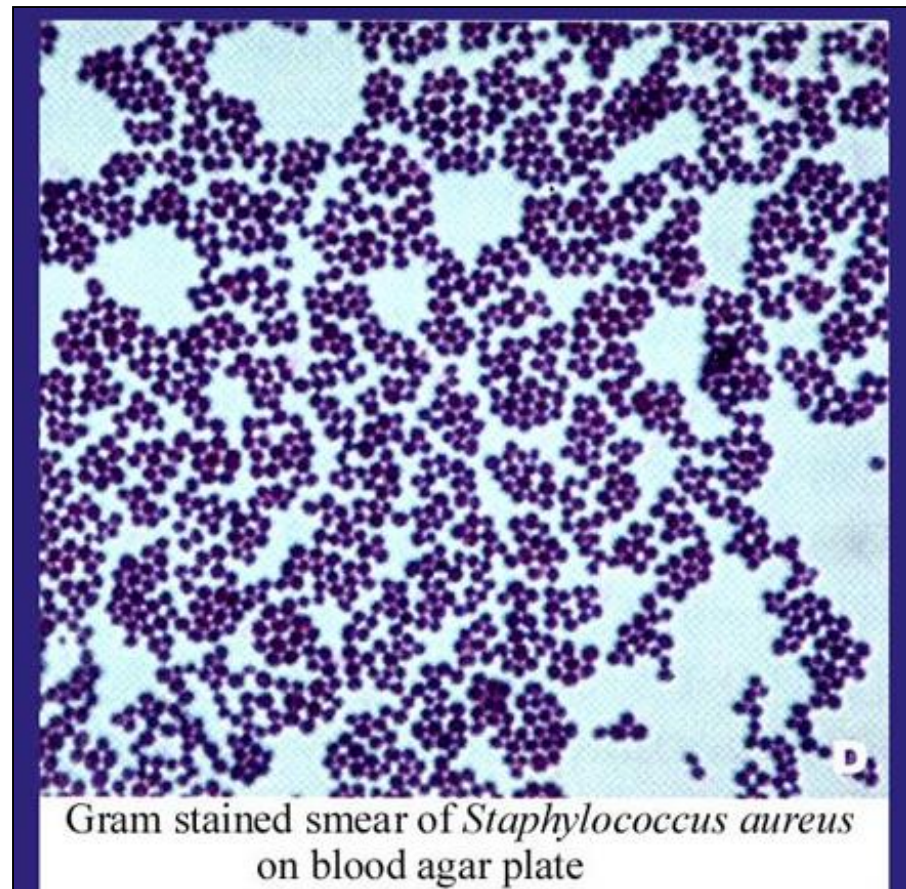
- Body surfaces of humans & animals
- Preferred habitat - anterior nares



# Features

## Microscopy

- ♣ Gram (+) ve cocci
- ♣ Present as clusters of varying sizes.
- ♣ Singles, chains, pairs, short chains are also seen.



# Features

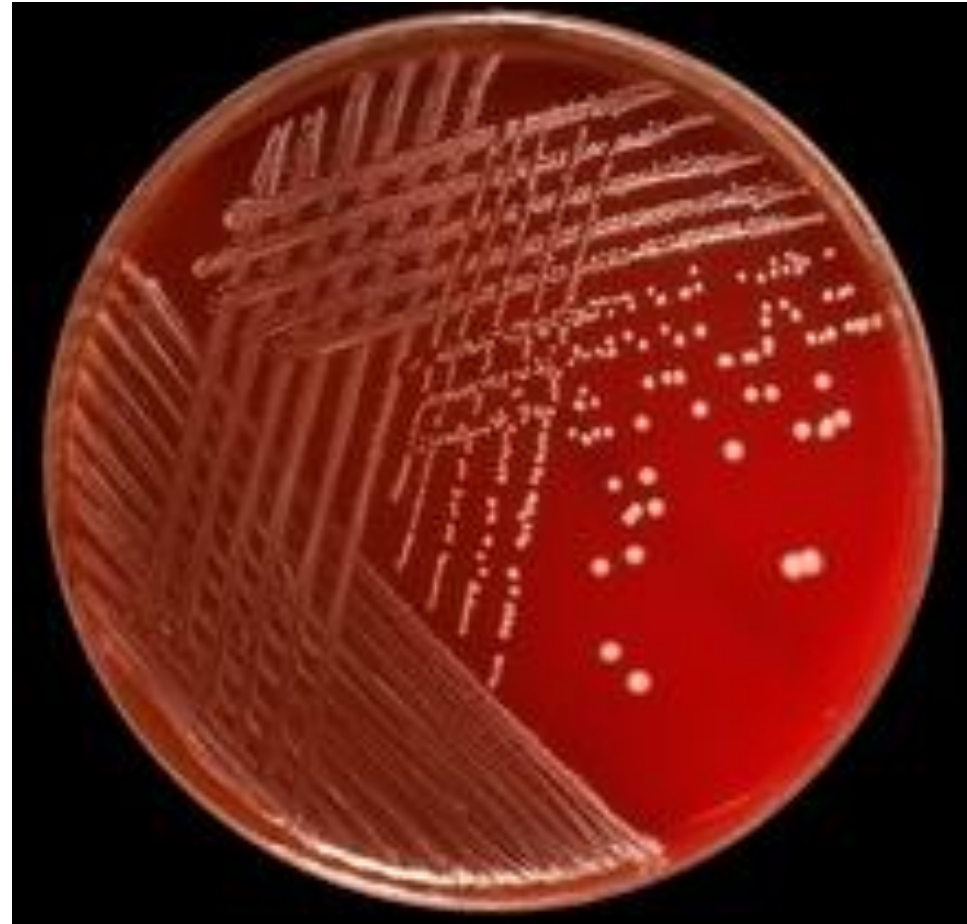
- ♣ Facultative anaerobic
- ♣ Catalase (+) ve
- ♣ Non - spore forming
- ♣ Non - motile
- ♣ Non capsulated (Occasionally capsulate)



