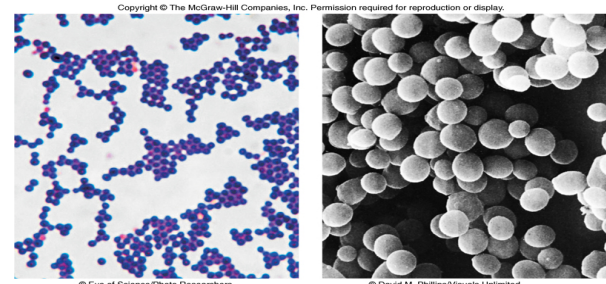


Staphylococcus aureus Diseases

Dr. mysoon Al-Ansari
Mic 460-7

General Characteristics of the Staphylococci

- Common inhabitant of the skin and mucous membranes
- Grows in large, round, opaque colonies
- Optimum temperature of 37°C, Facultative anaerobe
- Withstands high salt, extremes in pH, and high temperatures
- 31 species
- Gram-positive Spherical cells arranged in irregular clusters
- Lack spores and flagella, May have capsules
- Cause various diseases because they possess many virulence factors, e.g.; enterotoxin, haemolysins, proteases, leukocidin, TSST-1. Chemotherapeutic agents including antibiotics



Staphylococci

Coagulase-negative staphylococcus; frequently involved in nosocomial and opportunistic infections

- *S. epidermidis* – lives on skin and mucous membranes; endocarditis, bacteremia, Urinary Tract Infection (UTI)
- *S. hominis* – lives around apocrine sweat glands
- *S. capitis* – live on scalp, face, external ear
- All 3 may cause wound infections by penetrating through broken skin
- *S. saprophyticus* – infrequently lives on skin, intestine, vagina; UTI

The Two Types of Sweat Glands in Humans



ECCRINE GLANDS
(ALL OVER BODY)



APROCRINE GLANDS
(UNDERARMS AND PELVIC AREA)

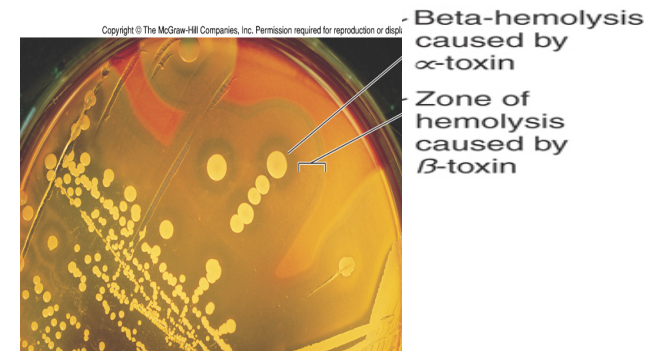
Virulence factors of *S. aureus*

Enzymes:

- Coagulase – coagulates plasma and blood; produced by 97% of human isolates; diagnostic
- Hyaluronidase – digests connective tissue
- Staphylokinase – digests blood clots
- DNase – digests DNA
- Lipases – digest oils; enhances colonization on skin
- Penicillinase – inactivates penicillin

Toxins:

- **Hemolysins** (α , β , γ , δ) – lyse red blood cells
- **Leukocidin** – lyses neutrophils and macrophages
- **Enterotoxin** – induce gastrointestinal distress
- **Exfoliative toxin** – separates the epidermis from the dermis
- **Toxic shock syndrome toxin (TSST)** – induces fever, vomiting, shock, systemic organ damage



Blood agar plate, *S. aureus*

TABLE 18.1**Major Virulence Factors of
*Staphylococcus aureus***

Name	Enzyme/Toxin	Effect
Coagulase	Enzyme	Coagulates blood plasma
Hyaluronidase	Enzyme	Digests connective tissue of the host
Staphylokinase	Enzyme	Digests blood clots
Lipase	Enzyme	Digests oils, allowing bacteria to more easily colonize the skin
Penicillinase	Enzyme	Inactivates penicillin, rendering the bacterium resistant
Hemolysins (α , β , γ , δ)	Toxin	Lyse red blood cells
Leukocidin	Toxin	Lyses neutrophils and macrophages
Enterotoxins	Toxin	Induce nausea, vomiting, and diarrhea
Exfoliative toxins (A, B)	Toxin	Cause desquamation of the skin
Toxic shock syndrome toxin	Toxin	Induces fever, vomiting, rash, organ damage

