Bacterial Skin and Soft Tissue Infections

Dr. Hala Mahmoud Altarawneh

Bachelor degree in Medicine and Surgery - Mutah university
MSC Medical Microbiology – University of Manchester
PhD Medical Microbiology - University of Manchester

Outlines

- Introduction
- Skin's Defence System and Skin microbiome
- Skin and soft tissue infections (SSTIs)
- Bacteria associated with SSTIs: *S. aureus*, and *S. pyogenes*
- Purulent, and Non-purulent SSTIs

1. Introduction

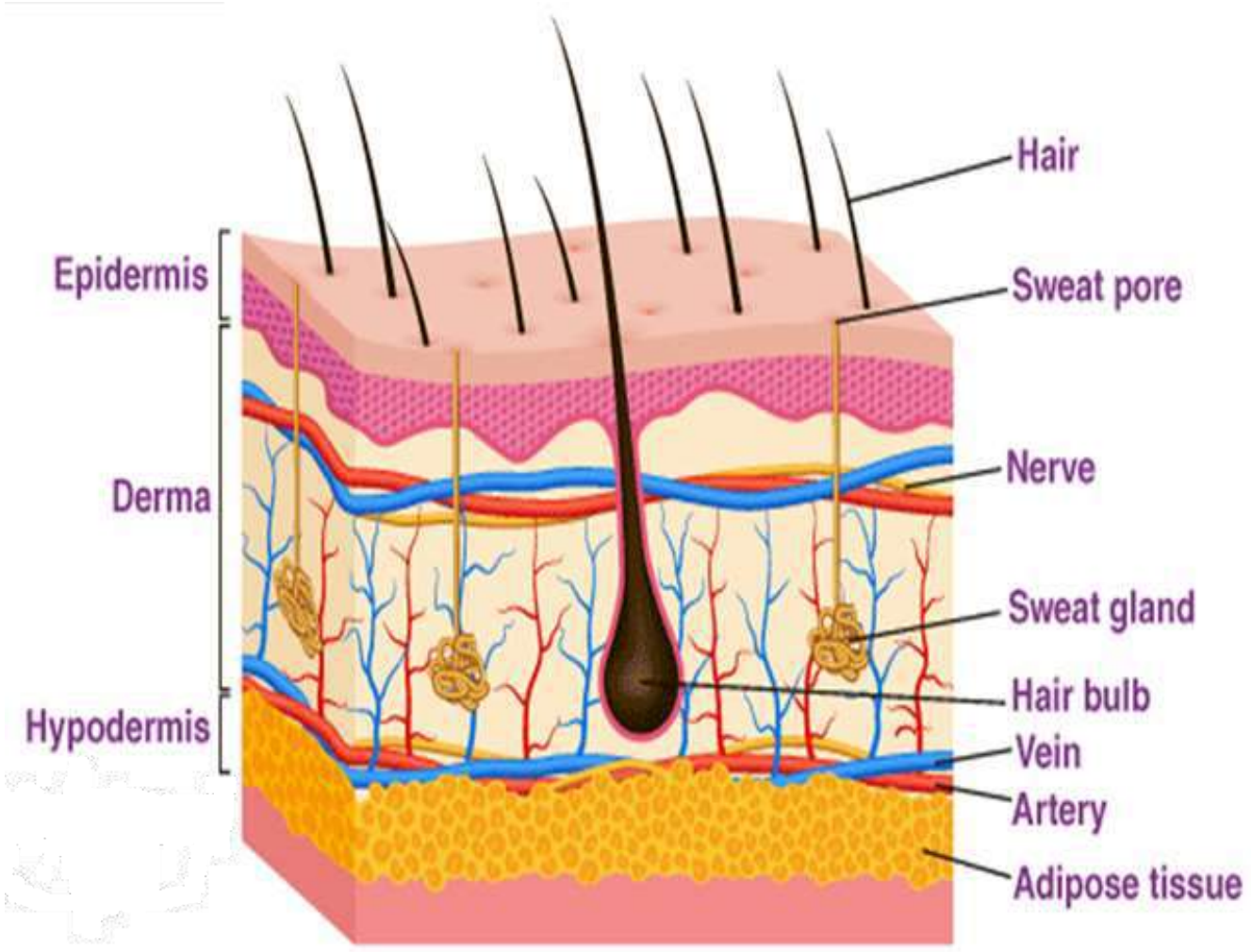
- The skin our body's largest organ, serves as:

    1. Protective Barrier: The skin acts as the body's first line of defence against environmental hazards, including pathogens, chemicals, and physical injuries.
    2. Regulatory Organ: Skin plays a crucial role in regulating body temperature through sweating and blood vessel dilation.
    3. Sensory Interface: The skin is equipped with a massive network of nerve endings that detect and respond to changes in temperature, pressure, and pain, making it a critical sensory organ that helps protect the body.

1. Introduction: Skin Structure

Composed of three primary layers:

- Epidermis
- Dermis
- Hypodermis



The Skin's Defence System

1. Physical Barrier:
    1. Stratum Corneum: composed of tightly packed dead cells and lipids that shield against pathogens and environmental irritants.
    2. Continuous Renewal: Old cells are regularly shed and replaced, helping to remove microbes that adhere to the skin surface.

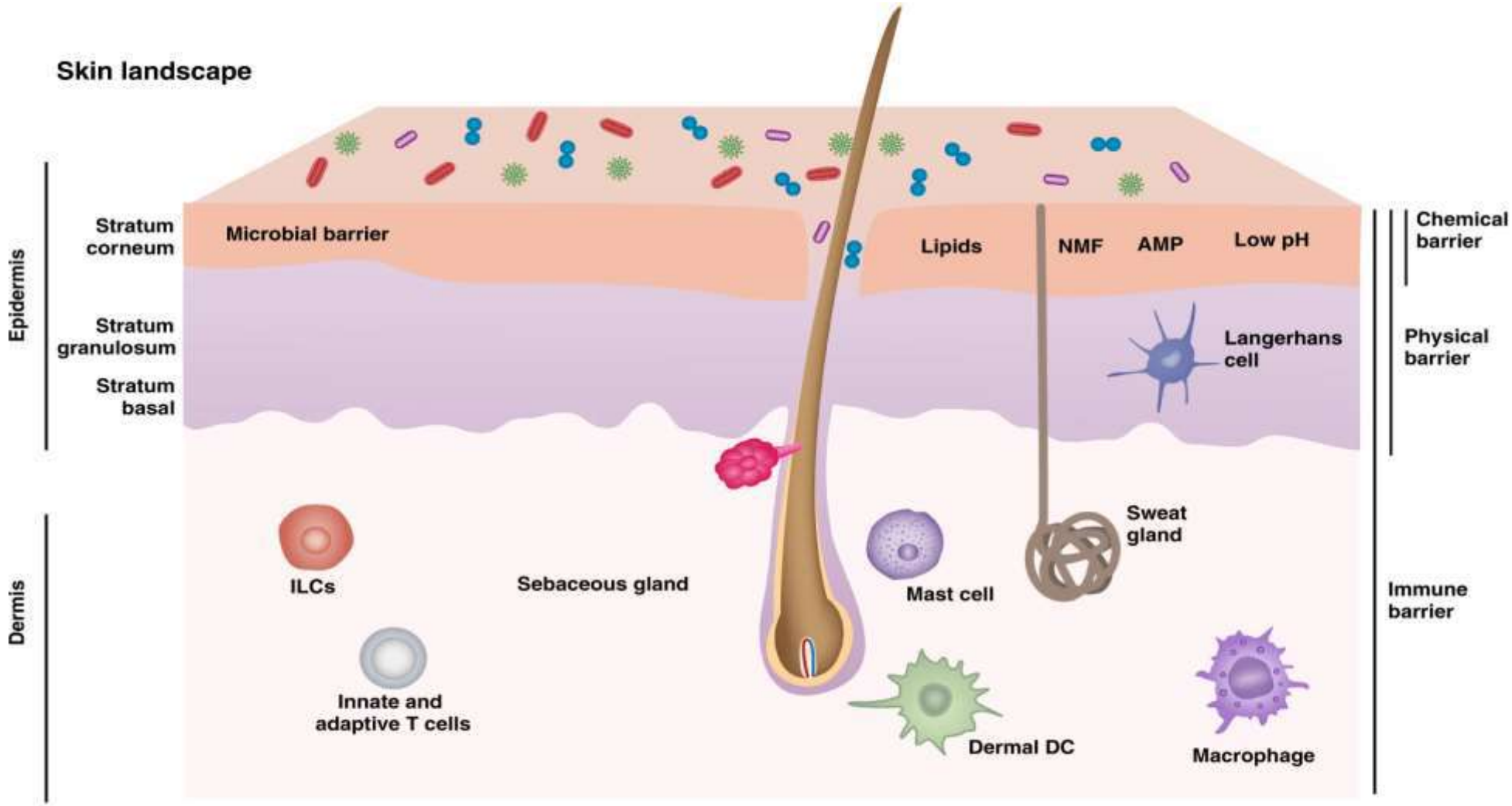
2. Chemical Barrier:
    - Acidic pH: its slight acidity inhibits the growth of many harmful bacteria.
    - Antimicrobial Peptides: Molecules such as defensins attack and destroy invading microbes.
    - Sebum Production: Oils secreted by sebaceous glands contain bactericidal properties.