# Features

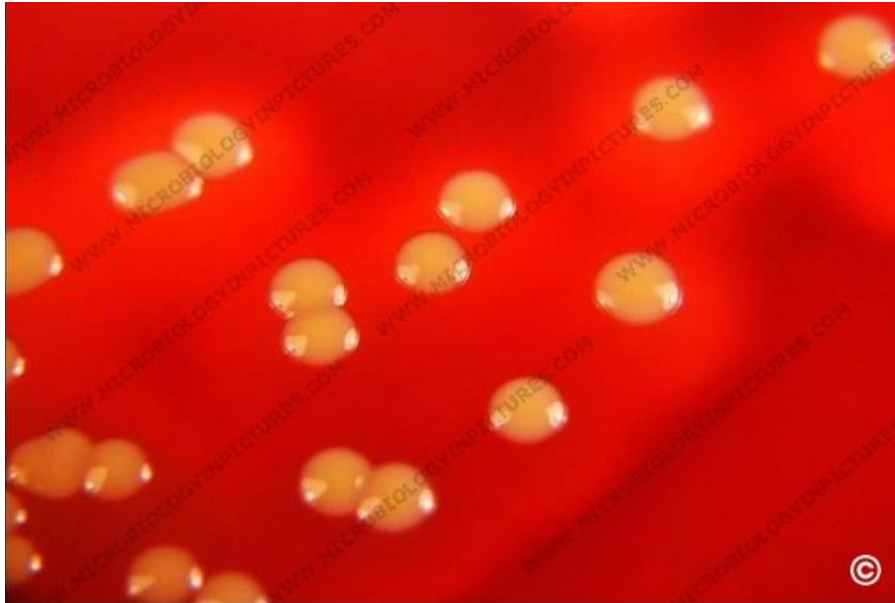
## Macroscopy / Cultural characteristics

- Incubation : 18 – 24 hrs at 37°C
- On blood agar / nutrient agar
- Circular, 1-3 mm diameter, opaque, smooth, shiny colonies



# Features

- Pigmented ( *S. aureus*) (golden yellow / cream colour) colonies
- Whitish colonies by CoNS



