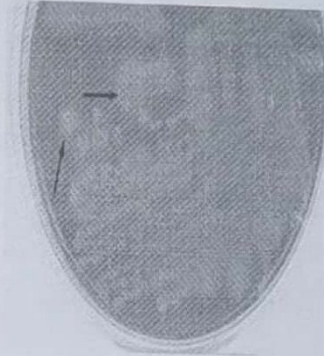
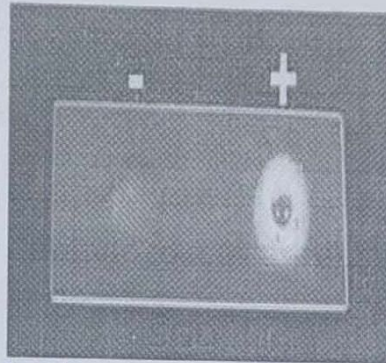


# Staphylococcus aureus

## SGD

A young patient landed to the emergency in shock. History revealed nasal surgery 5 days back. On examination, nasal packing was obtained from his nose. Gram staining and Catalase test and culture revealed the following results:



Toxic Shock Syndrome

TSST

1. What can be the most possible disease and the causative agent?
2. Enumerate the virulence factors of the organism. Which component of the bacteria is responsible for his condition?
3. What are MRSA and its treatment?
4. What other biochemical tests can be used for its confirmation? *Coagulase & DNase*
5. What are the different modes of pathogenesis of this organism? *Catalase, Coagulase, DNase, Streptokinase & Hyaluronidase*
6. Why are the colonies yellow in color? *Staphyloxanthin*
7. Name 5 toxins & 5 enzymes produced by this organism. *Exfoliatin, Enterotoxin, P. V. Leukocidin, TSST, Alpha*
8. What is Beta lactamase and its importance? *Enzymes inhibit  $\beta$ -lactamase  $\rightarrow$  resistant to vaccines*

Virulence factor  $\rightarrow$  Cell wall mediated. Protein A  $\rightarrow$  Bc of IgG  
 $\rightarrow$  Teichoic acid  
 $\rightarrow$  Lipoteichoic acid  $\rightarrow$  mediated adhesion.  
 $\rightarrow$  Polysaccharides capsule.  
 $\rightarrow$  Peptidoglycan layer  $\rightarrow$  Cytolines.

$\rightarrow$  Toxins.  $\rightarrow$  Exfoliatin  $\rightarrow$  Scalded skin syndrome, bullous impetigo, TSST.  
 Enterotoxin  $\rightarrow$  Food poisoning.  
 Exotoxin  $\rightarrow$  Alpha toxin  $\rightarrow$  Pores  $\rightarrow$  skin necrosis.  
 P.V. Leukocidin  $\rightarrow$  Kill white blood cell

Enzyme  $\rightarrow$  coagulase, DNase, Hyaluronidase, Catalase, Staphylokinase, Lipase, nucleases, protease.

Pyogen Local disseminated

Cellulitis, Impetigo

Meningitis  
Endocarditis

Toxigenic

TSST  
Diarrhea  
Scalded skin

KEY:

1. Toxic shock syndrome & *Staphylococcus aureus*.
2. Carotenoid pigment, Polysaccharide capsule / Microcapsule, Peptidoglycan. Surface receptors, Teichoic acids, Protein A, Enterotoxin, Toxic shock syndrome toxin, Exfoliative toxin, alpha toxin, P-V leukocidin, Enzymes include coagulase, Dnase, fibrinolysin, hyaluronidase, proteases, nucleases and lipases.

**Toxic shock syndrome toxin**

3. Some strains of *S. aureus* resistant to  $\beta$ -lactamase-resistant penicillins, such as methicillin & nafcillin, by virtue of changes in the penicillin-binding protein in their cell membrane. (**Methicillin-resistant *S. aureus* (MRSA) or Nafcillin-resistant *S. aureus* (NRSA).**)

**Drugs of choice for MRSA:** Vancomycin, Gentamicin, Daptomycin, Trimethoprim-sulfamethoxazole, Clindamycin, MRSA strains resistant to all Beta-lactam drugs, including both penicillins & cephalosporins.