The Skin's Defence System (Cont.)

3. Biological Barrier:

- Microbiota: The skin hosts a diverse array of microorganisms, which compete with pathogens and prevent their colonization.
- Immune Cells: The dermis is rich in immune cells like Langerhans cells and macrophages that detect and fight infections.

The Skin's Defence System (Cont.)



The Skin's Defence System: Skin Microbiota

- Skin microbiota are a diverse community microorganisms (e.g., bacteria, fungi, viruses, and mites) living on humans that do not harm the host under normal circumstances.
- The skin microbiota protects the skin by competing with pathogens for resources, producing antimicrobial substances, and maintaining an acidic pH.

The Skin's Defence System: Skin Microbiome (Cont.)

Aspect	Resident microbiota	Transient microbiota
Definition	Microorganisms that permanently colonise the skin.	Microorganisms that temporarily reside on the skin.
Composition	Mostly harmless microbes.	Mix of harmless and potentially harmful microbes.
Origin	Established during early life and relatively stable over time.	Acquired from the environment, objects, or other individuals.
Function	• Protect against pathogens through competition. • Produces substances that inhibit pathogenic growth. • Educate and modulate the immune system.	• Do not typically contribute to physiological functions. • Presence can be beneficial or harmful depending on the context.

The Skin's Defence System: Skin Microbiome (Cont.)

Aspect	Resident microbiota	Transient microbiota
Removal	Not easily removed, integrated into the skin’s ecosystem.	Can be removed by routine hygiene practices like washing.
Health Impact	Essential for skin health and immune response.	Can cause infections if they proliferate or penetrate the skin barrier.
Examples	*Staphylococcus epidermidis*, *Propionibacterium acnes*, Micrococci yeasts.	**Bacteria:** *S. aureus, S. pyogenes Clostridia (gangrene)* **Fungi:** *Candida albicans* **Viruses:** *Herpes simplex* viruse 1 and 2, *Papilloma*-warts

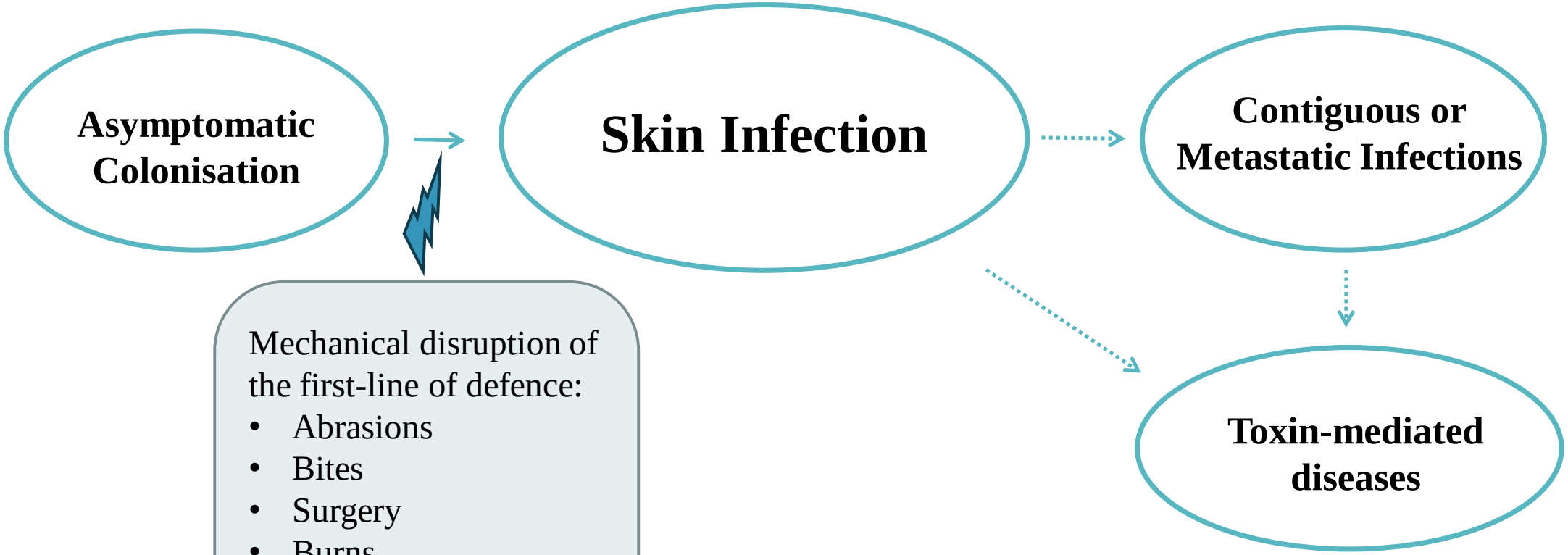
Bacterial Skin and Soft Tissue Infections

Introduction

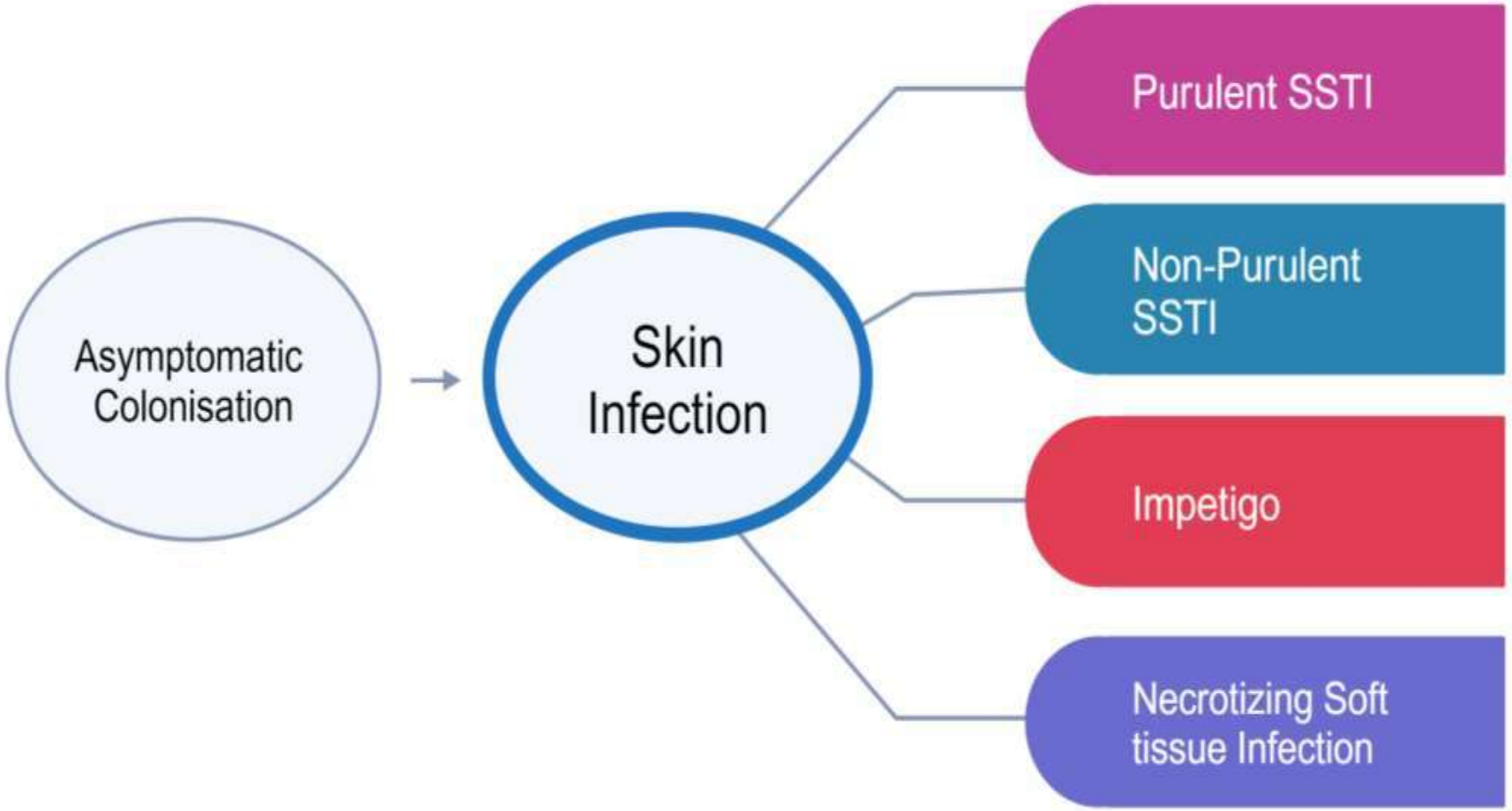
- Skin and soft tissue infections (SSTIs) are a group of heterogeneous conditions affecting the epidermis, dermis, subcutaneous tissue, or superficial fascia.
- SSTIs range from mild infections, such as folliculitis, to serious life-threatening infections, such as necrotizing fasciitis.