*S. aureus*



*S. epidermidis*

# Features

Narrow zone of haemolysis present on BA



# Virulence factors

♣ Structural

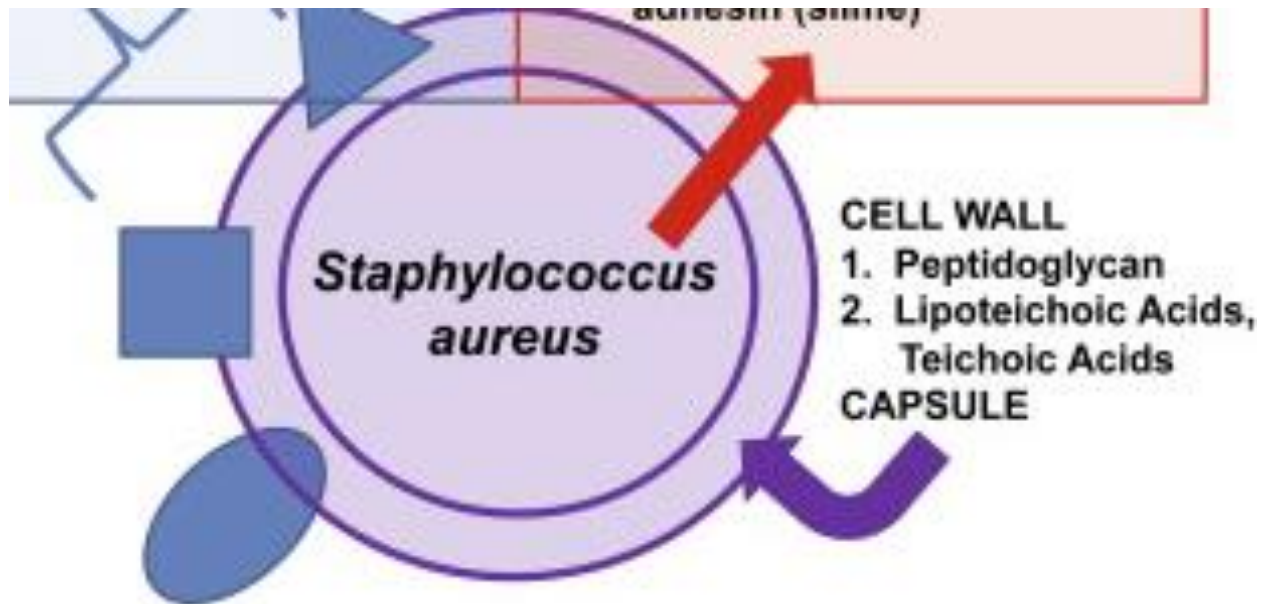
♣ Enzymes

♣ Toxins

# Virulence factors

## Structural

- ▶ Protein A
- ▶ Capsule (some strains)
- ▶ Peptidoglycan



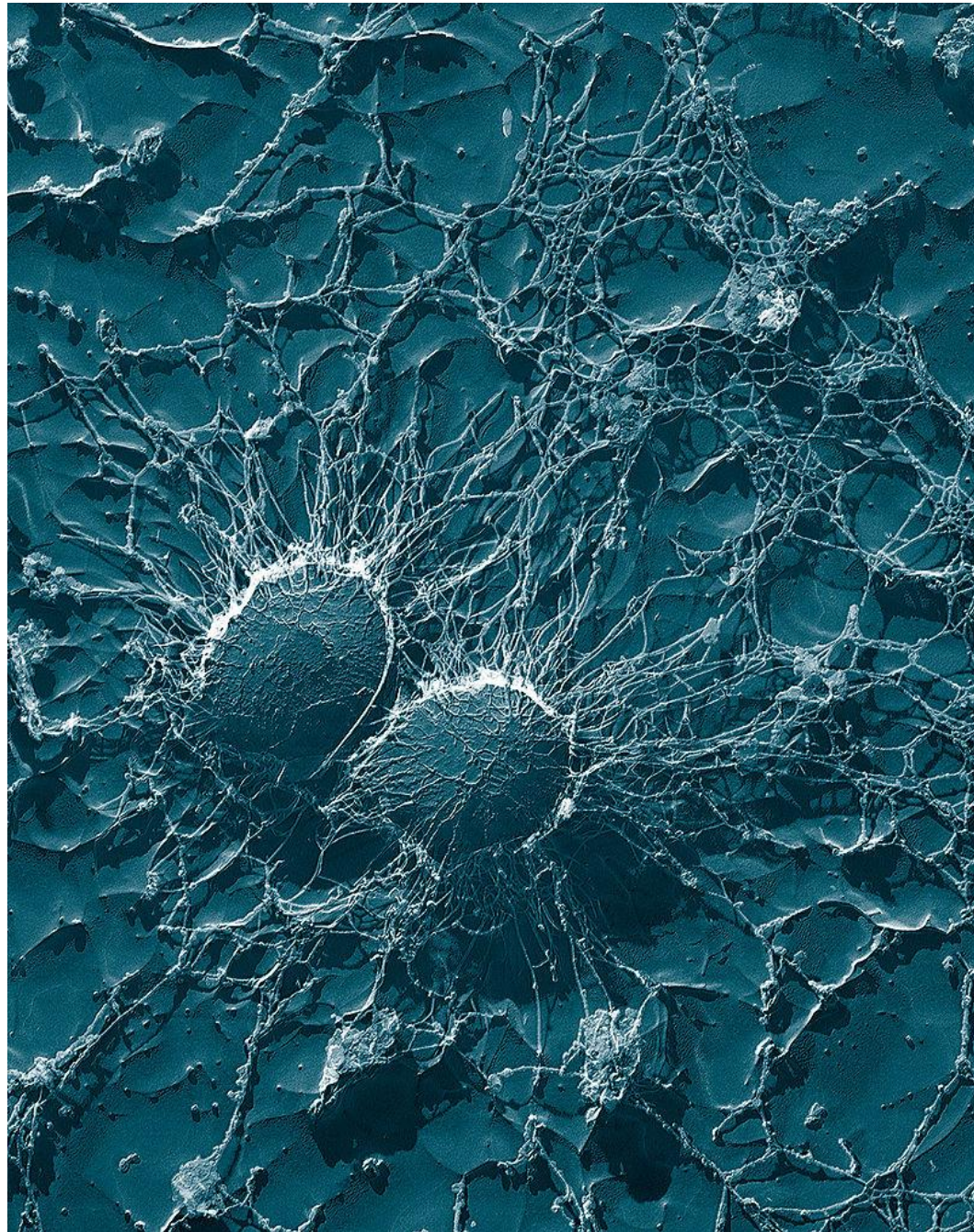


# Virulence factors

## Enzymes

### ♣ Coagulase

*S. aureus* forms a fibrin capsule that protects it from the immune system

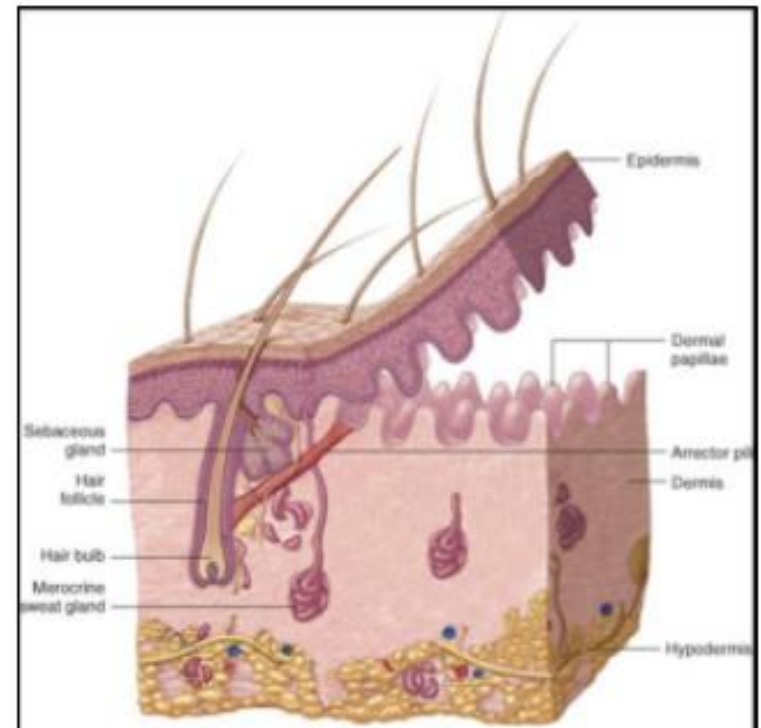




# Virulence factors

## Enzymes

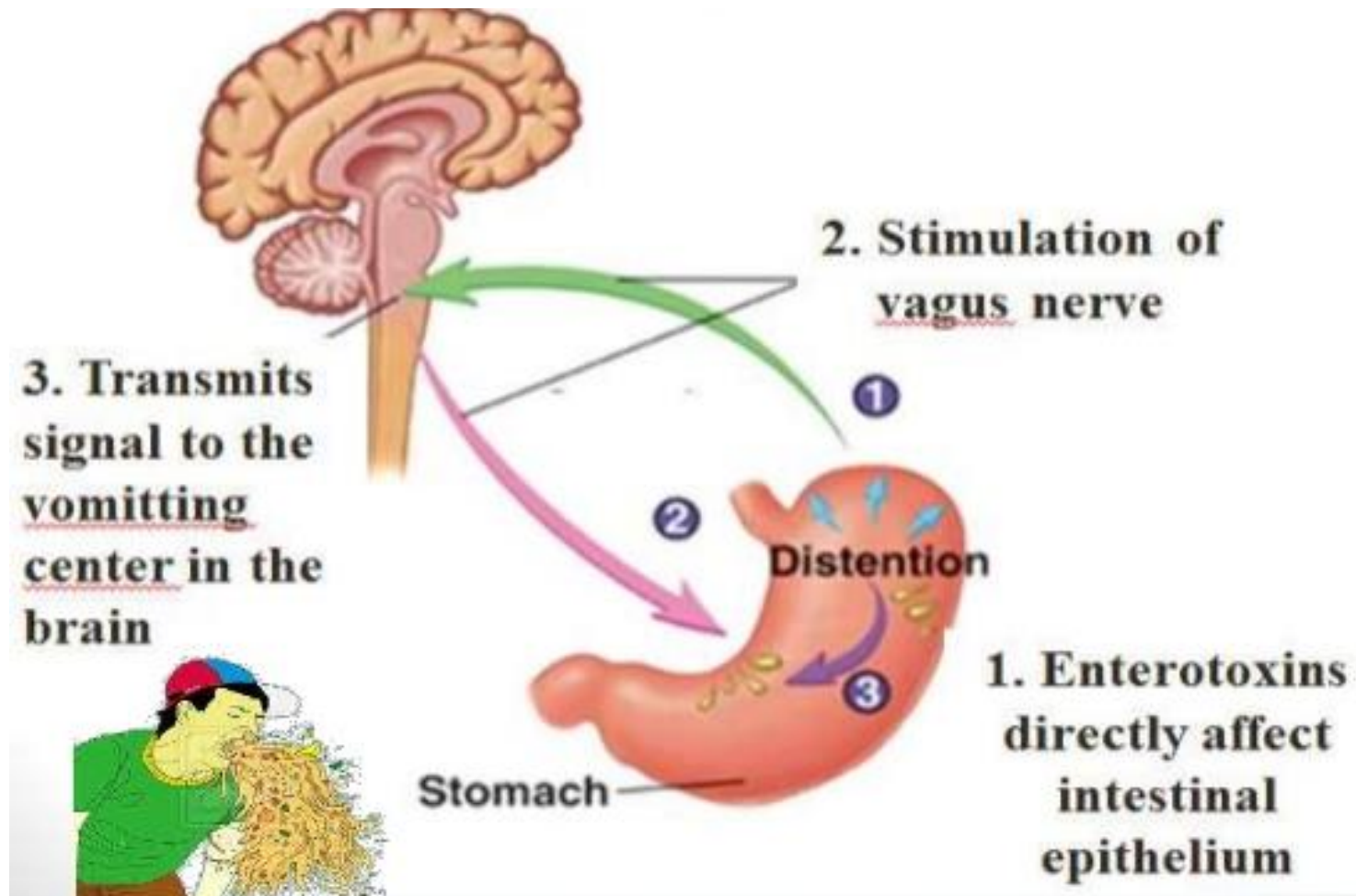
- ♣ Hyaluronidase - Hydrolyses hyaluronic acid in tissues.
- ♣ Fibrinolysin (Staphylokinase) - Dissolve fibrin clot
- ♣ Lipase - Lipid hydrolysis
- ♣ Protease
- ♣ DNA ase - Degrade DNA.