4. Coagulase test & Dnase test
5. Pyogenic: Localized: Abscess, cellulitis, etc.  
Systemic: Sepsis, endocarditis, osteomyelitis

Toxigenic: Toxic shock syndrome

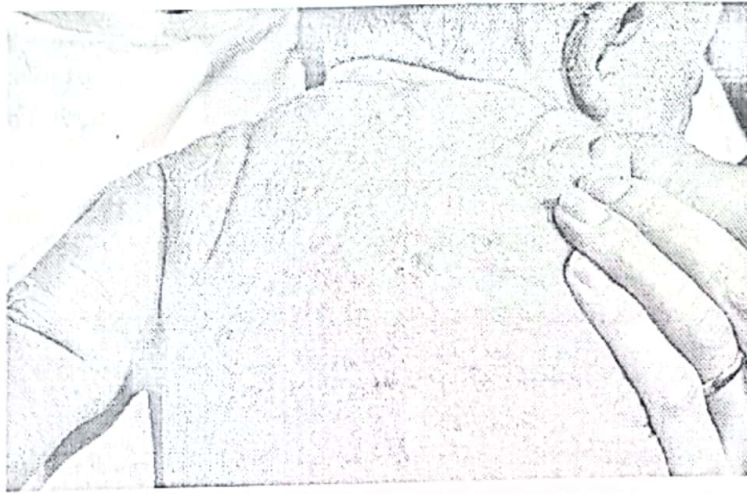
Food poisoning

6. Due to production of carotenoid pigment.
7. Toxins: Enterotoxin, Toxic shock syndrome toxin, Exfoliative toxin, alpha toxin, P-V leukocidin  
Enzymes: Coagulase, Hyaluronidase, Proteases, Nucleases, Lipases, Dnases
8.  **$\beta$  lactamase production:** More than 90% of *S. aureus* strains contain plasmids that encode  $\beta$ -lactamase, the enzyme that degrades many penicillins so resistant to penicillin G. Penicillin ( $\beta$ -lactam ring), has high affinity for penicillin binding protein (PBP) in peptidoglycan layer. Penicillin bind to PBP & inhibit peptidoglycan synthesis, kills bacteria. As a result, most of these strains produce  $\beta$ -lactamase, which destroy  $\beta$ -lactam ring of Penicillin &  $\beta$ -lactamase producing bacteria survive or become resistant. Rx of  **$\beta$ -lactamase producing strains:**  $\beta$ -lactamase stable penicillins, e.g. methicillin, nafcillin or cloxacillin, some cepha-losporins, or vancomycin, combination of  $\beta$ -lactam drug +  $\beta$ -lactamase inhibitor e.g. amoxicillin +clavulanic acid.



## Staphylococcus aureus SGD

A young boy developed fever with large bullae & erythematous macular rash, causing sloughing of skin & electrolyte imbalance.



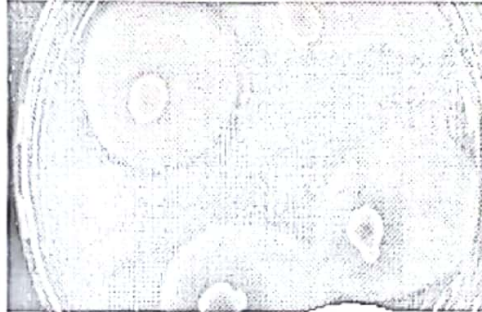
1. <sup>Scalded skin syndrome</sup> What is the disease and the causative agent? Exfoliatin toxin → protease → cleaves desmoglein of desmosome of epithelial cells → skin eruption
2. Which component of the organism has caused this condition and how? → Toxin.
3. Name two species of this organism. <sup>Agalctae</sup> Epidermidia
4. What are VRSA and their treatment and prevention? <sup>synercid</sup>  
↓  
Daptomycin  
Quinopristin - Daltopristin.

KEY:

1. Scalded skin syndrome & *Staphylococcus aureus*
2. Exfoliative toxin: Epidermolytic: acts as protease, cleaving desmoglein in desmosomes, leading to separation of epidermis at granular cell layer, characterized by fever, large bullae & an erythematous macular rash, causing skin to slough, serous fluid exudes & electrolyte imbalance. Hair & nails can be lost, Recovery occurs within 7–10 days.
3. *Staphylococcus epidermidis* & *Staphylococcus saprophyticus*
4. **Vancomycin resistance:** Rare strains called vancomycin-intermediate *S. aureus* (VISA), with reduced sensitivity to vancomycin and strains fully resistant to vancomycin VRE have emerged. Combination of two streptogramins, quinupristin-dalfopristin (Synercid) effective, but Synercid available as investigational drug.

## Staphylococcus SGD

a.



b.