Introduction

Progression of Bacterial Skin and Soft Tissue Infections



Introduction
Skin Infections



Infectious agent:

Common:

S. aureus

S. pyogenes

P. aeruginosa

Uncommon:

Vibrio vulnificus

Aeromonas hydrophila

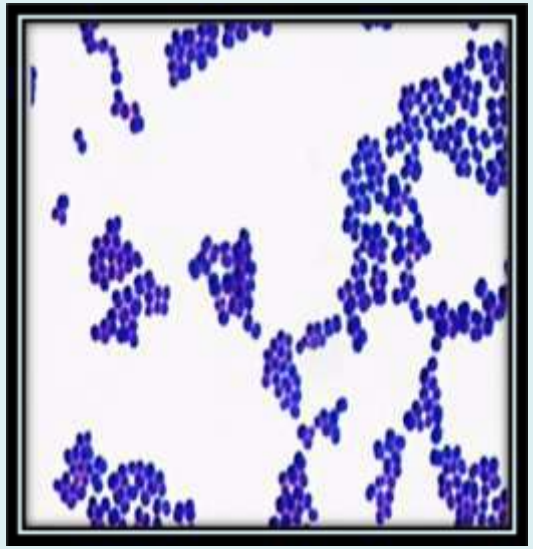
Infectious agent:

Common:

- ***S. aureus***
- *Streptococcus pyogenes*
- *P. aeruginosa*

Uncommon:

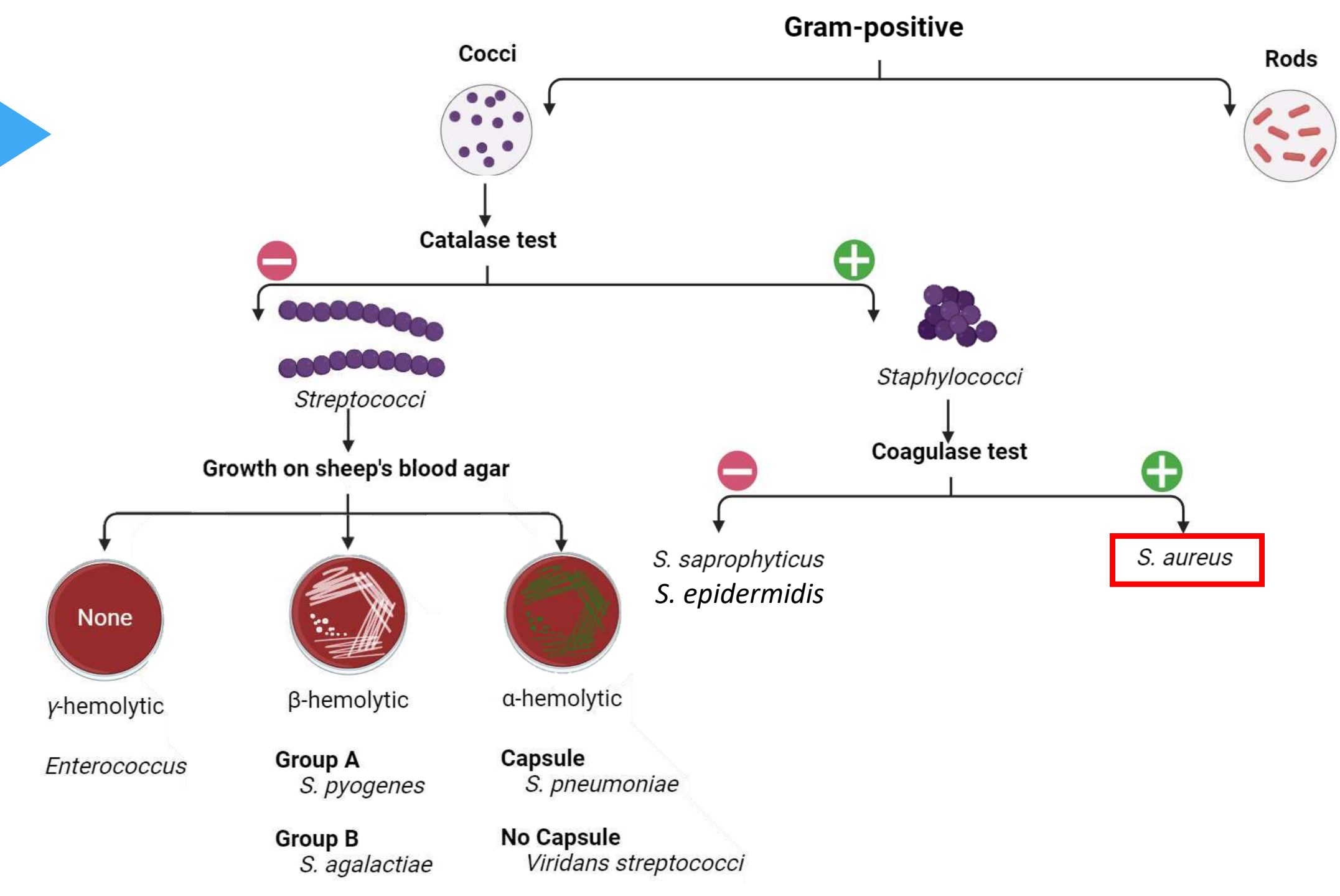
- *Vibrio vulnificus*
- *Aeromonas hydrophila*



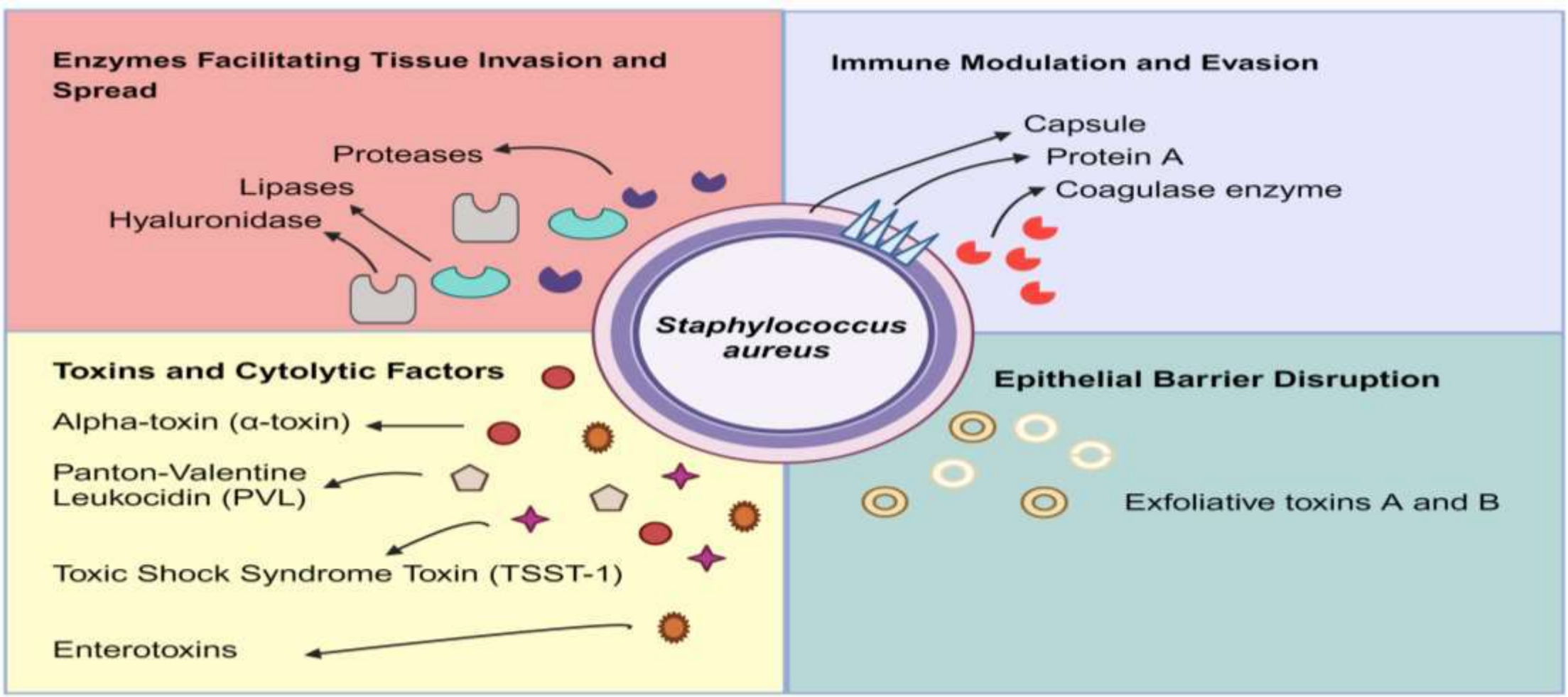
Infectious agents - *Staphylococcus aureus*

- Gram-positive cocci that clusters like grapes.