# Toxins

## ► Enterotoxins (A-E)

Increase intestinal fluid secretion



# Toxins

## ► Toxic shock syndrome toxin



Pyrogenic toxin

# Toxins

- ▶ **Epidermolytic toxins (Type A & B)**  
**Cause blister formation**





# Toxins

► Haemolysins ( $\alpha$  ,  $\beta$  ,  $\gamma$  ,  $\delta$  )

Causes lysis of red cells



# Toxins

## Leucocidin

**Toxic for leucocytes & macrophages**

Panton-Valentine toxin (PVL) - associated with skin and soft tissue infections





# Toxins

## ► Exfoliative toxins

Associated with staphylococcal scalded skin syndrome



# Sources of infections

- Infected lesions
- Carriers
- Animals

# Transmission

- ♣ Direct contact

  - Most important method

- ♣ Cross infection

- ♣ Air born transmission

# Antibiotic resistance

## Methicillin-resistant *Staphylococcus aureus* (MRSA)

Resistant to cloxacillin / flucloxacillin

Vancomycin - can be used to R<sub>x</sub> MRSA  
infections

# MRSA

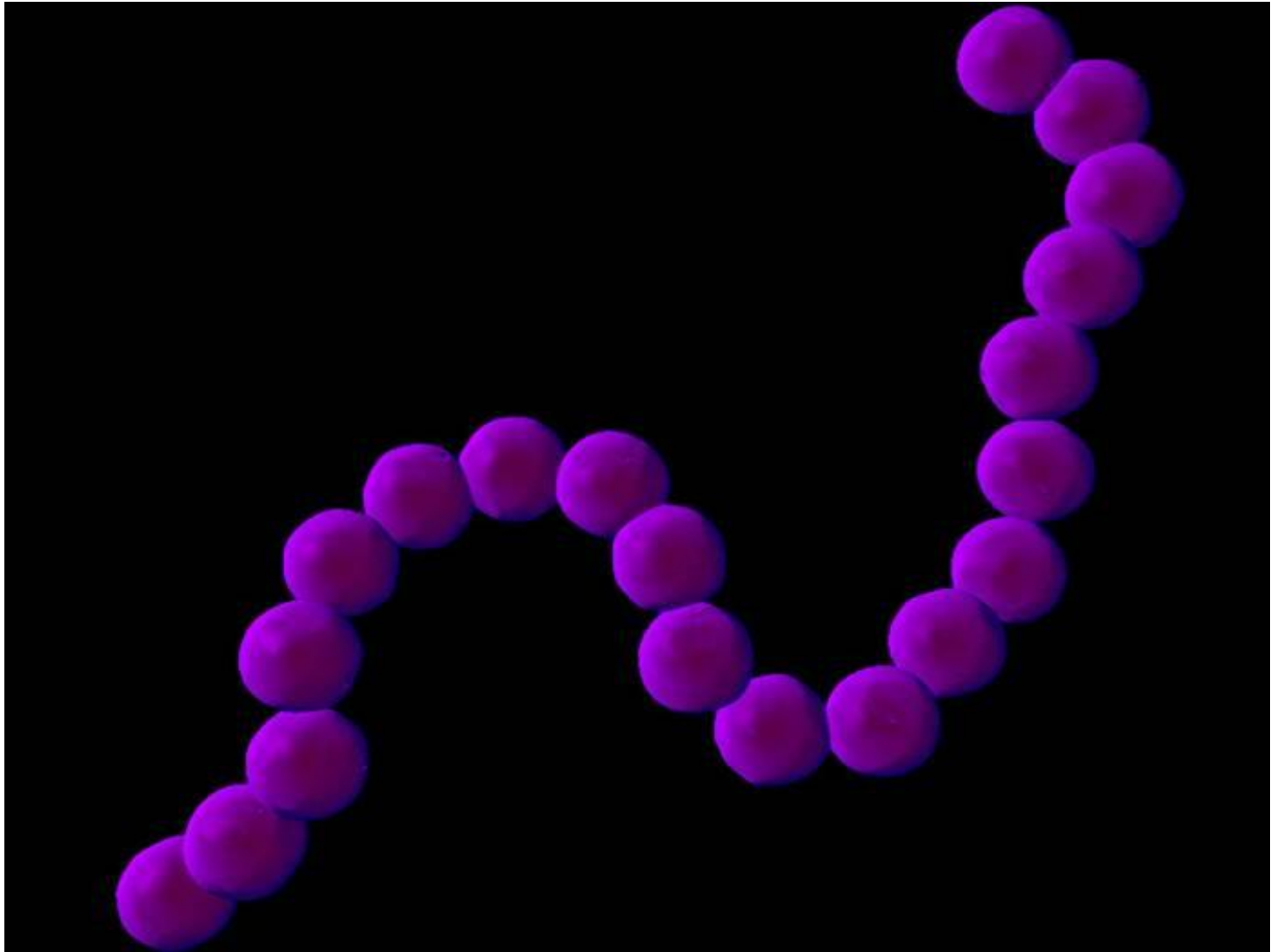
- Public health threat in the hospital and in the community
- MRSA, the resistance gene is **mecA**, encodes low-affinity penicillin-binding protein 2A (**PBP2A**)
- PVL is encoded by a mobile phage (**SLT**) that can transfer PVL to other strains.
- PVL is usually low in health care–associated MRSA (HCA-MRSA), whereas it is present in almost 100% of isolates of community-acquired MRSA (CA-MRSA)

