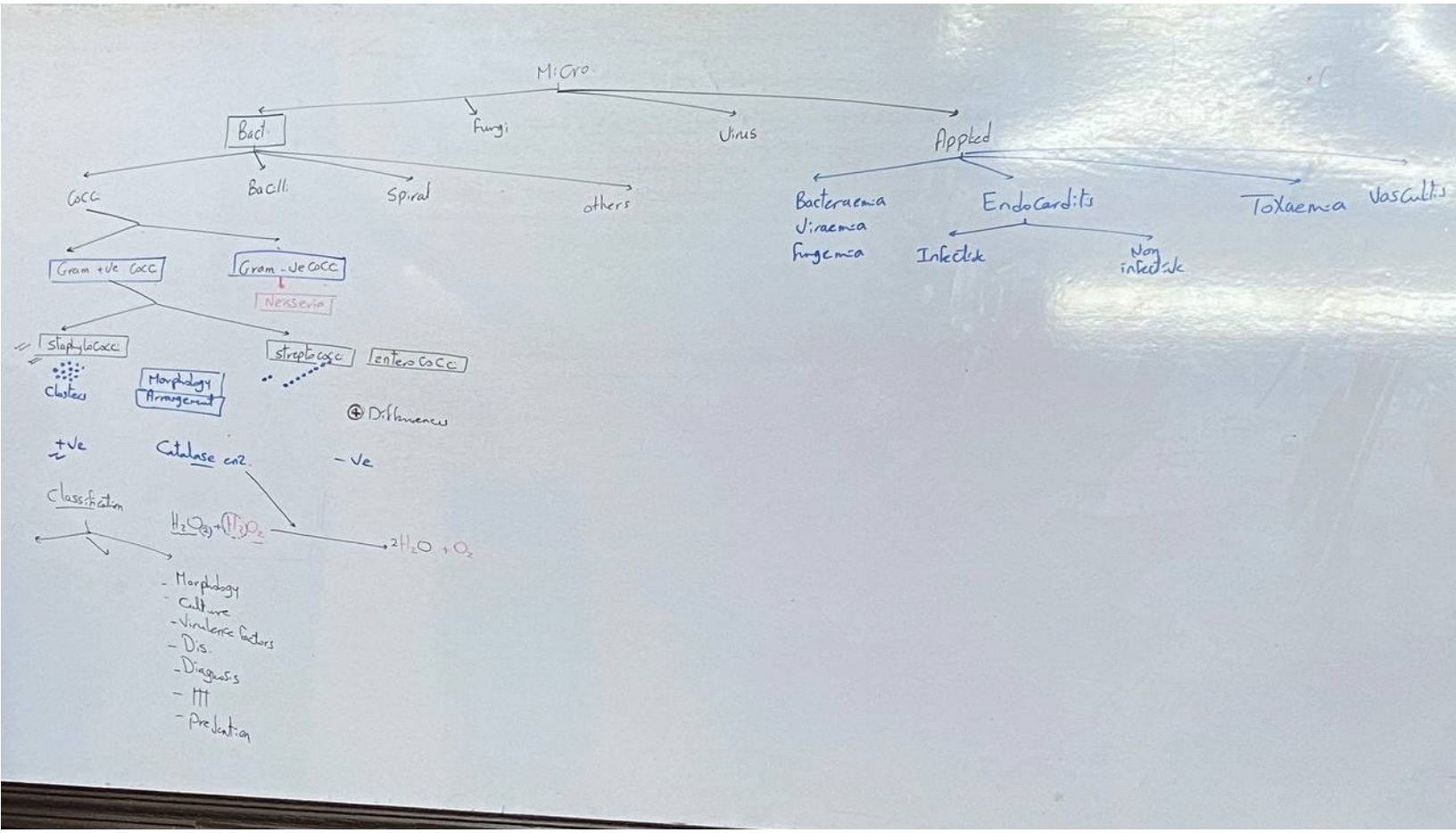
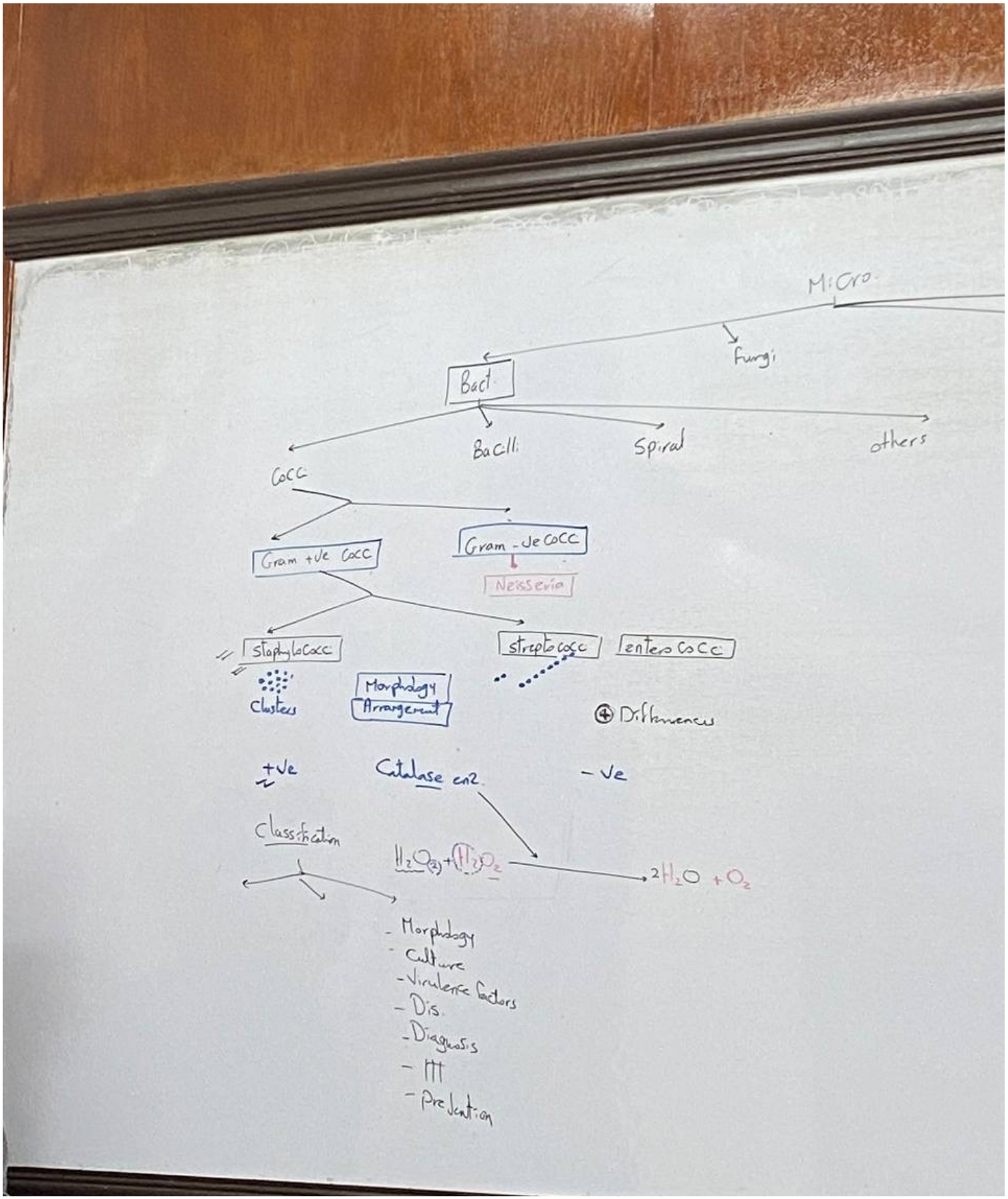
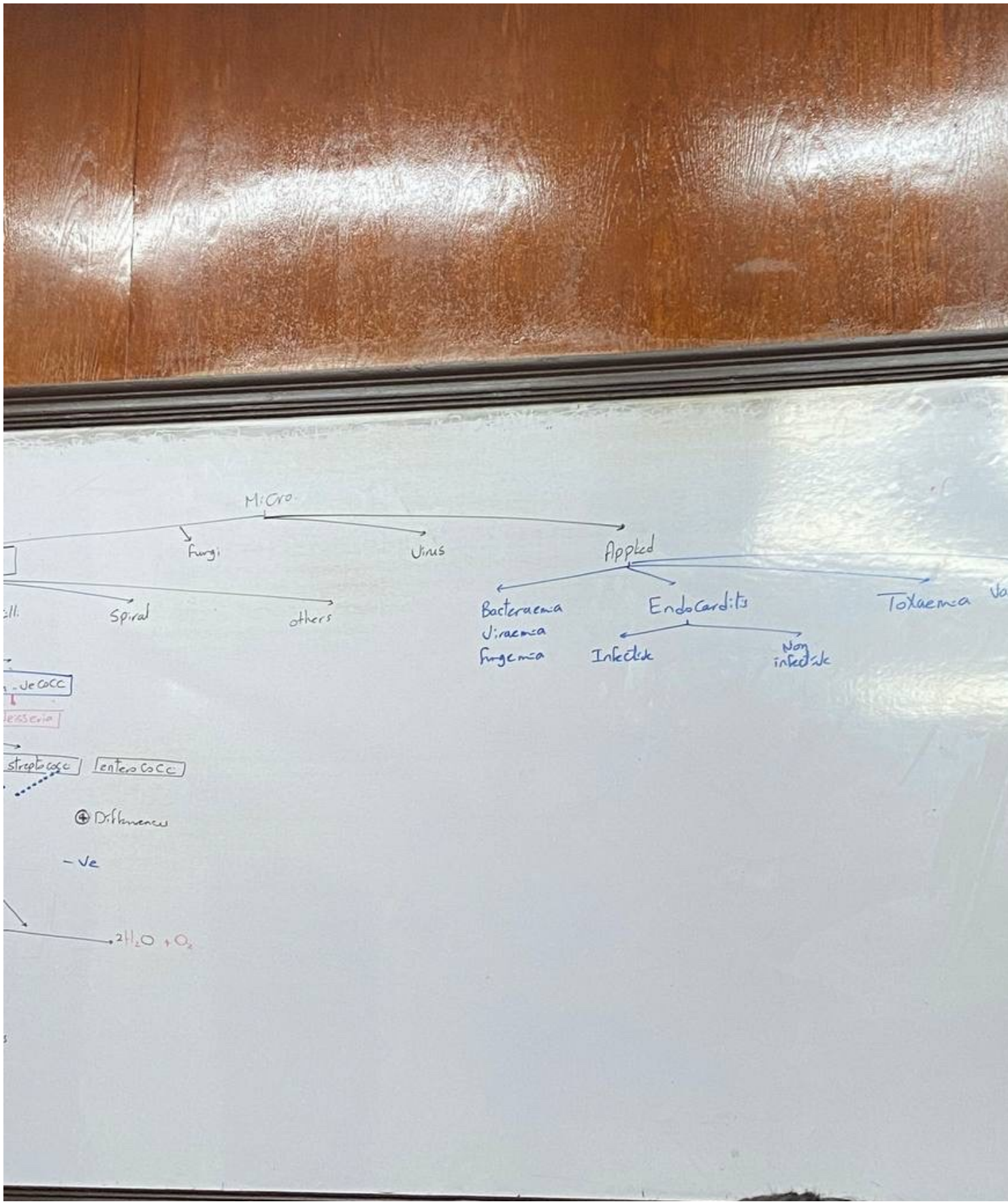
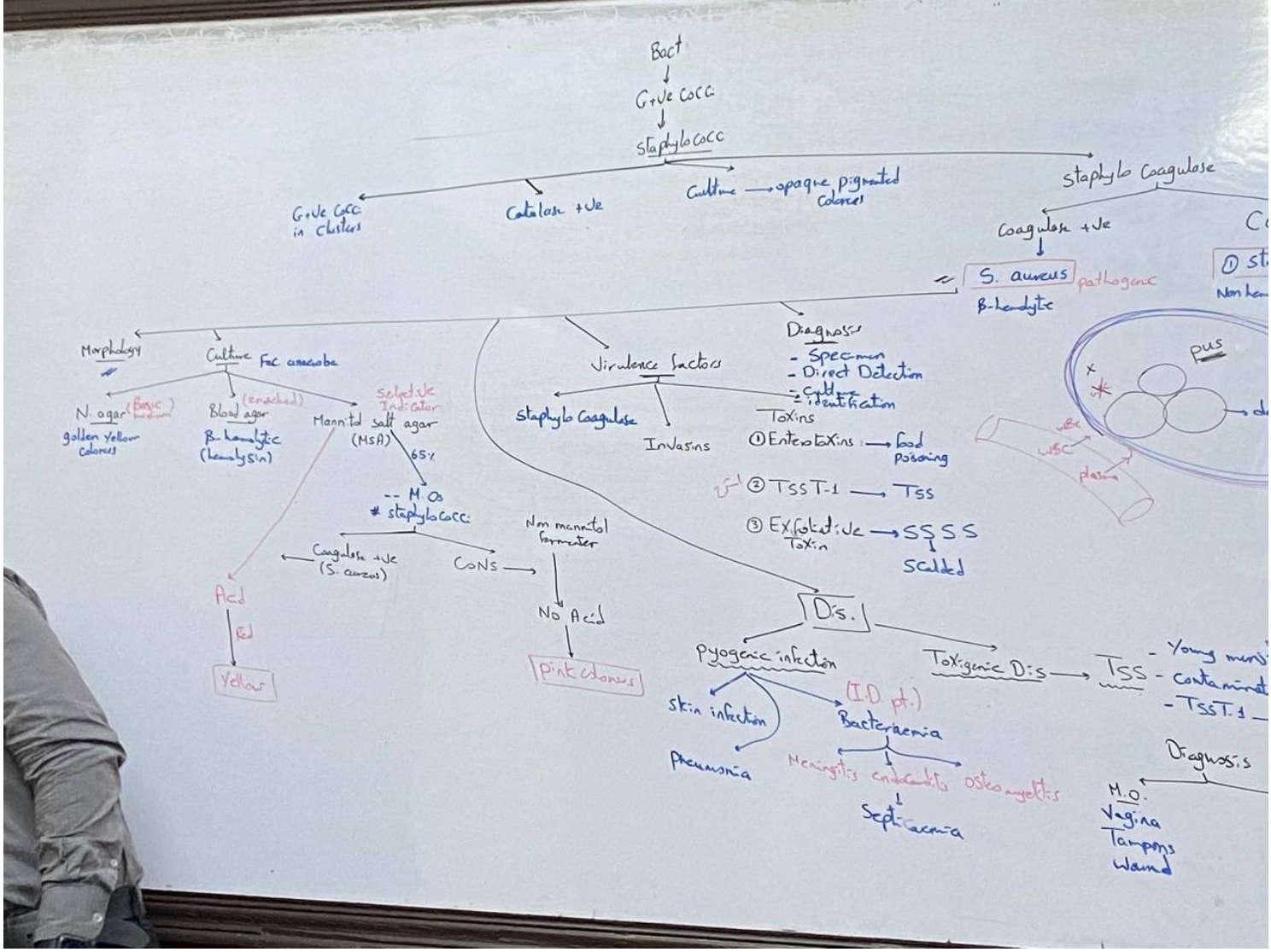
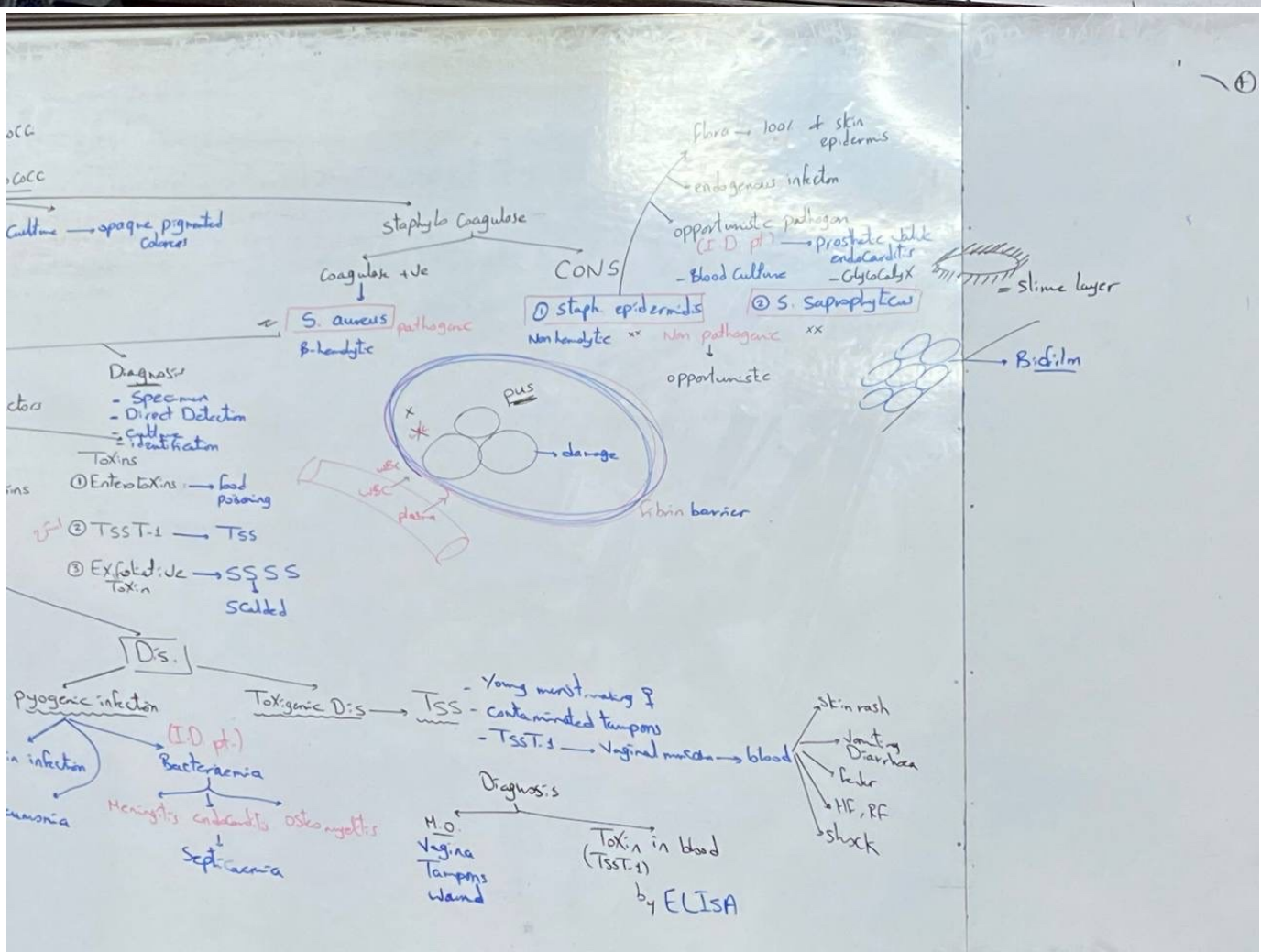
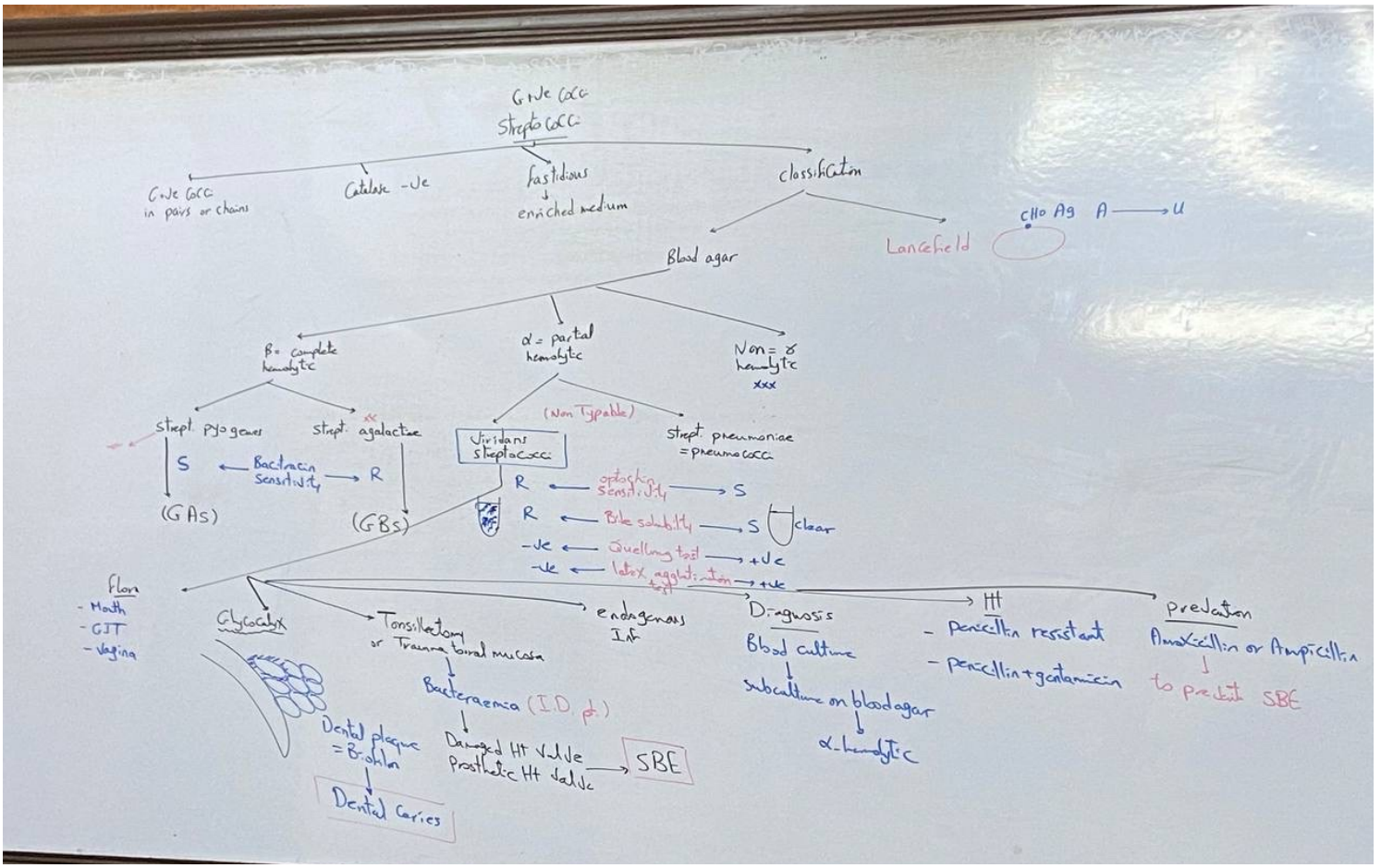

Micro
Bact
Fungi
Virus
Appled
Cocc
Bacill
Spiral
others
Bacteraemia
Viraemia
fungemia
Endocarditis
Toxaemia
Vasculitis
Infective
Non infective
Gram +ve cocc