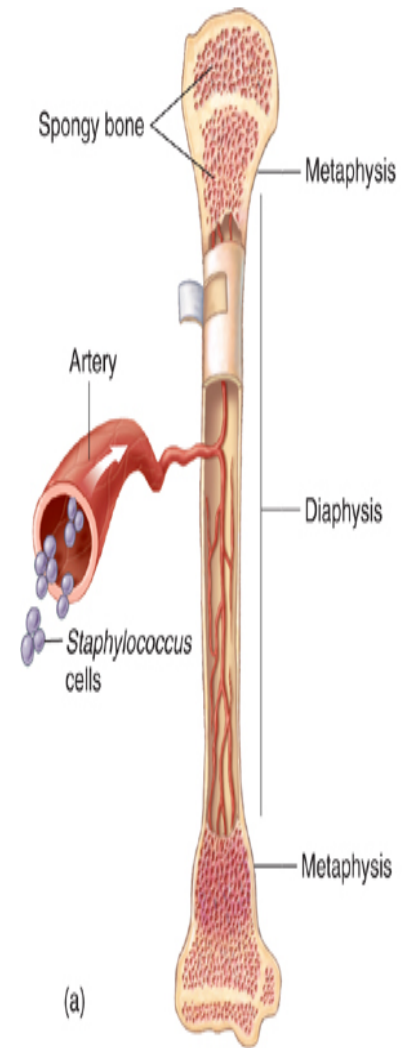
Epidemiology and Pathogenesis

- Present in most humans environments
- Carriage rate for healthy adults is 20-60%
- **Present mostly in:** anterior nares, skin, nasopharynx, intestine
- **Develop infection:** poor hygiene and nutrition, tissue injury, preexisting primary infection, diabetes, immunodeficiency
- Increase in community acquired methicillin (antibiotic) resistance - MRSA

Staphylococcal Disease

Range from localized to systemic

- **Localized cutaneous infections** – invade skin through wounds, follicles, or glands
 - **Folliculitis** – superficial inflammation of hair follicle; usually resolved with no complications but can progress
 - **Furuncle** – boil; inflammation of hair follicle or sebaceous gland progresses into abscess or pustule
 - **Carbuncle** – larger and deeper lesion created by aggregation and interconnection of a cluster of furuncles
 - **Impetigo** – bubble-like swellings that can break and peel away; most common in newborns
- **Systemic infections**
 - **Osteomyelitis** – infection is established in the metaphysis; abscess forms
 - **Bacteremia** – primary origin is bacteria from another infected site or medical devices; endocarditis possible



Staphylococcal Disease

- **Toxigenic disease**
 - **Food intoxication** – ingestion of heat stable enterotoxins; gastrointestinal distress
 - Staph food poisoning is caused by infection with the *Staphylococcus aureus* (*S. aureus*) bacterium. The bacteria multiply in food and produce toxin even at 4°C temperatures.
 - Foods include meats, poultry and egg products, salads (egg, tuna, chicken, potato, macaroni), bakery products (cream filled), sandwich fillings, milk and dairy products.
 - **Staphylococcal scalded skin syndrome** – toxin induces bright red flush, blisters, then desquamation of the epidermis
 - **Toxic shock syndrome** – toxemia leading to shock and organ failure