# Coagulase negative Staphylococci

- Skin commensal
- May contaminate clinical specimens
- Occasionally cause infections
- Opportunistic pathogen
  - Infect immunocompromised & debilitated patients
- Commonly responsible for device-related infections



# Streptococcus



# Features

- ♣ Gram (+) ve cocci
- ♣ Arranged in pairs or in chains

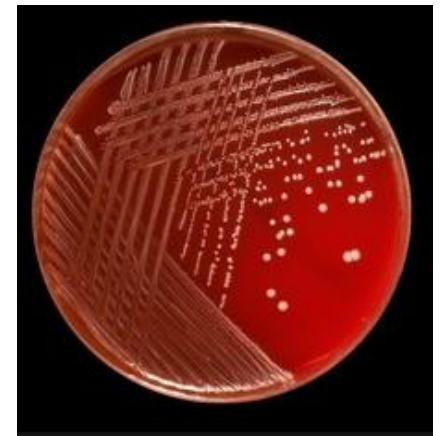
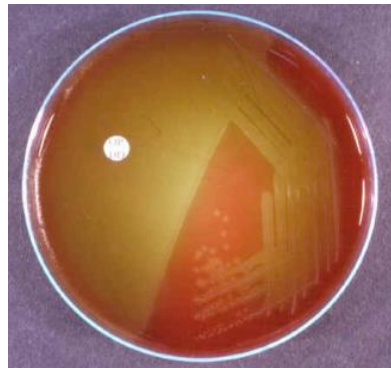
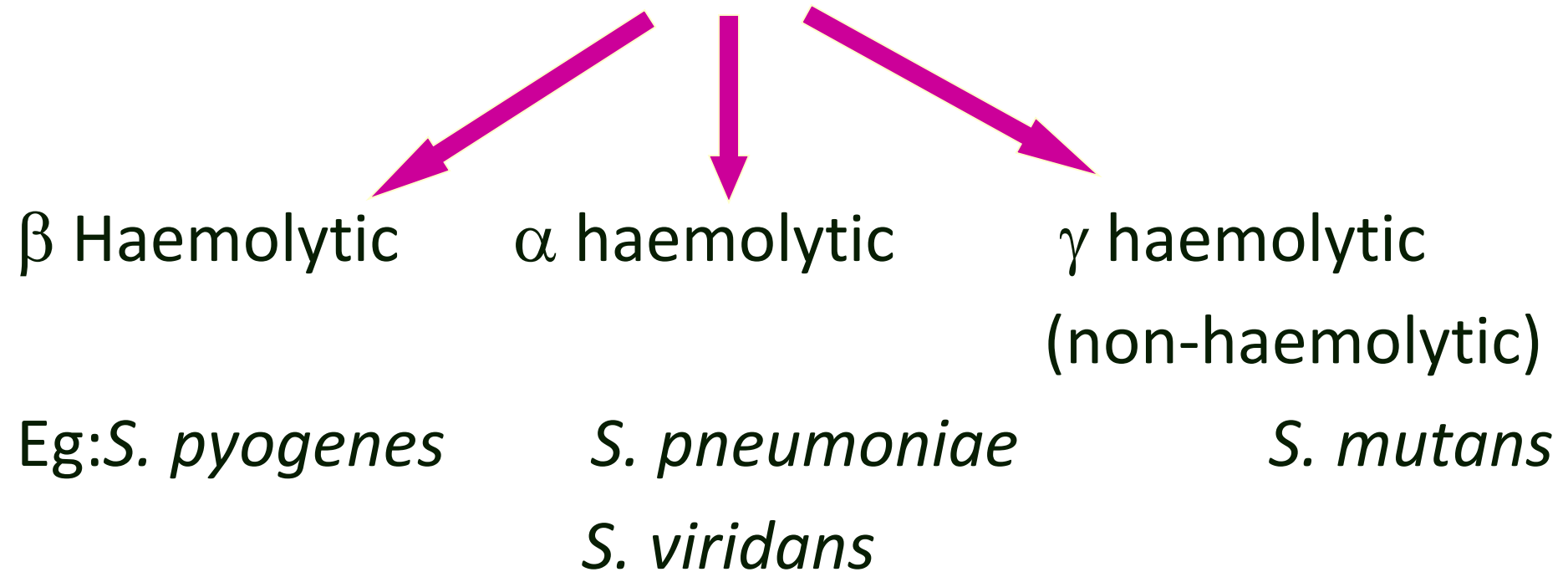


# Features

- ♣ Non-motile
- ♣ Non spore forming
- ♣ Catalase (-) ve
- ♣ Most are facultative anaerobes
- ♣ Some are strict anaerobic

# Classification

Depending on type of haemolysis on blood agar



- **$\beta$  haemolysis**

Clear zone of haemolysis produced by strains producing soluble haemolysins

Eg: Streptolysin O & S

- **$\alpha$  haemolysis**

Incomplete haemolysis produces partial clearing (green colouration)

# Classification of $\beta$ - haemolytic Streptococci

- 20 Lancefield groups (Depending on polysaccharide antigen in cell wall)  
A-H & K-V



## Medically important Streptococci

- Group A- *Streptococcus pyogenes*
- Group B- *Streptococcus agalactiae*
- Group D Streptococci
- Viridians group of Streptococci
- *Streptococcus pneumoniae*
- Anaerobic Streptococci