Gram -ve cocc
Neisseria
Staphylococc
streptococc
entero cocc
Clusters
Morphology
Arrangement
Differences
+ve
-ve
Catalase cm2
Classification
$H_2O_{2(g)} + H_2O_2 \rightarrow 2H_2O + O_2$
- Morphology
- Culture
- Virulence factors
- Dis
- Diagnosis
- ttt
- Prevention

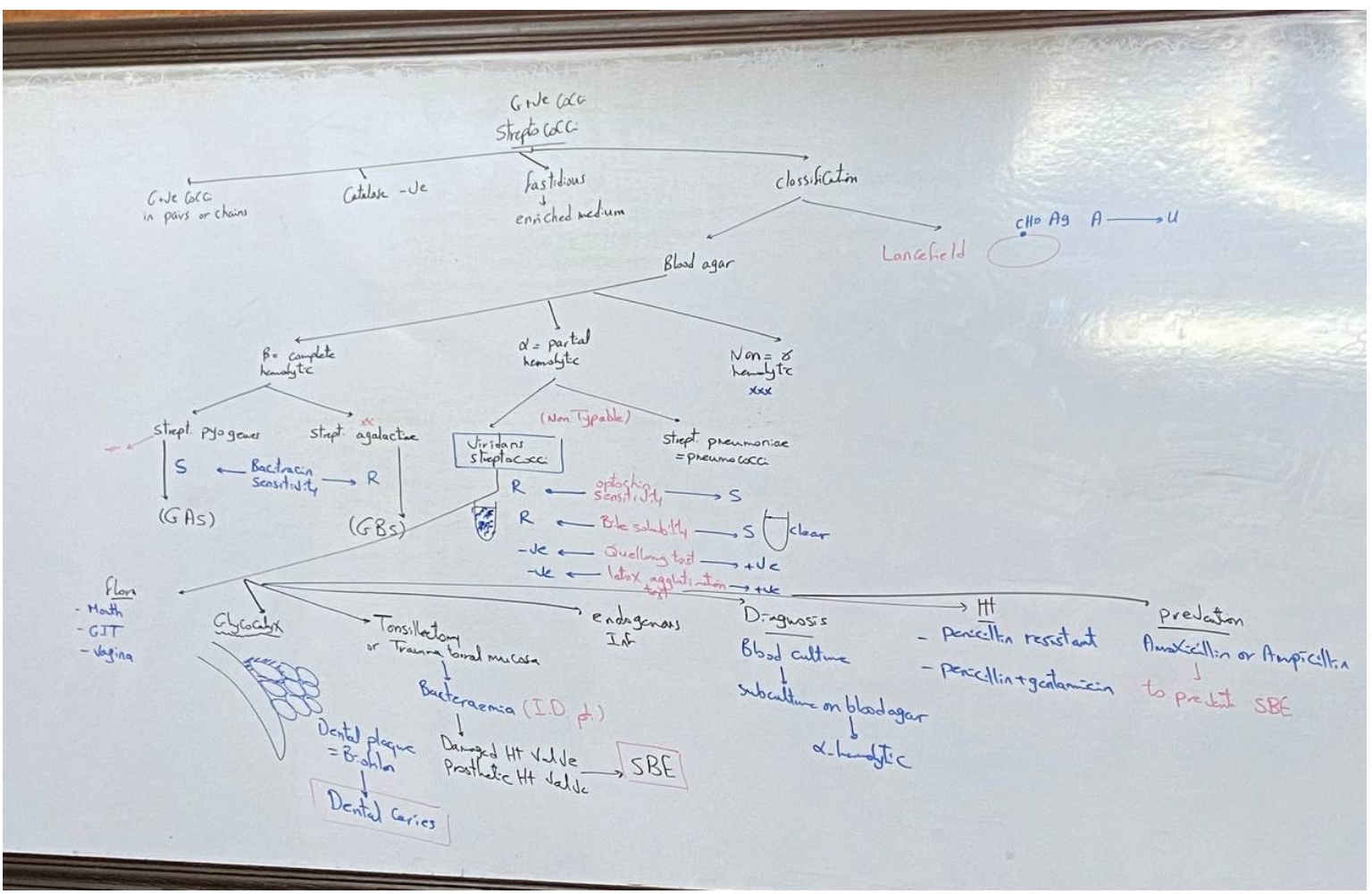

M:Cro.
Fungi
Bact.
Bacill.
Spiral
others
Cocc
Gram +Ve Cocc
Gram -Ve Cocc
Neisseria
staphylococci