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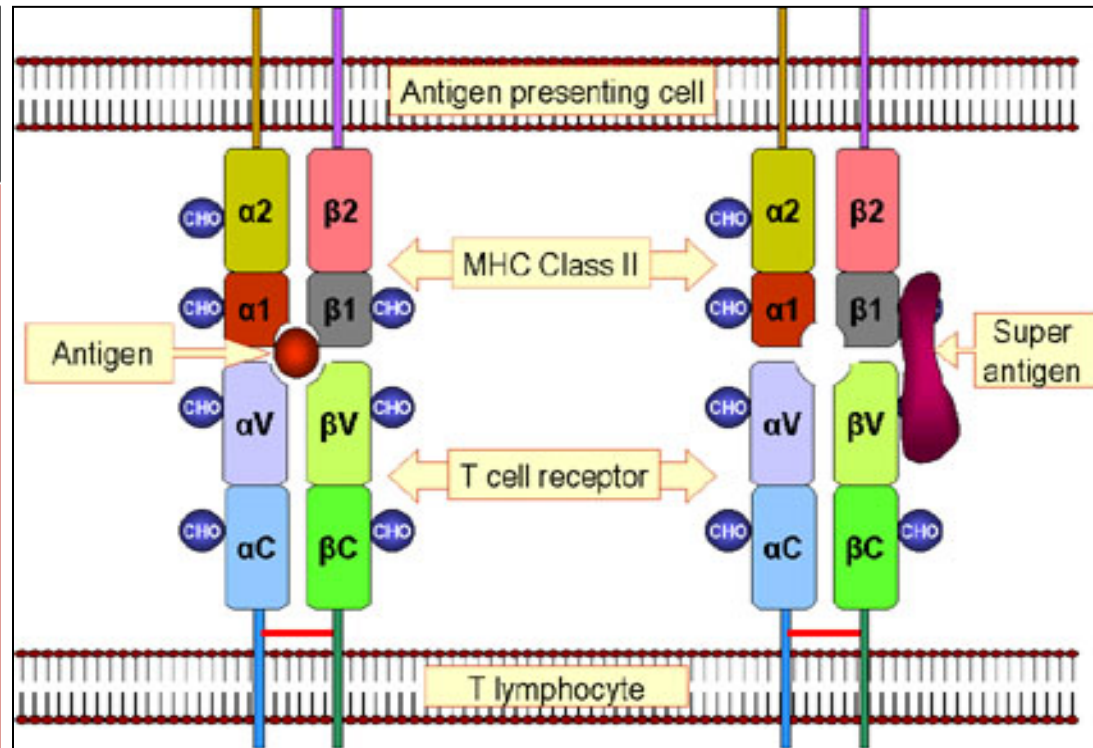


**Effects of
staphylococcal
toxins on skin**

Toxic Shock Syndrome Toxin

TSS Symptoms

- 8-12 h post infection
- Fever
- Susceptibility to Endotoxins
- Hypotension
- Diarrhea
- Multiple Organ System Failure
- Erythroderma (rash)

