

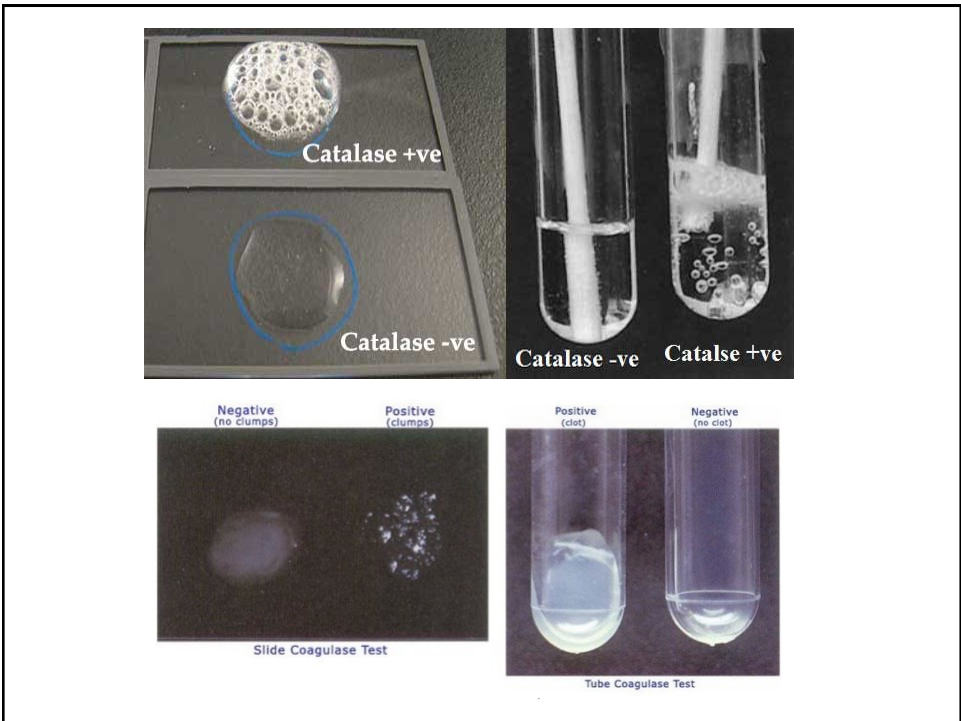
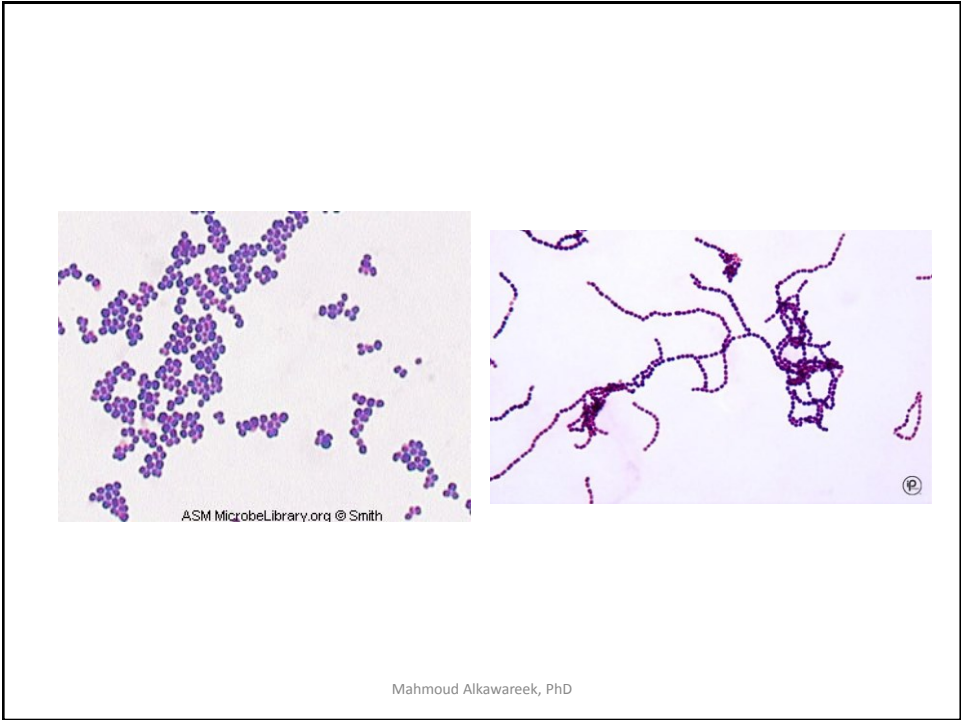
Gram Positive Cocci