- Characteristics:
  - Coagulase-positive: distinguishes *S. aureus* from other less virulent staphylococcal species
  - Common inhabitant of the skin and mucous membranes
  - Salt-tolerant, can grow in high osmotic pressure and low moisture
  - Facultative anaerobe


Gram-positive
Cocci
Rods
Catalase test
Streptococci
Staphylococci
Growth on sheep's blood agar
Coagulase test
S. saprophyticus
S. epidermidis
S. aureus
None
γ-hemolytic
Enterococcus
β-hemolytic
Group A
S. pyogenes
Group B
S. agalactiae
α-hemolytic
Capsule
S. pneumoniae
No Capsule
Viridans streptococci

Infectious agents - *Staphylococcus aureus*
Virulence Factors



Infectious agents - *Staphylococcus aureus* Virulence Factors

Virulence Factor	Mechanism of Action	Clinical Manifestations
Protein A	Binds Fc region of IgG, inhibits phagocytosis	Persistent inflammation, erythema, swelling, warmth.
Coagulase	Converts fibrinogen to fibrin, forming protective clots around bacteria	Localization of infection, abscess formation, potentially facilitating spread when abscesses burst
Enzymatic spread (Hyaluronidase, Lipases, Proteases)	Degrades tissue components, promotes bacterial spread	Increased inflammation, spread of infection.
Alpha-toxin (α-toxin)	Forms pores in host cell membranes	Tissue destruction, pain, drainage
Exfoliative toxins	Cleaves desmoglein 1, causes epidermal separation	Blistering, peeling (e.g., scalded skin syndrome)

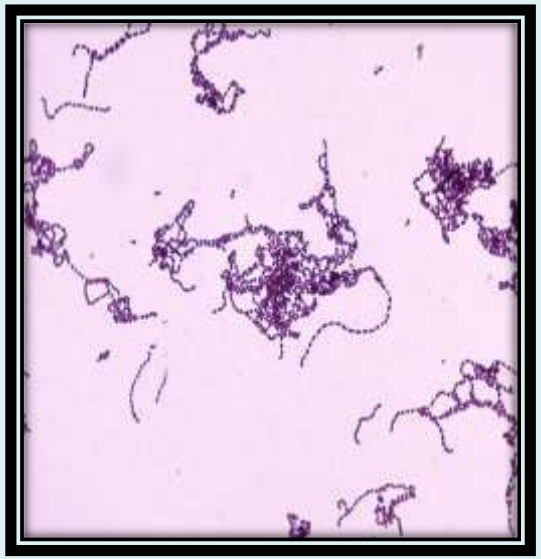
Infectious agent:

Common:

- *S. aureus*
- ***Streptococcus pyogenes***
- *P. aeruginosa*

Uncommon:

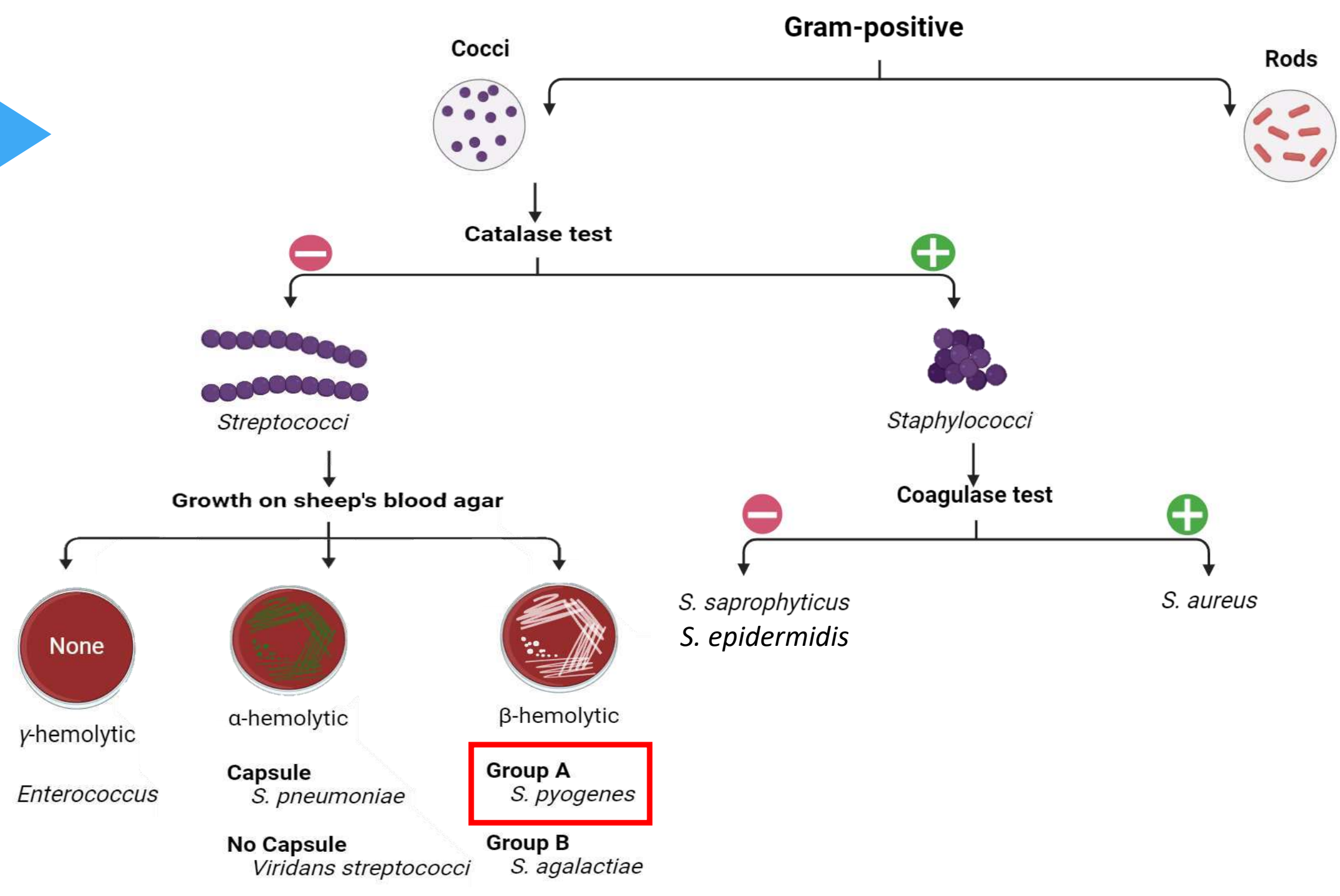
- *Vibrio vulnificus*
- *Aeromonas hydrophila*



Streptococcus pyogenes

- Gram-positive cocci that typically arranged in chains.
- Its also known as Group A Streptococcus (GAS).

- Characteristics:
  - Catalase test-negative: distinguishes Streptococcus from Staphylococcus species.
  - Commonly colonise nasopharynx and skin
  - Facultative anaerobe
  - β- haemolytic: it produces streptolysin (Streptolysin O and S) , an exotoxin that lyses red blood cells, resulting in a clear zone around the colonies.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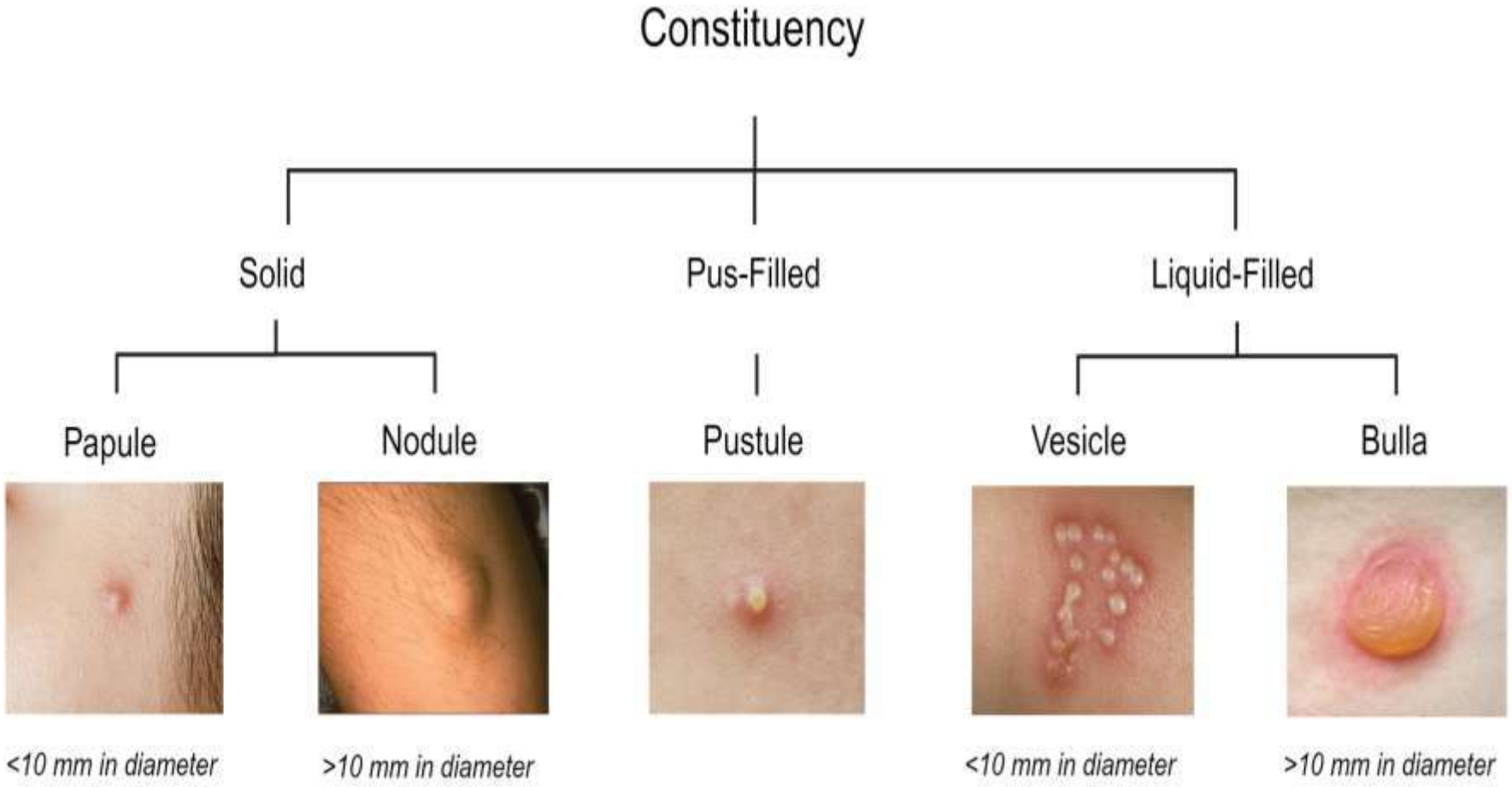
β-hemolytic
Group A
S. pyogenes
Group B
S. agalactiae
S. saprophyticus
S. epidermidis
S. aureus

