



# Microbiology

2025-2024

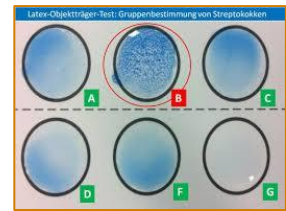
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# Streptococci

- **Classification of Streptococcus Species**

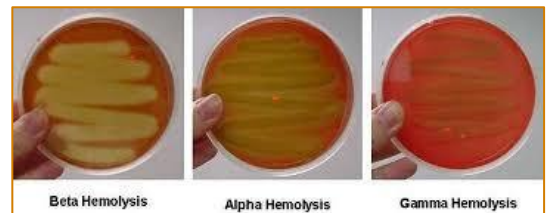
- Classifying over 100 species in the *Streptococcus* genus is complex due to three overlapping methods:

1. **Serologic Properties:** Lancefield groupings (A to W).



2. **Hemolytic Patterns:** Types of hemolysis on blood agar:

- a. **Beta ( $\beta$ ):** complete hemolysis
- b. **Alpha ( $\alpha$ ):** partial hemolysis
- c. **Gamma ( $\gamma$ ):** no hemolysis



3. **Biochemical Properties:** Based on physiological traits.

- **Key Pathogenic Species:**

- These species are particularly relevant for human health due to their pathogenic potential

- ✓ *Streptococcus pyogenes* (Group A Streptococcus/GAS)
- ✓ *Streptococcus agalactiae* (Group B Streptococcus/GBS)
- ✓ *Group D Streptococcus* (Enterococci)
- ✓ *Streptococcus pneumoniae*
- ✓ *Streptococcus viridans*

- **Streptococcus pyogenes (Group A Streptococcus, GAS)**

- **Characteristics & Culture:**

- ✓ **Morphology:** Spherical cocci (1-2  $\mu\text{m}$ ) in chains.
- ✓ **Colony Appearance:** Forms 1-2 mm white colonies with large  $\beta$ -hemolysis zones on blood agar.
- ✓ **Identification:** Contains Lancefield group A antigen.

- **Immune Evasion Mechanisms:**

- ✓ **Capsule:** Hyaluronic acid capsule inhibits phagocytosis.
- ✓ **M Protein:** Blocks complement binding (C3b) and aids in adherence and invasion of host cells.
- ✓ **C5a Peptidase:** Deactivates C5a, hindering immune cell recruitment.

- **Toxins and Enzymes:**

1. **Streptococcal Pyrogenic Exotoxins (Spe):** Act as superantigens, causing severe illnesses like necrotizing fasciitis, toxic shock syndrome, and scarlet fever rash.
2. **Streptolysin S:** Oxygen-stable hemolysin causing  $\beta$ -hemolysis.
3. **Streptolysin O:** Oxygen-labile hemolysin; induces antistreptolysin O (ASO) antibodies, useful for recent infection diagnosis.
4. **Streptokinase:** Dissolves clots, aiding bacterial spread.
5. **DNases (A-D):** Break down DNA in pus, enhancing tissue invasion.

➤ **Epidemiology:**

- ✓ **Prevalence:** CDC estimates ~10 million annual noninvasive cases (pharyngitis and pyoderma).
- ✓ **Transmission:** Spread via respiratory droplets, especially in crowded environments.
- ✓ **Infections:** Caused by newly acquired strains colonizing the oropharynx or skin.

➤ **Clinical Manifestations:**

**1. Suppurative (Pus-forming) Infections:**

- ✓ **Pharyngitis:** Throat redness, exudates, lymphadenopathy.
- ✓ **Scarlet Fever:** Red rash on chest/extremities (complication of pharyngitis).
- ✓ **Pyoderma:** Skin infection with pustules.
- ✓ **Erysipelas:** Painful, inflamed skin infection with systemic symptoms.
- ✓ **Cellulitis:** Infection of skin and subcutaneous tissue.
- ✓ **Necrotizing Fasciitis:** Severe infection destroying muscle and fat.
- ✓ **Streptococcal Toxic Shock Syndrome:** Severe, systemic infection with bacteremia and fasciitis.

**2. Non-suppurative (Post-infectious) Infections:**

- ✓ **Rheumatic Fever:** Inflammatory disease affecting heart, joints, and skin, typically post-pharyngitis.
- ✓ **Acute Glomerulonephritis:** Renal inflammation post-infection, with symptoms like edema, hematuria, and hypertension.