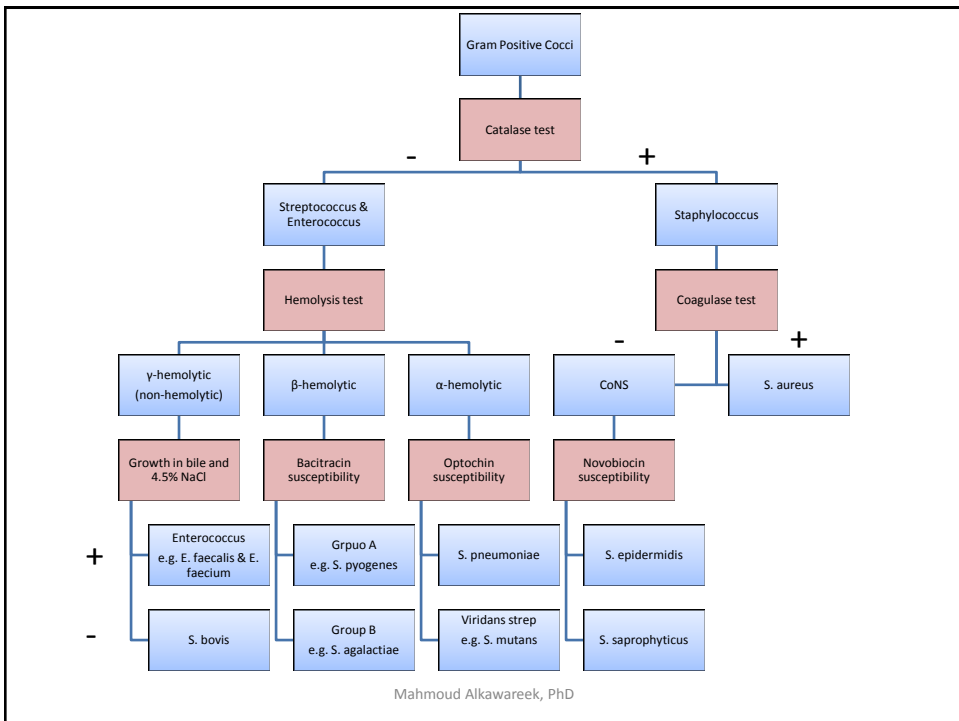
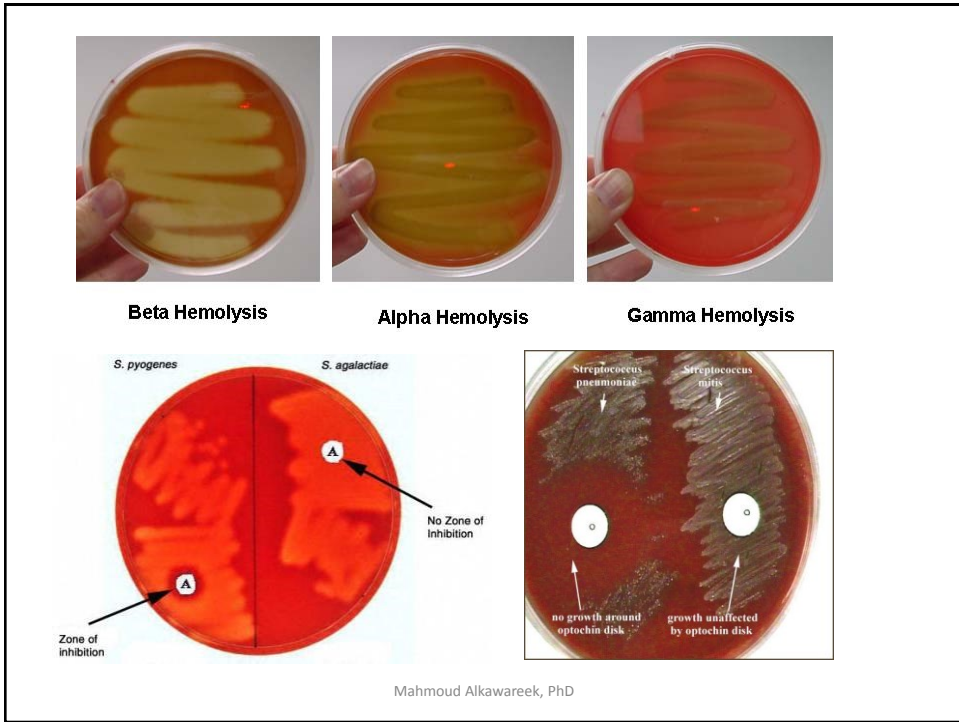
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Introduction