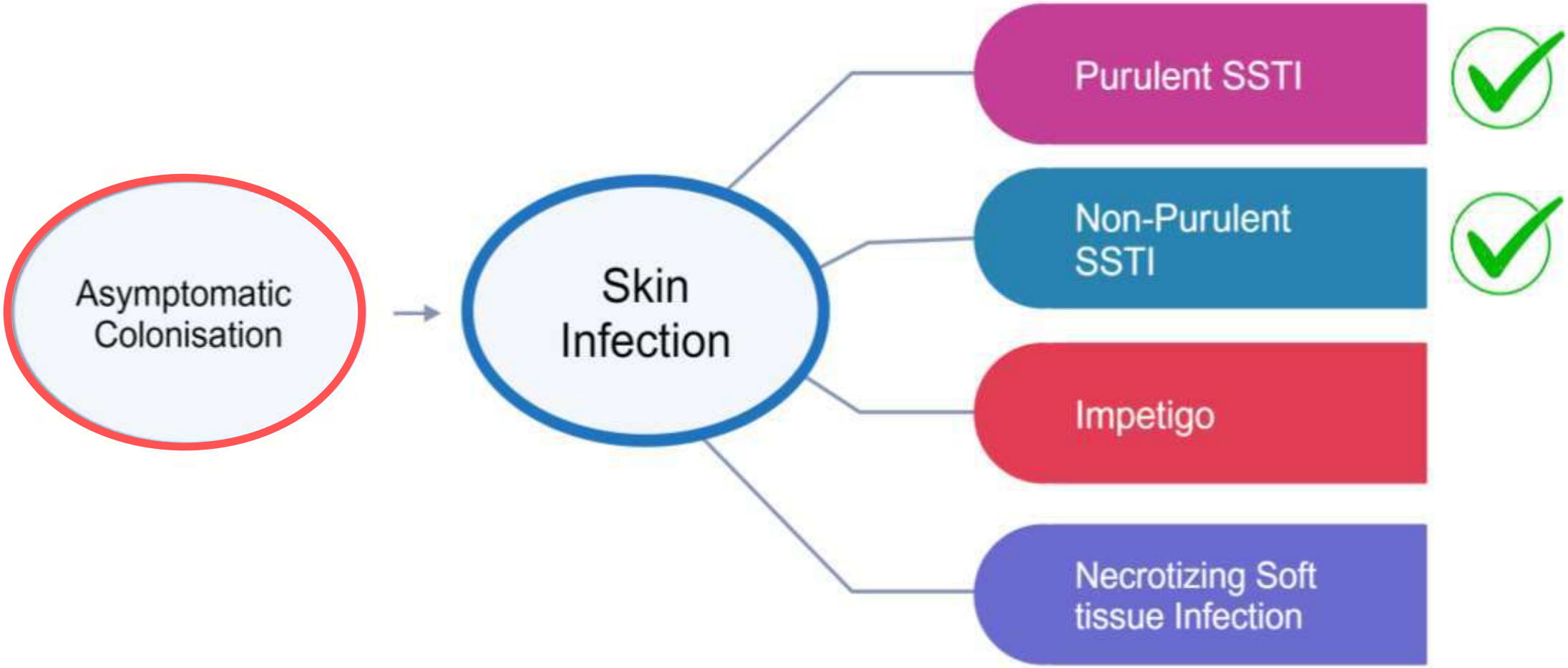
Introduction

Primary raised skin lesions

- ✓Papule
- ✓Nodule
- ✓Pustule
- ✓Vesicle
- ✓Bulla

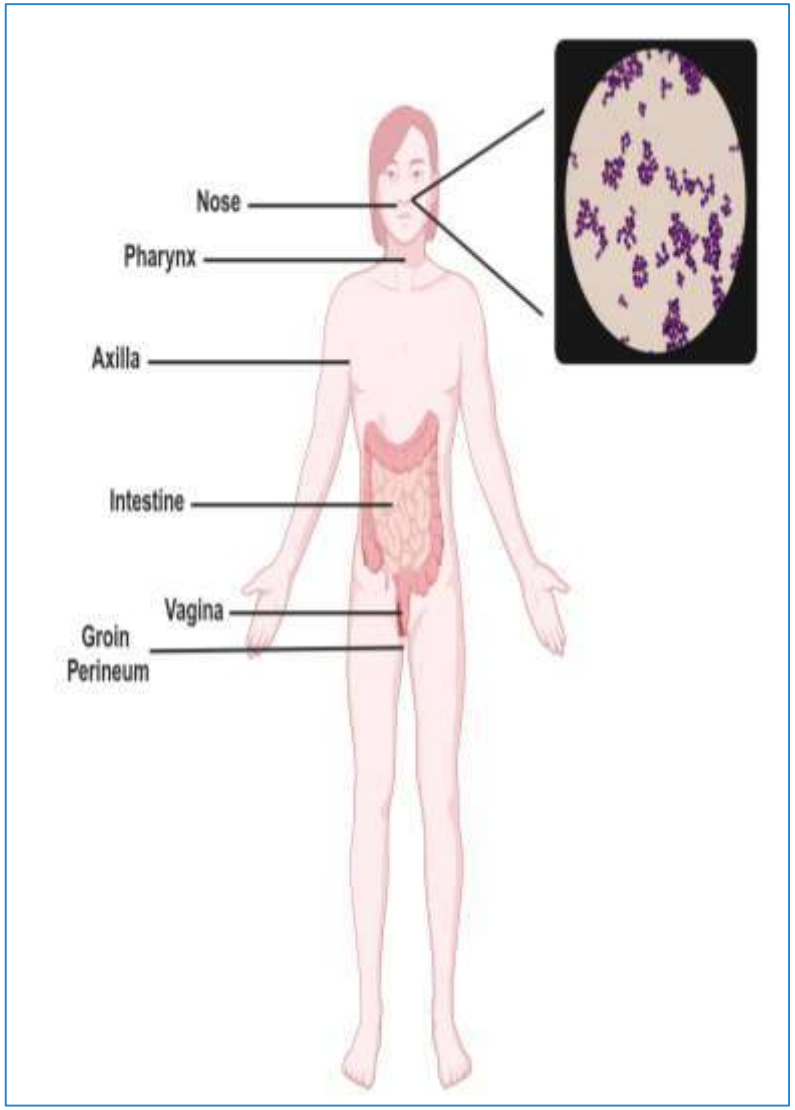


Skin Infections



Asymptomatic Colonisation

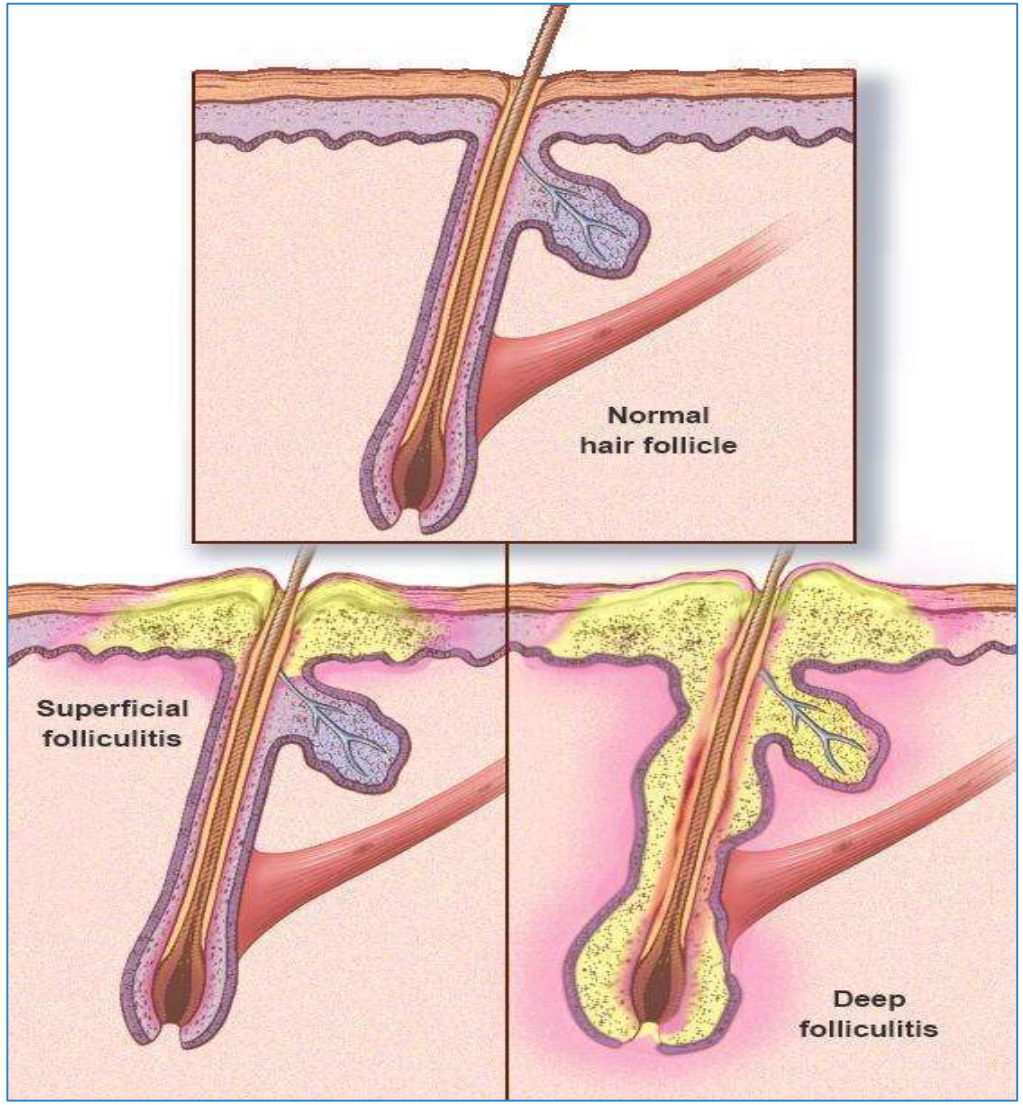
- Asymptomatic colonisation refers to the presence of bacteria on the body without causing symptoms of infection.
- Example: *S. aureus:*
  - Up to 30% of the human population are asymptomatically and permanently colonized with nasal *S. aureus*.
  - *S. aureus* colonises the human body with preference for primarily nose, intestine, some areas of the skin (axillae, groin, and perineum), as well as the pharynx and vagina.



Skin Infections

Purulent SSTIs - Folliculitis

- A localized inflammation of the hair follicle or sebaceous glands.
- Could be superficial or deep infection in the hair follicle



Skin Infections

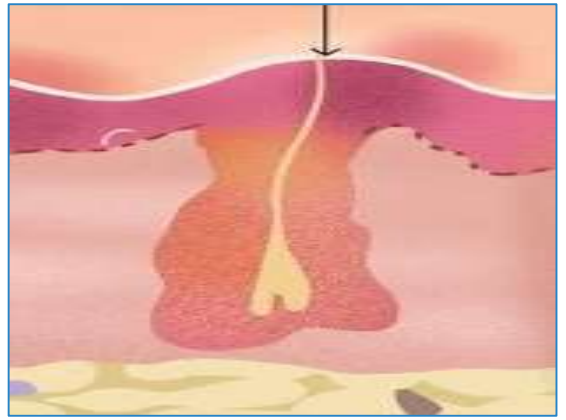
Purulent SSTIs - Folliculitis

- Characterized by erythema, tender papules, and/or pustules at the site of hair follicles.
- Causative agents:
  - *S. aureus* (primarily cause)
  - *Pseudomonas aeruginosa*: Hot tub folliculitis or pseudomonal folliculitis that appears after exposure to contaminated water.
- Self-limiting condition that does not require antibiotic treatment.

Skin Infections

Purulent SSTIs - Furuncle

- Furuncle is a deep folliculitis extends beyond the hair follicle into the surrounding tissue. This deeper penetration leads to the formation of a larger, more painful nodule (or boil) that is filled with pus.