streptococc
enterococci
Clusters
Morphology
Arrangement
④ Differences
+Ve
Catalase en2.
-Ve
Classification
$H_2O_2 + H_2O_2 \rightarrow 2H_2O + O_2$
- Morphology
- Culture
- Virulence factors
- Dis.
- Diagnosis
- ttt
- Prevention


Micro
Fungi
Virus
Applied
Spiral
others
Bacteraemia
Viraemia
fungemia
Endocarditis
Toxaemia
Infective
Non infective
streptococc
enterococc
Differences
-Ve
$2H_2O + O_2$


Bact
G+Ve cocc
Staphylococc
G+Ve Cocc in clusters
Catalase +Ve
Culture → opaque pigmented colonies
Staphylo Coagulase
Coagulase +Ve
S. aureus
pathogenic
β-hemolytic
Morphology
Culture Fac anaerobe
N. agar (Basic medium)
golden Yellow Colonies
Blood agar (enriched)
β-hemolytic (hemolysin)
Mannitol salt agar (MSA)
Selective Indicator
65%
-- M.O
* staphylococci
Coagulase +Ve (S. aureus)
CoNS
Non mannitol fermenter
Acid
Red
Yellow
No Acid
Pink colonies
Virulence factors
Staphylo Coagulase
Invasins
Diagnosis
- Specimen
- Direct Detection
- Culture identification
Toxins
① EnteroToxins → food poisoning
② TSST-1 → TSS
③ Exfoliative Toxin → SSSS
Scalded
pus
damage
fibrin barrier
plasma
Dis.
Pyogenic infection
Toxigenic Dis → TSS
- Young menstruating ♀
- contaminated tampons
- TSST-1 → Vaginal mucosa → blood
skin infection
Pneumonia
(I.D. pt.)
Bacteraemia
Meningitis endocarditis osteomyelitis
Septicaemia
Diagnosis
M.O.
Vagina
Tampons
Wound


Flora → 100% of skin epidermis
endogenous infection
opportunistic pathogen
(I.D. pt.) → Prosthetic valve endocarditis
- Blood Culture
- GlycoCalyx
= slime layer
Biofilm
CONS
① Staph. epidermidis
Non hemolytic xx
② S. Saprophyticus xx
Non pathogenic
opportunistic
Staphylo Coagulase
Coagulase +Ve
S. aureus
pathogenic
β-hemolytic
Diagnosis
- Specimen
- Direct Detection
- Culture identification
Toxins
① EnteroToxins → food poisoning
② TSST-1 → TSS
③ Exfoliative Toxin → SSSS
Scalded
pus
damage
fibrin barrier
plasma
Dis.
Pyogenic infection
Toxigenic Dis → TSS
- Young menstruating ♀
- contaminated tampons
- TSST-1 → Vaginal mucosa → blood
skin rash
Vomiting Diarrhea
Fever
HF, RF
Shock
(I.D. pt.)