• **Streptococcus agalactiae (Group B Streptococcus, GBS)**

➤ **Identification:**

- ✓ **GBS Antigen Detection:** Distinguishes GBS from other streptococci.
- ✓ **Biochemical Reactions:** Resistant to bacitracin.

➤ **Colonization:**

- ✓ Commonly found in the **lower gastrointestinal** and **genitourinary tracts**.
- ✓ **Vaginal Carriage in Pregnancy:** Observed in 10-30% of pregnant women, posing a risk for newborn infections.

➤ **Infections in Adults:**

- ✓ Primarily affects **older adults** or those with underlying health conditions.
- ✓ **Common Infections:** Bacteremia, pneumonia, bone and joint infections, and skin/soft tissue infections.

• **Streptococcus pneumoniae**

➤ **Characteristics:**

- ✓ **Morphology:** Encapsulated, gram-positive, oval-shaped diplococci (0.5-1.2  $\mu\text{m}$ ).
- ✓ **Hemolysis:** Displays  $\alpha$ -hemolysis on blood agar due to **pneumolysin** activity, which degrades hemoglobin and produces a green product.

➤ **Virulence & Structure:**

- ✓ **Polysaccharide Capsule:** Virulent strains have a capsule, used for serotyping and included in polyvalent vaccines.
- ✓ **Pneumolysin:** Destroys ciliated epithelial and phagocytic cells, aiding infection spread.
- ✓ **Phosphorylcholine:** Found in the cell wall, it assists in host cell invasion and immune evasion.

- **Epidemiology:**
  - ✓ **Colonization:** Commonly inhabits the throat and nasopharynx, especially in children and adults living with children.
  - ✓ **Spread of Disease:** From the nasopharynx to lungs (pneumonia), sinuses (sinusitis), ears (otitis media), and meninges (meningitis).
  - ✓ **Vaccination:** Pediatric and adult vaccines have lowered disease incidence.
- **Pathogenesis:**
  - ✓ **Immune Response:** Host immune reaction to bacterial components (not toxins) causes symptoms.
  - ✓ **Secretory IgA Protease:** IgA protease neutralizes host defenses in the respiratory tract, while pneumolysin damages host tissues.
  - ✓ **Amidase:** Triggers immune response by releasing cell wall components that activate complement.
- **Clinical Relevance:**
  - ✓ **Capsule's Role in Virulence:** Only encapsulated strains are virulent, making the capsule essential for infection potential.
- **Viridans Streptococci**
  - **Characteristics:**
    - ✓ **Hemolysis:** Primarily  $\alpha$ -hemolytic, producing a green color on blood agar (from Latin "viridis," meaning green). Some strains are nonhemolytic.
  - **Colonization:**
    - ✓ Commonly found in the **oropharynx**, **gastrointestinal tract**, and **genitourinary tract**.
  - **Clinical Significance:**
    - ✓ Although generally less virulent, viridans streptococci can cause infections, especially in immunocompromised individuals and as a contributor to endocarditis following bloodstream entry.
- **Enterococcus**
  - **Characteristics:**
    - ✓ **Morphology:** Gram-positive cocci, often in pairs or short chains.
    - ✓ **Habitat:** Found primarily in the **large intestine** and **genitourinary tract**, with high concentrations in feces.
    - ✓ **Growth:** Facultatively anaerobic, tolerant to a wide temperature (10°C–45°C), pH range (4.6–9.9), and high levels of **NaCl** and **bile salts**.
    - ✓ **Hemolysis:** Variable patterns observed.
  - **Virulence:**
    - ✓ **Adherence:** Strong ability to adhere to tissues and form biofilms, contributing to infection persistence.
    - ✓ **Antibiotic Resistance:** Known for resistance, especially in healthcare settings, complicating treatment.
  - **Clinical Significance:**
    - ✓ **Nosocomial Infections:** A leading cause of hospital-acquired infections, particularly **urinary tract infections** associated with catheter use or instrumentation.

- **Case Example - Scarlet Fever Management:**

- **Symptoms:** Fever (101.8°F), sore throat with swollen tonsils and exudate, sandpaper-like rash.
- **Diagnosis:** Positive throat culture for *Streptococcus pyogenes* (Group A strep).
- **Treatment:** Penicillin for infection, paracetamol for fever, and lozenges for throat pain.
- **Outcome:** Fever and rash resolved after 48 hours; completion of antibiotics prevents complications like rheumatic fever.

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