- A well-demarcated, firm, painful, purulent nodule.
- Commonly appears in areas prone to irritation and sweat, such as the neck, breasts, buttocks, and thighs.
- It affects only one hair follicle with single point of drainage.



Skin Infections

Purulent SSTIs - Furuncle

- Lesions progress and becomes more swollen over time. After several days, the nodule may rupture releasing pus and eventually pain relieve. They often drain and heal spontaneously without leaving a scar.

- Treatment:
  - Warm Compresses: to facilitate drainage.
  - Incision and Drainage: if the furuncle does not drain on its own.
  - Antibiotics: oral antibiotisc used when infection is severe or if there are multiple boils.

Skin Infections

Purulent SSTIs - Carbuncle

- Carbuncles are **clusters of furuncles** interconnected subcutaneously, creating a large, pus-filled pockets, which eventually **drain** from **several sites** to the surface.
- Carbuncles often associated with fever, fatigue, and swollen lymph nodes.
- Leave a scar when it heals.
- The locations are similar to furuncles

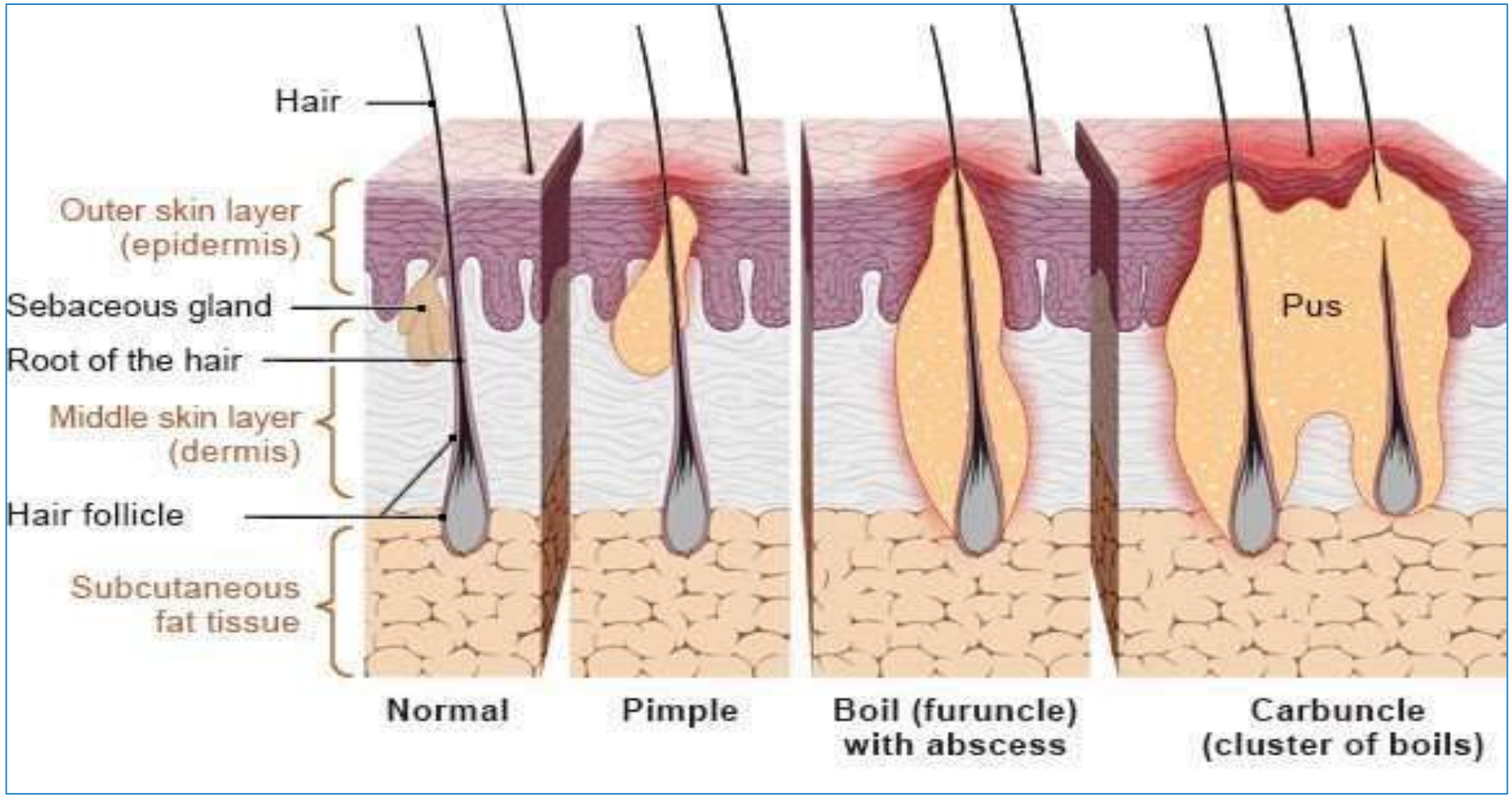
Skin Infections

Purulent SSTIs - Carbuncle

- Treatment:
  - Incision and Drainage: Almost always necessary due to the depth and severity of the infection.
  - Oral or Intravenous Antibiotics: Necessary to treat the deeper infection and prevent spread, especially if systemic symptoms are present.