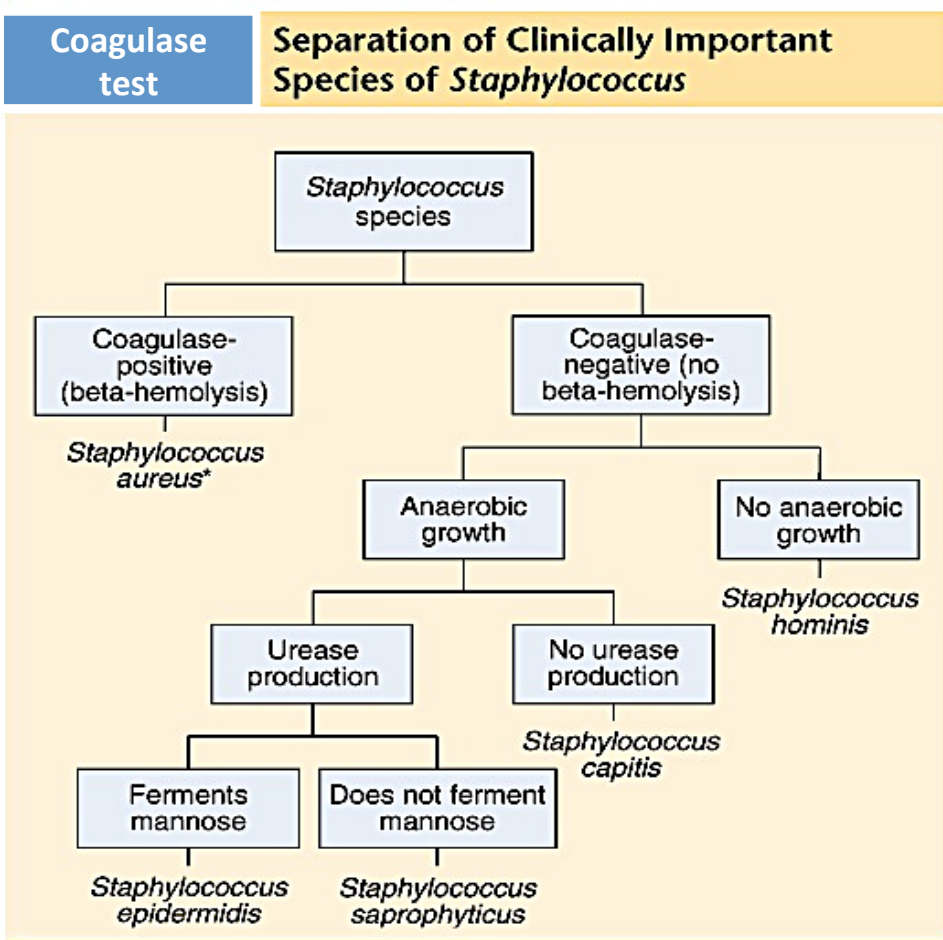


- **Superantigen:** are microbial products that have the ability to promote massive activation of immune cells, leading to the release of inflammatory mediators
- Non-specific binding of toxin to receptors triggers excessive immune response

Identification of *Staphylococcus* in Samples

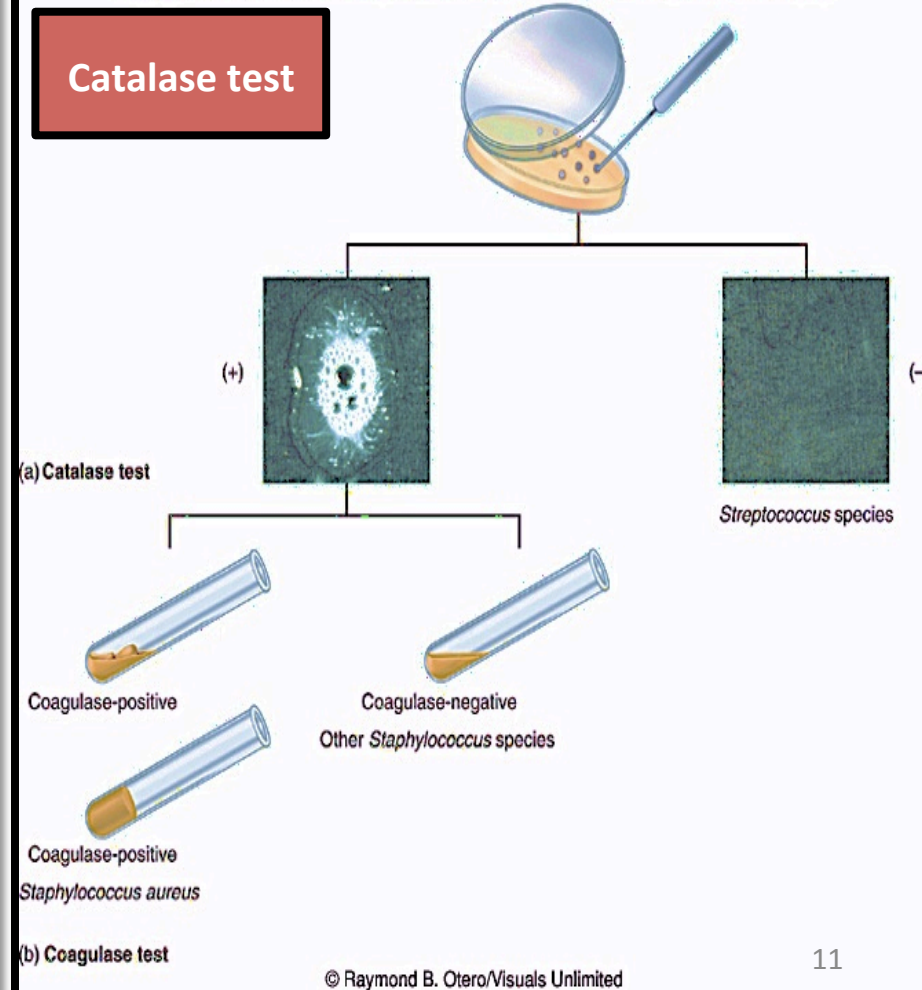
- Frequently isolated from pus, tissue exudates, sputum, urine, and blood
- Cultivation, catalase, biochemical testing, coagulase

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* A few strains of *S. aureus* are coagulase-negative.

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