***Streptococcus pyogenes***

# Suppurative conditions

## 1. Sore throat



## 2.Impetigo



# 3.Erysipelas



### 3.Cellulitis

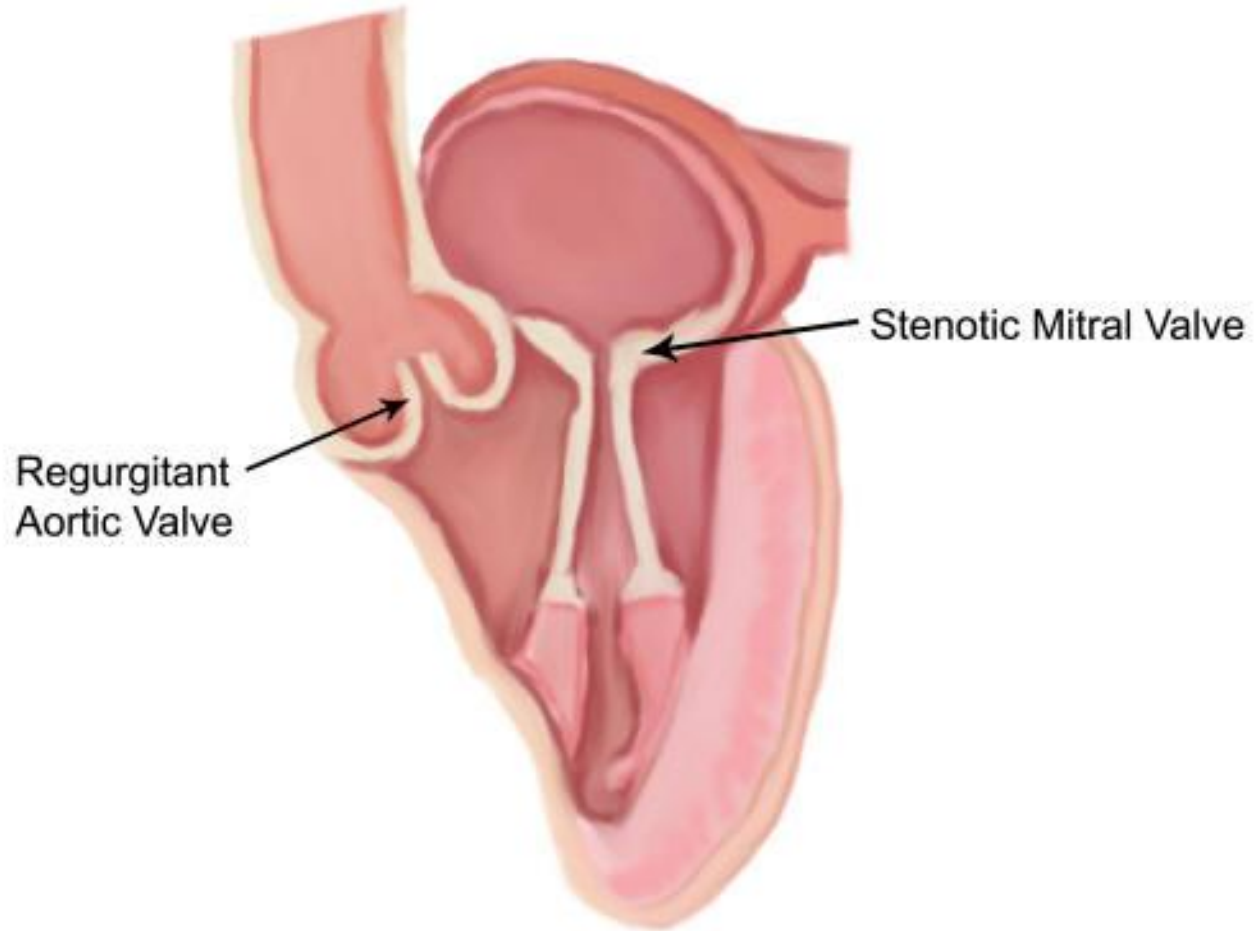




# Non – suppurate conditions

## Rheumatic fever

### Rheumatic Mitral Stenosis



# Post streptococcal glomerulonephritis



# **Virulence factors**

## **1. M protein**

- \* Main antiphagocytic factor
- \* Antibody to M protein responsible for type specific immunity

## **2. Fimbriae**

- \* Enhance attachment to the epithelial cells

## **3. Hyaluronic acid capsule**

- \* Antiphagocytic action

## 4. Extracellular products

- \* Enzymes & toxins

### A ) Erythrogenic toxins

Produce erythematous rashes



## B) Haemolysins

- \* Lyses RBC

Eg: Streptolysin O  
Streptolysin S

## **C) Streptokinase (Fibrinolysin)**

- \* Participate in fibrin lysis
- \* Prevent formation of Fibrin barrier
- \* Prevent localization of infection
- \* Use in early Rx of coronary thrombosis



## **D) DNA ase**

- \* Antigenic
- \* Hydrolyze nucleic acid & nuclear proteins
- \* Liquefy viscous exudates

## **F) Hyaluronidase** (spreading factor)

## **G) NAD ase**

- \* Leucotoxic

# Group B streptococci

## *Streptococcus agalactiae*

- Normal habitat – gut & vagina
- A main causes for neonatal meningitis

## Group D Streptococci & enterococci

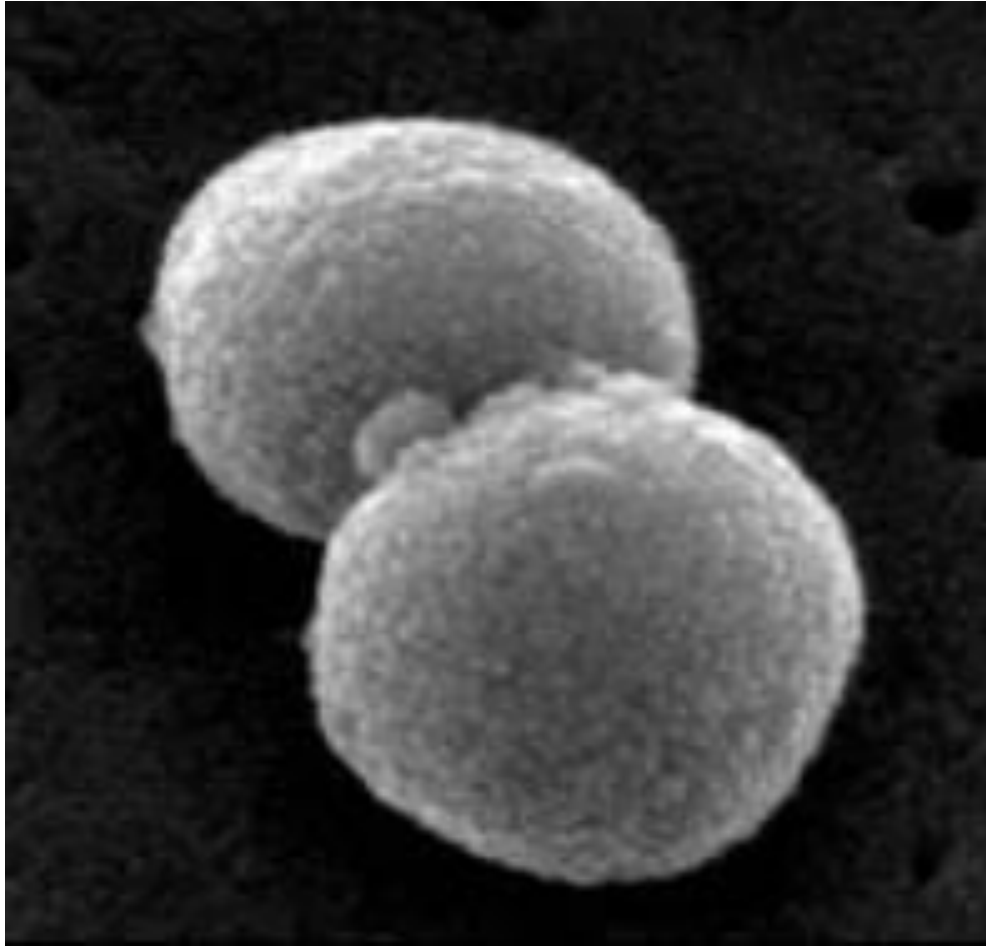
- ♠ Commensals of intestine & vagina.
- ♠ Oval Gram (+) ve cocci arranged in pairs or in short chains
- ♠ Important strains
  - E. faecalis*
  - E. faesium*
- ♠ Causes urinary tract infections, wound infections.