Skin Infections

Purulent SSTIs - Folliculitis VS Furuncle VS Carbuncle



Question

- ✓ **Folliculitis**
- ✓ **Furuncle**
- ✓ **Carbuncle**
- ✓ **Skin abscess**

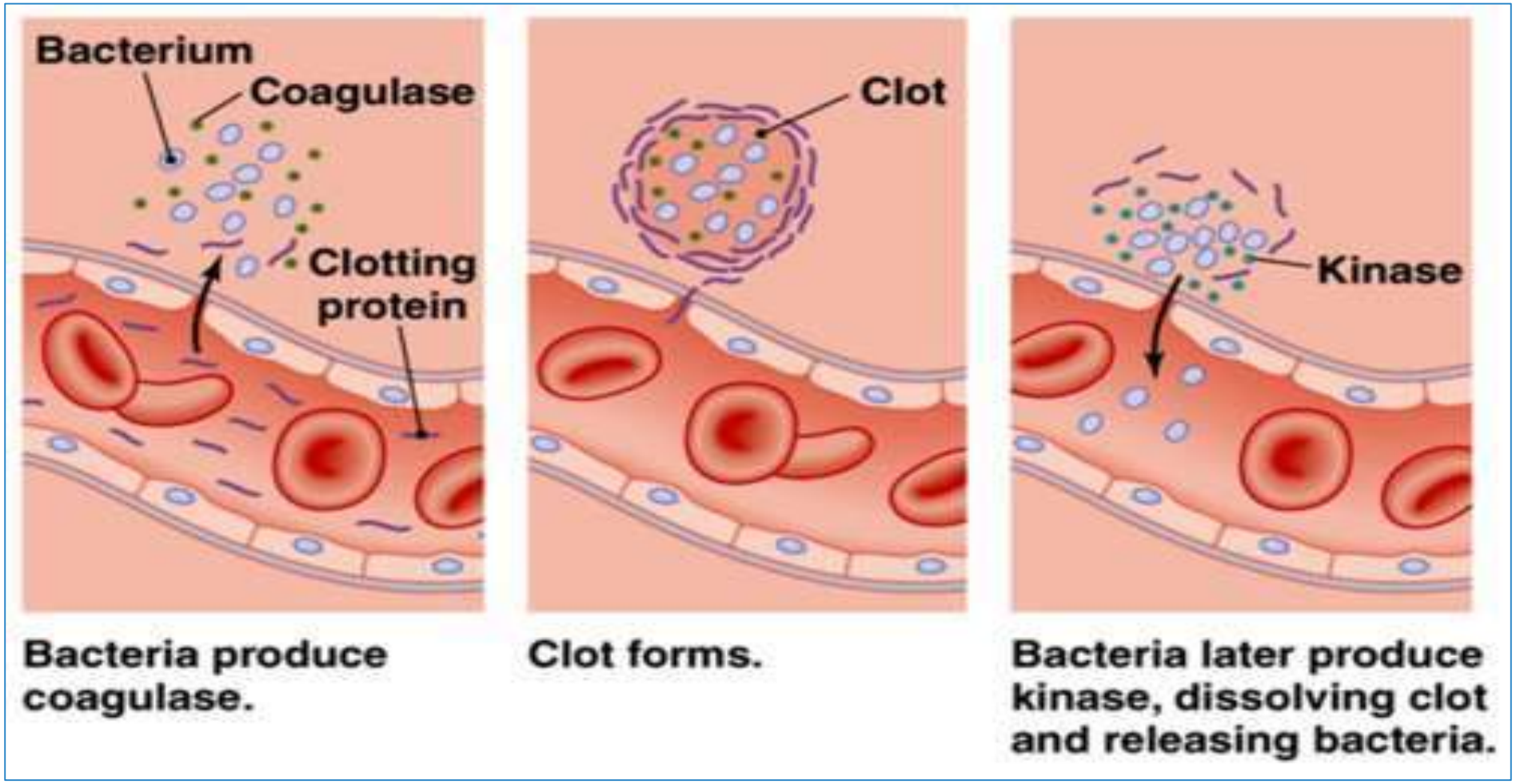
Q: Abscesses are a frequent manifestation of *S. aureus* skin and soft tissue infections, why?

- The tendency of *S. aureus* to cause localized infections primarily results from its **Coagulase** enzyme.
- This enzyme plays a pivotal role in converting fibrinogen to fibrin, leading to the formation of a clot around the infection site.

Fibrinogen → **Fibrin** → **Clot** formation around the infection site.

→ The clot acts as a barrier, both protecting the bacteria from the immune system and physically preventing the spread of the bacteria.

Question: answer (Cont.)



Skin Infections

Non-Purulent SSTIs – Erysipelas and Cellulitis

- Both are acute infection of the skin and subcutaneous tissue.
- Clinical features: Local signs**:** **erythema**, **oedema**, **warmth**, **tenderness**
  - Specific to erysipelas: raised, **sharply demarcated** lesion
  - Specific to cellulitis: **poorly defined** lesion with induration
- Regional lymphadenopathy.
- Almost always unilateral.
  - Common location: lower limbs (most common), and face.

Skin Infections

Non-Purulent SSTIs – Erysipelas and Cellulitis (cont.)

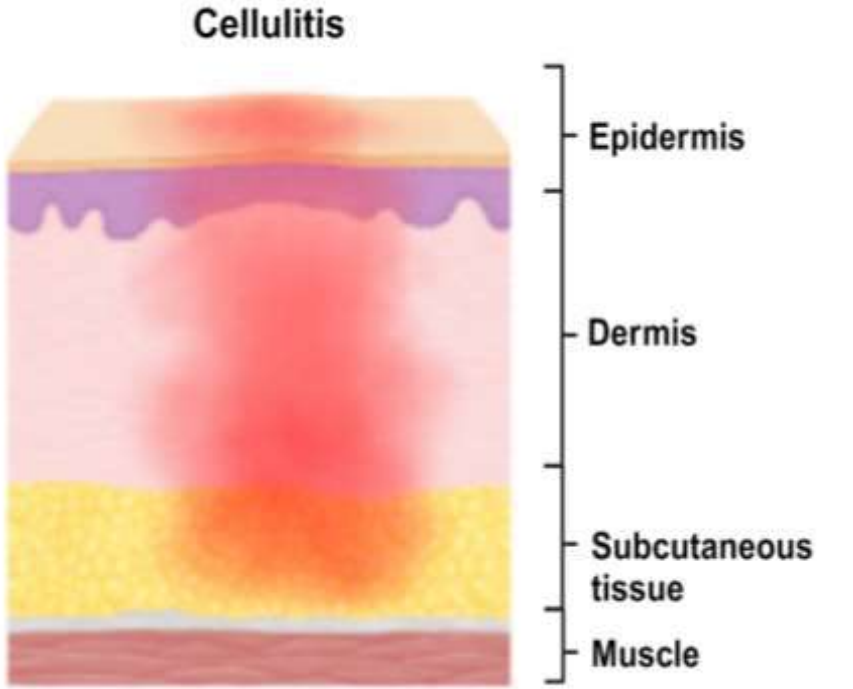
Erysipelas
Butterfly sign" on the face

Cellulitis

Skin Infections

Non-Purulent SSTIs – Cellulitis

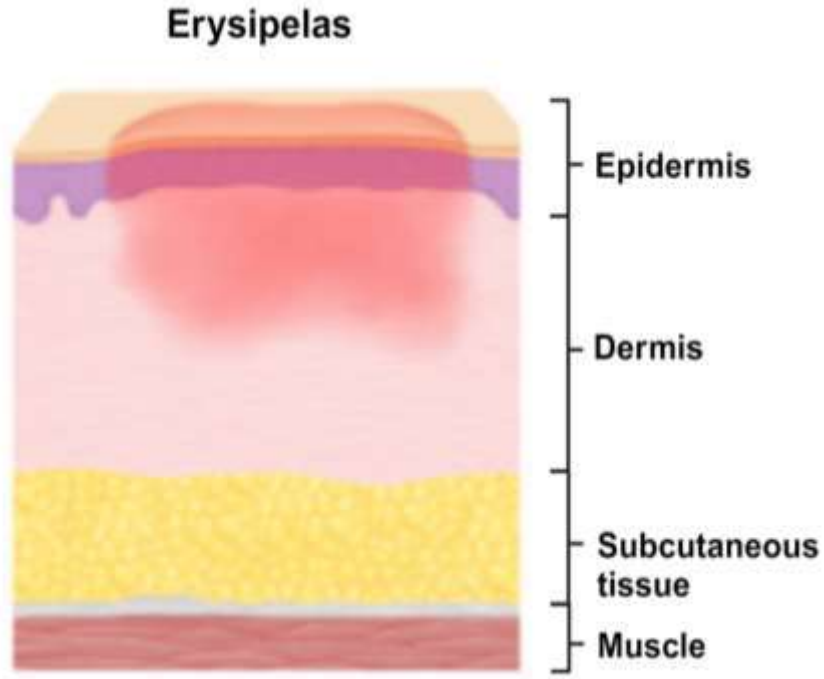
- Infection involve the **deep dermis** and **subcutaneous adipose tissue.**
- Usually, indolent course and onset (over few days).
- May present with purulent exudate (usually associated with *S. aureus*), referred to as purulent cellulitis.