- Coagulase Clotase*
1. Name these biochemical tests. This test is used for differentiation of which two species of bacteria?
  2. In which bacteria both of these tests are positive? *Staphylococcus Aureus* -
  3. What are the two types of test (b) and what is its principle?  
*Coagulase Slide & Tube*

KEY:

1. Dnase test & Coagulase test. *Staphylococcus aureus*: Positive **coagulase & Dnase test**  
*Staphylococcus epidermidis* & *Staphylococcus saprophyticus* (coagulase-negative **Staphylococci**).
2. *Staphylococcus aureus*
3. Slide test and tube test. **Coagulase**: Enzyme causes plasma to clot by activating prothrombin to form thrombin. Thrombin then catalyzes activation of fibrinogen to form the fibrin clot.

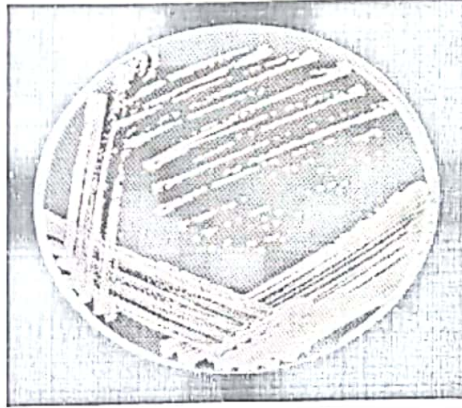


1. What can be the probable cause of the infection?
2. Is this organism normally a pathogen or commensal?
3. Name two biochemical tests used in the laboratory for its diagnosis.
4. Name two antibiotic classes of this organism.

## Staphylococcus epidermidis

A 40 year old adult male suffering from valvular heart disease, had to go for a prosthetic heart valve surgery. 1 Week after surgery he developed infection of heart valves.

Culture of blood revealed the following growth on blood agar:



1. What can be the probable cause of his infection?
2. Is this organism normally a pathogen or flora?
3. Name two biochemical tests used in the laboratory for its diagnosis.
4. Name two virulence factors of this organism.

Capsule & Teichoic acid,



KEY:

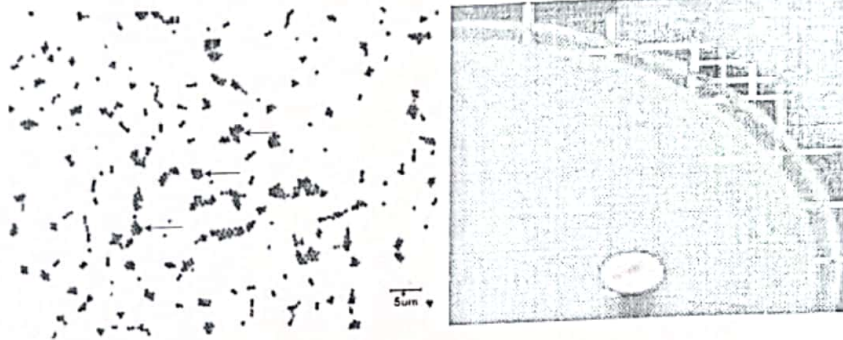
1. Staphylococcus epidermidis
2. Flora
3. Catalase positive, Coagulase & Dnase negative, Sensitive to novobiocin
4. **Teichoic acid:** Ribitol phosphate polymers: Mediate adherence.  
**Polysaccharide capsule, Receptors for Staphylococcal phages**



## Staphylococcus saprophyticus

### SGD

A young female presented with urinary tract infection. Gram staining showed gram positive cocci, having the following result on novobiocin sensitivity test:



1. Name the causative agent.
2. Is this organism catalase positive? *yes*
3. Is this organism coagulase or Dnase positive? *no*
4. Enumerate two other causative agents of UTI.

*E. coli*  
*Proteus*

KEY:

1. Staphylococcus saprophyticus
2. Catalase positive.
3. Coagulase & Dnase negative.
4. E.coli, Proteus.



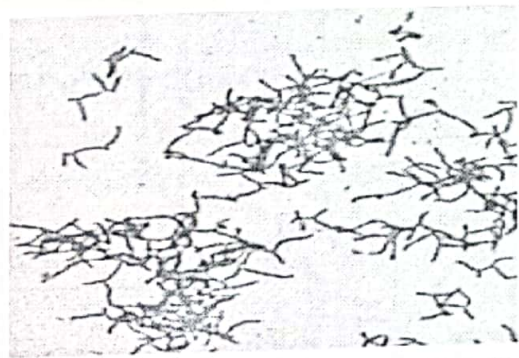
1. Name the causative agent and the disease.
2. What are the different types of this disease?
3. Classify Gram positive rods.