# Viridans group of Streptococci

- Found as commensals in the mouth & throat
- $\alpha$  haemolytic / non haemolytic
- Causes Infective endocarditis



***Streptococcus pneumoniae***  
**(Pneumococcus)**



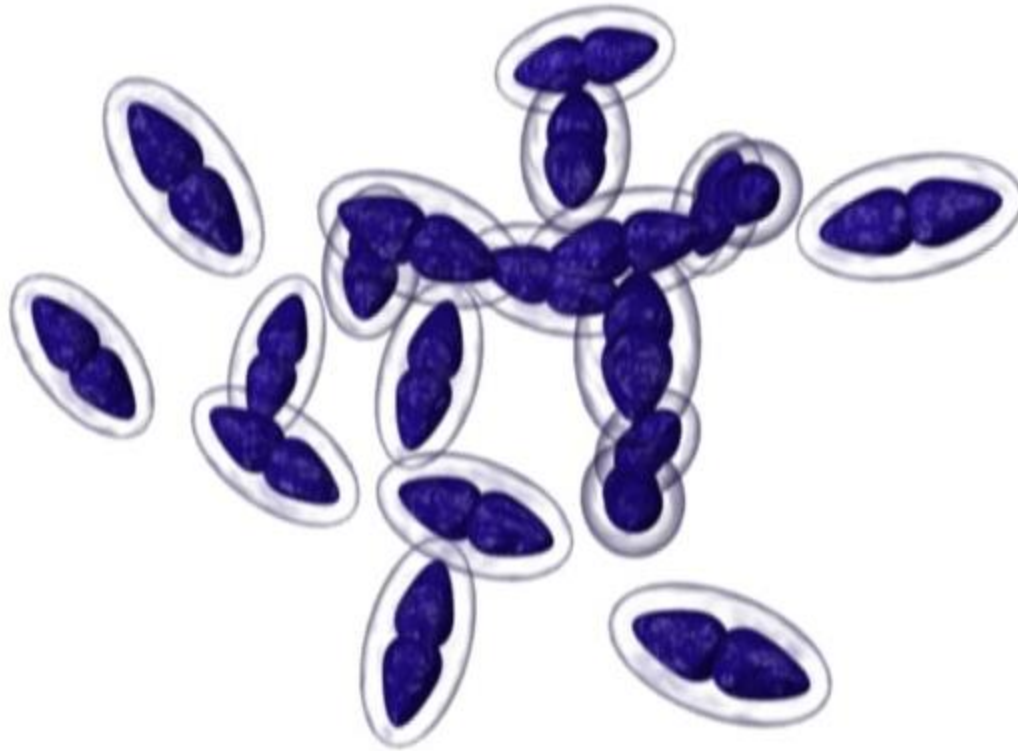
Scanning EM view of Pneumoococci

- Ovoid cocci
- Lancet shaped
- Occur in pairs (diplococci) with broader ends opposed





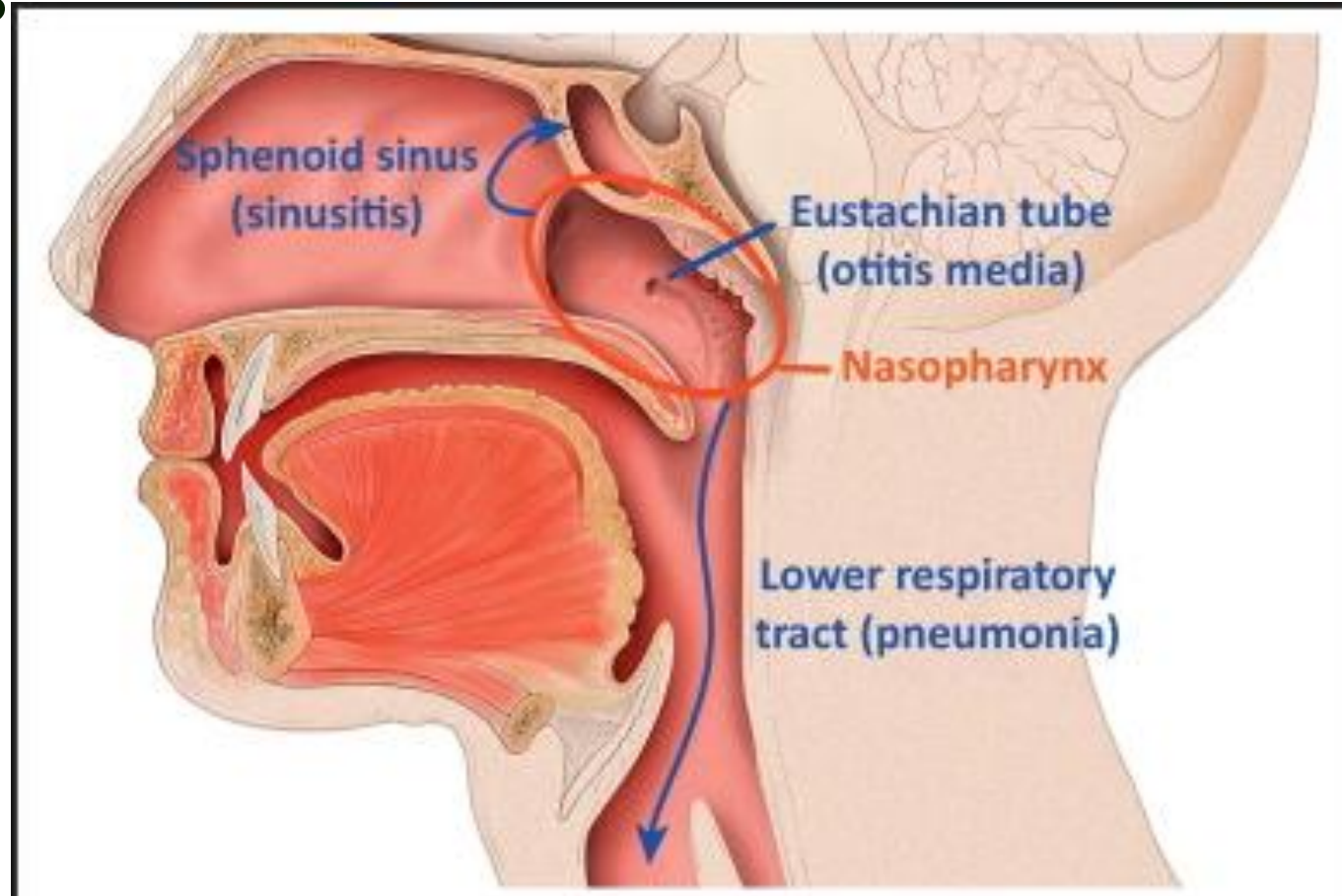
- Facultative anaerobes
- Non motile
- Capsulated