- Gram +ve cocci are spherical bacteria that appear in purple color after Gram staining, most medically important are:
 - Staphylococcus
 - Streptococcus
 - Enterococcus
- Arranged either in random clusters (staphylococci) or in chains/pairs (streptococci and enterococci)
- All 3 genera are facultative anaerobic bacteria
- Distinguished in the lab based on:
 - Biochemical tests: e.g. catalase and coagulase tests
 - Hemolysis: alpha, beta and gamma hemolytic
 - Growth in presence of bile salts and high NaCl (4.5%) media
 - Susceptibility to certain antibiotics: e.g. novobiocin, optochin and bacitracin

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Staphylococci

- *S. aureus*
 - Normal flora in many humans; especially on skin and nose and groin
 - Most virulent species in this genus
 - Infections acquired from endogenous or exogenous sources
 - Produces carbohydrate capsules and slime (biofilm)
 - Can cause variety of infections including skin infections (e.g. boils, carbuncles, and abscesses), lung infection, osteomyelitis, arthritis, endocarditis and septicemia
 - Most strains resistant to penicillin but susceptible to methicillin group. However number of MRSA strains is increasing. All but few are still susceptible to vancomycin

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Staphylococci

- *S. aureus*
 - Virulence factors:
 - Many enzymes and exotoxins including:
 - Coagulase: clot formation
 - Enterotoxins: vomiting and diarrhea (food poisoning)
 - Epidermolytic toxins: exfoliation of the skin
 - Hemolysins: lysis of RBC
 - Hyaluronidase: degrades hyaluronic acid in connective tissues
 - Leukocidin: kills white blood cells

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Staphylococci

- CoNS:
 - Weaker pathogens
 - *S. epidermidis*:
 - Normal flora; mainly on skin
 - Infections mainly in immunocompromised patients (nosocomial infections)
 - Forms biofilm; known for medical device associated infections
 - *S. saprophyticus*:
 - A common cause of community-acquired urinary tract infections

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Streptococci

- All streptococci are normal human commensals (flora) colonizing the mouth and upper respiratory tracts
- Most produce polysaccharide capsules
- Produce a wide range of virulence factors; mainly toxins
- Separated into different species by their ability to hemolyse blood and by their capsule antigens

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Streptococci

- α -hemolytic streptococci:
 - *S. pneumoniae* (Pneumococci)
 - Common colonizer of the upper respiratory tract
 - More than 80 serotypes
 - However, it is an opportunistic pathogen, capable of causing a wide range of infections:
 - Respiratory: pneumonia, otitis media and sinusitis
 - Severe meningitis
 - Septicemia
 - Sensitive to several antibiotics, including penicillin and cephalosporins. However, penicillin-resistant strains are now spreading worldwide
 - 2 vaccines available: Prevnar (for children) and Pneumovax (for adults)

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Streptococci

- α -hemolytic streptococci:
 - Viridans streptococci
 - Most common *S. mutans*
 - Normal flora in mouth and oropharynx
 - Low virulence but highly associated with dental caries and periodontal disease
 - Among most common causes of infective endocarditis
 - Sensitive to many antibiotics including penicillin but in serious infections (i.e. endocarditis) a combination of penicillin and aminoglycosides is used
 - Requires antibiotic prophylaxis during dental procedures in patients with a suspected heart valve abnormality

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Streptococci

- β -hemolytic streptococci:
 - *S. pyogenes* (group A streptococci)
 - Normal flora in the nasopharynx, but considered among major human pathogens
 - Causes a wide range of infections in humans, including skin and soft tissue infections, upper respiratory tract infections, septicemia and post-natal sepsis
 - Known for post-infectious complications including rheumatic fever and glomerulonephritis
 - Produces a variety of virulence factors:
 - Hemolysin
 - Leukocidin
 - Hyaluronidase
 - Streptokinase: dissolves clots
 - Erythrogenic toxin: causes erythematous rash in scarlet fever

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Streptococci

- β -hemolytic streptococci:
 - *S. agalactiae* (group B streptococci)
 - Normal flora; mainly in female genital tract
 - Usually harmless but can cause serious diseases in pregnant women and neonates such as:
 - Neonatal meningitis
 - Neonatal septicemia
 - Septic abortion
 - Best way to prevent such infections is the prepartum screening of this bacteria and if proven present, antibiotics administered during delivery (usually IV penicillin)

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Streptococci

- γ -hemolytic streptococci:
 - *S. bovis*
 - Group D streptococci
 - Mainly present in animals GI (i.e. cattle and sheep)
 - Causes some human infections such as endocarditis and UTI
 - It has also been associated with colorectal cancer

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Enterococcus

- γ -hemolytic bacteria that can grow in presence of high concentrations of NaCl or bile salts
- Most important species are *E. faecalis* & *E. faecium*
- Normal flora in GIT but can cause some serious infections such as endocarditis, UTI and abdominal wound infections (many of which are hospital acquired)
- Known for its high resistance to several antibiotics including vancomycin (i.e. VRE)

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