## Non-Spore forming Gram Positive rods

### Actinomycetes

#### SGD

A 20 years male developed granulomatous inflammation having swollen, lumpy jaw, fluctuant mass with draining sinuses, followed by a broken jaw. Gram staining of pus revealed Gram-positive branching rods, with presence of hard, lobulated, sulfur granules.

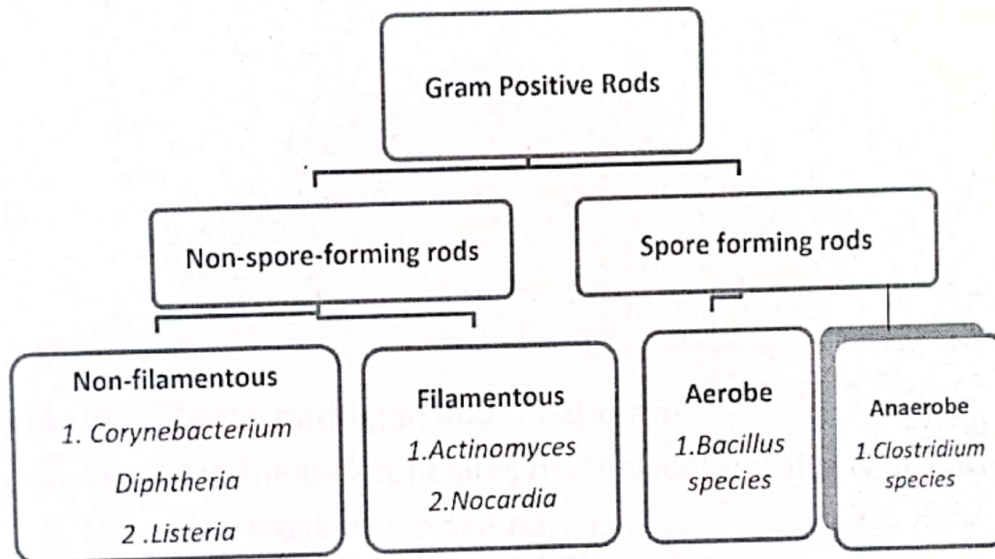


Gram stain of *Actinomyces israelii*

1. Name the causative agent and the disease. *Actinomyces is*
2. What are the different types of this disease?
3. Classify Gram positive rods.

**KEY: 1**

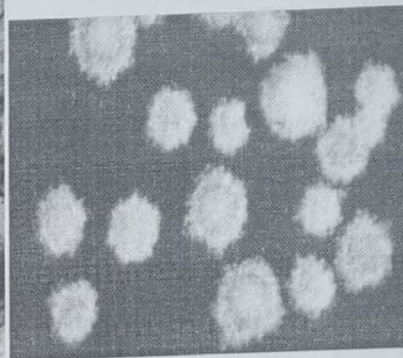
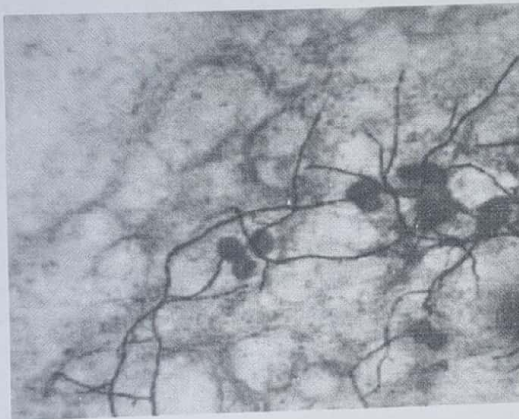
- 1. Actinomyces israelii and actinomycosis**
- 2. Cervicofacial Actinomycosis, Thoracic Actinomycosis, Abdominal Actinomycosis, Genital Actinomycosis**
- 3. Penicillin G Drug of Choice**





## Nocardia SGD

A patient of AIDS presented with fever, weight loss, chest pain ending up with lung abscess with cavity formation. Sputum culture revealed weakly acid fast bacilli after ZN staining and chalky white colonies on blood agar.



1. Identify the pathogen and the disease. *Nocardiosis.*
2. What are the different sites of involvement of this disease?
3. Name the weakly acid fast bacilli.

*Nocardia Asteroides*  
*M. Leprae*