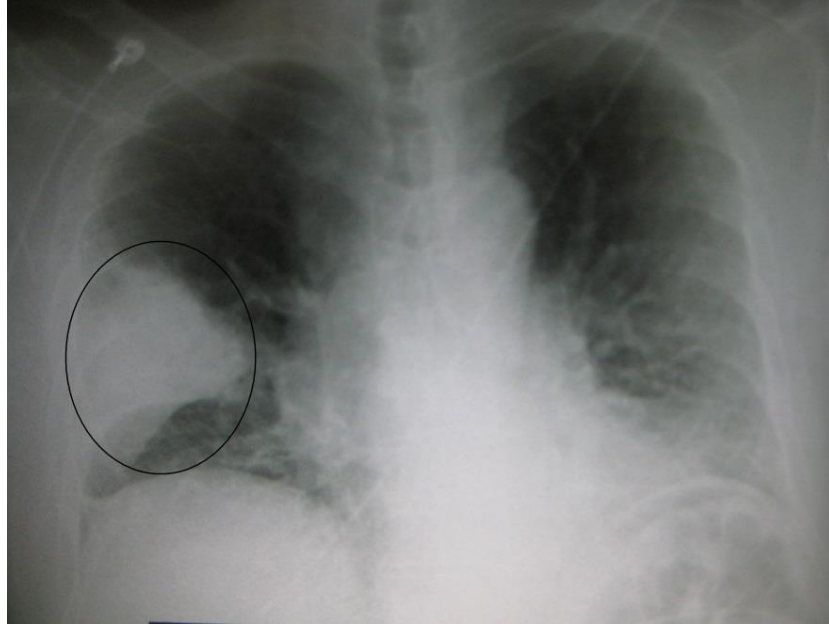
- Commensals in oropharynx

# Clinical manifestations

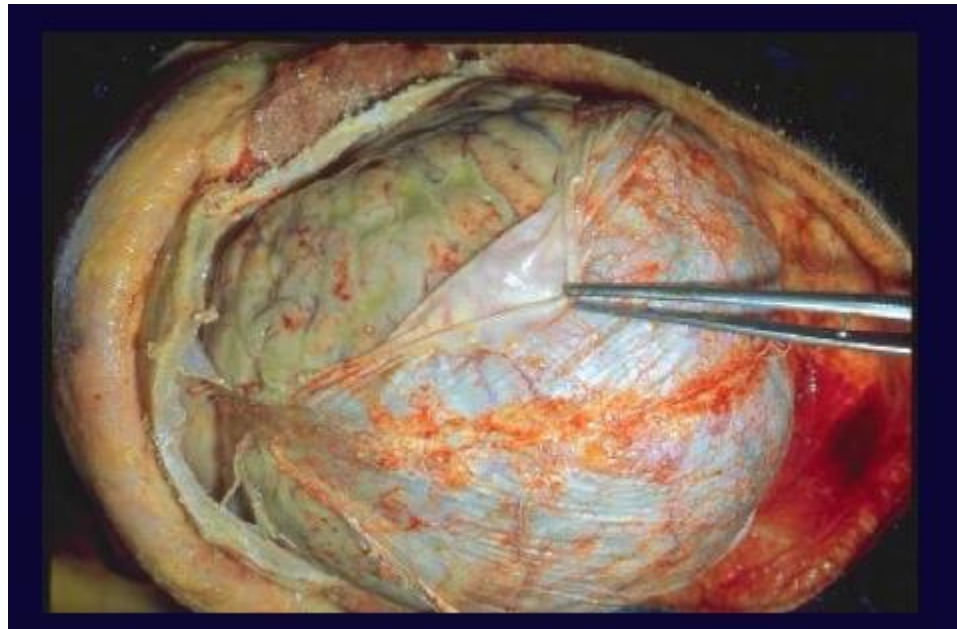
- Otitis media
- Sinusitis
- Mastoiditis



- Pneumonia



- Meningitis



# Virulence factors

- Polysaccharide capsule

- Protect bacterium against phagocytosis
- more antigenic
- Has >85 antigenic types

- Pneumolysin

- Membrane damaging toxin

# Classification of medically important bacteria

## Rigid thick walled cells

### » Gram positive

» Cocci (Staphylococci , Streptococci)

» Bacilli Spore forming

» Non-spore forming

### » Gram negative

» Cocci

» Bacilli Aerobic

» Anaerobic

» Facultative anaerobic

» Acid fast (eg: Mycobacteria)

• Flexible thin-walled cells (eg: Spirochetes)

Wall-less cells (eg: Mycoplasma)





# Lab diagnosis

- Specimens

Pneumonia- Sputum

Blood

Meningitis - CSF

Blood

- **Ix**

Gram stain

Culture

Require enriched media Eg: Blood agar

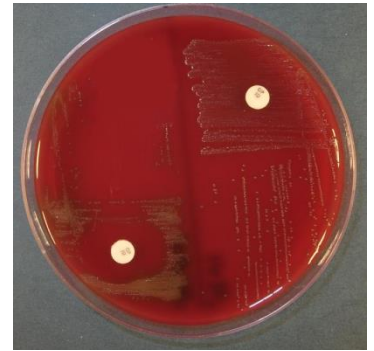
- 5-10% Co<sub>2</sub>

- Incubate for 24 hrs

- Produce 1 mm colonies with  $\alpha$  haemolysis

- Prolong incubation produce central depression of colonies-**Draughtsman appearance**

- Optochin sensitivity.
- Detection of capsule.
  - Adding India ink to a suspension of organism
  - Capsule seen as clear zone



Quellung reaction (capsular swelling test)

When organism mixed with type specific antiserum – increase the thickness of the capsule.

- Latex agglutination test

For detection of capsular antigen

Specially in CSF samples