Skin Infections

Non-Purulent SSTIs – Erysipelas

- Infection involving the upper dermis and superficial lymphatics (known as superficial cellulitis).
- Acute onset. Fever, chills, and malaise.
- Always non-purulent.
- Involvement of the ear → Erysipelas
- there is no deep dermis and subcutaneous tissue in the ear's pinna → Milian’s ear sign



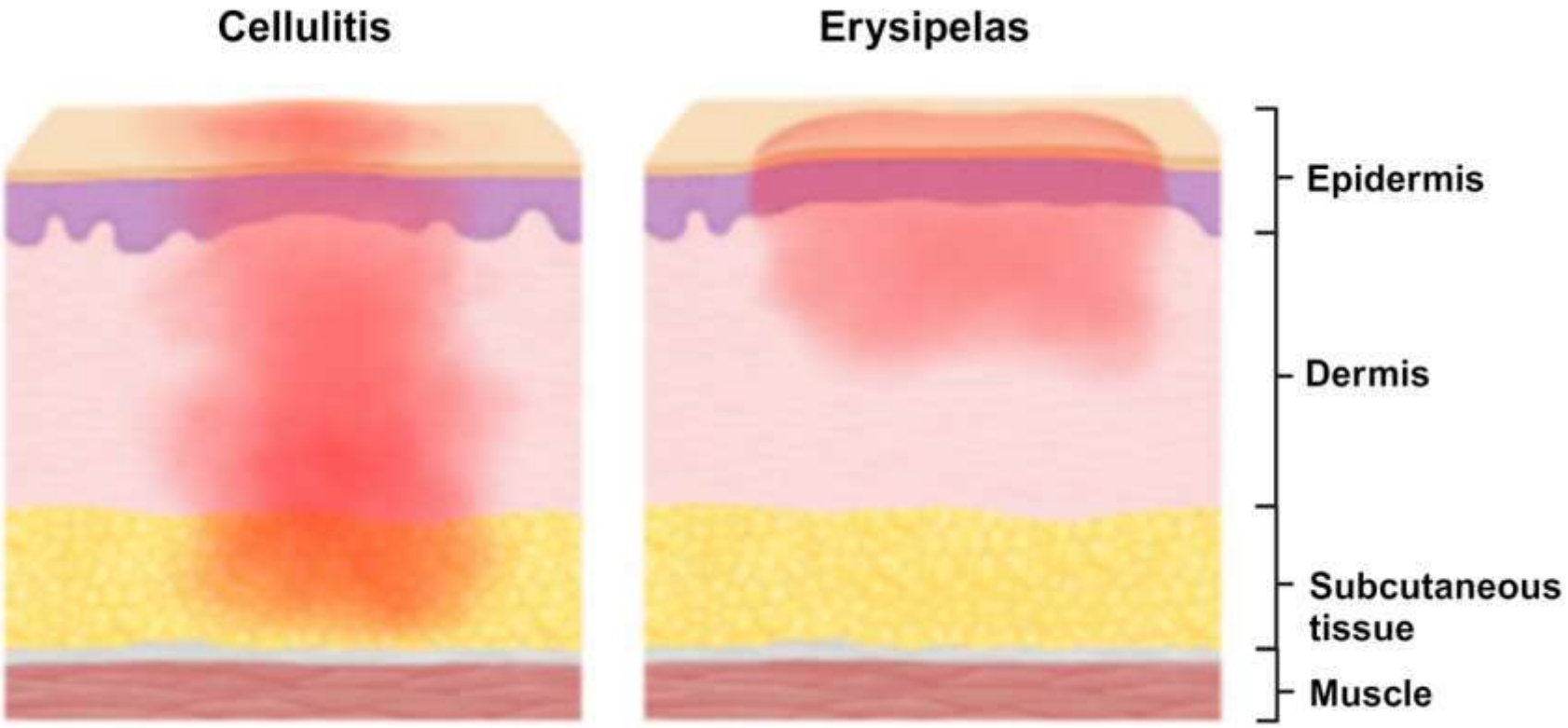
Skin Infections

Non-Purulent SSTIs – Erysipelas and Cellulitis (cont.)

- Etiology:
  - Beta-haemolytic streptococci: mostly group A Streptococcus (*S. pyogenes*)
  - *S. aureus*
- Diagnostics: Diagnosis is usually clinical.
- Treatment:
  - Empiric antibiotic therapy active against streptococci and S. aureus is the mainstay of treatment for non-purulent SSTIs.
  - Supportive care: Elevation of the affected limbs, rest and acute pain management as needed

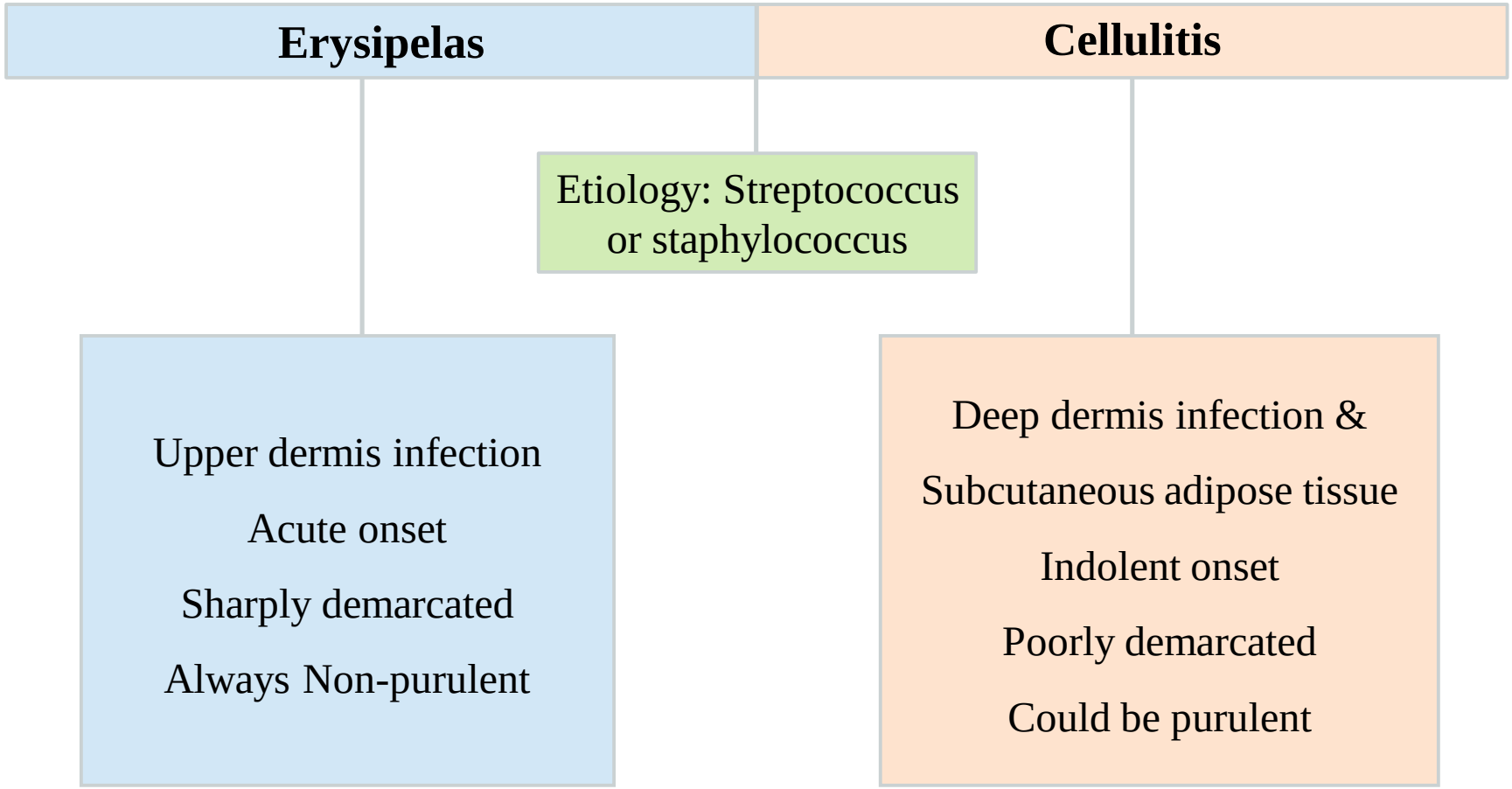
Skin Infections

Non-Purulent SSTIs – Erysipelas vs Cellulitis



Skin Infections

Non-Purulent SSTIs – Erysipelas vs Cellulitis (cont.)



Thank you