Bacteraemia
Meningitis endocarditis osteomyelitis
Septicaemia
Diagnosis
M.O.
Vagina
Tampons
Wound
Toxin in blood (TSST-1)
by ELISA

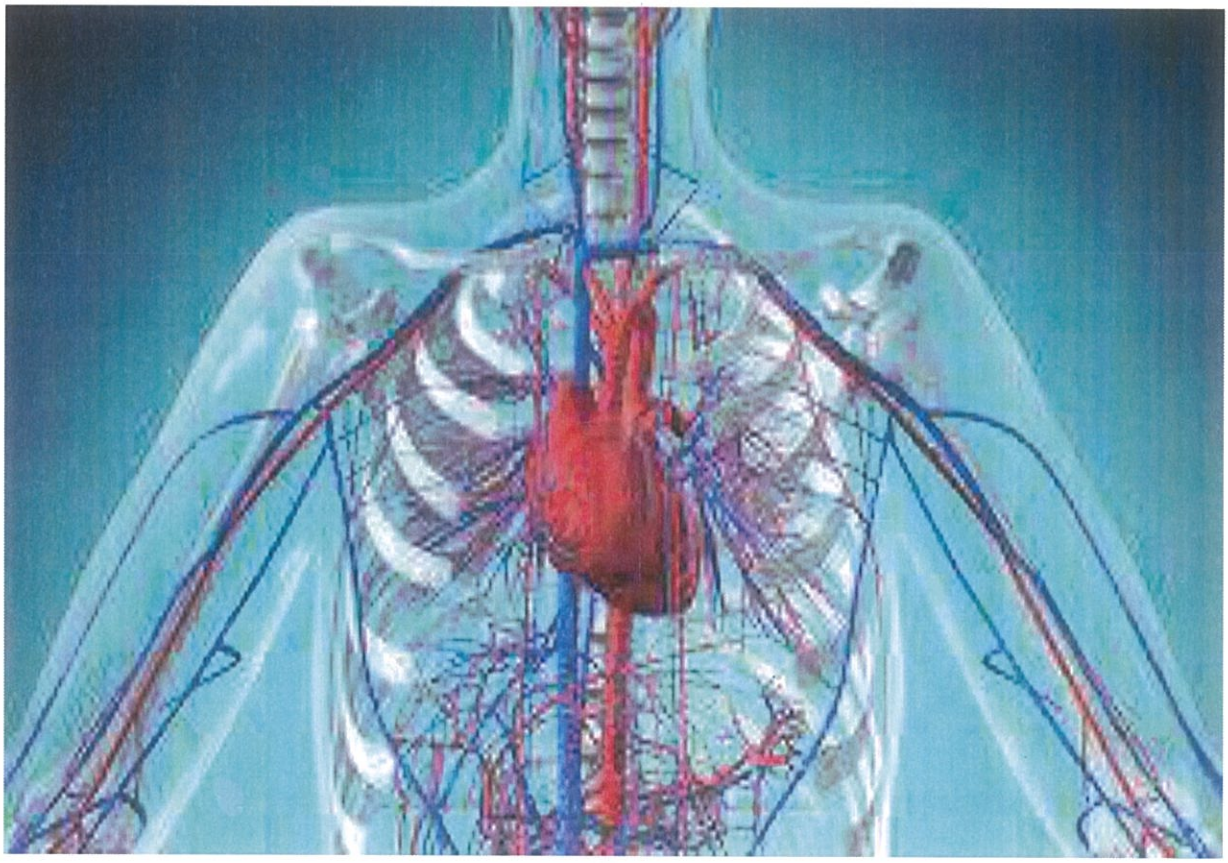

G+ve cocci
Streptococci
G+ve cocci in pairs or chains
Catalase -ve
Fastidious
enriched medium
classification
Lancefield
CHO Ag A → U
Blood agar
β = complete haemolytic
α = partial haemolytic
Non = γ haemolytic
xxx
Strept. pyogenes
Strept. agalactiae
(Non Typable)
Viridans streptococci
Strept. pneumoniae = pneumococci
S
Bacitracin Sensitivity
R
(GAs)
(GBs)
R ← optochin sensitivity → S
R ← Bile solubility → S clear
-ve ← Quelling test → +ve
-ve ← latex agglutination test → +ve
Flora
- Mouth
- GIT
- Vagina
Glycocalyx
Tonsillectomy or Trauma to oral mucosa
endogenous Inf
Diagnosis
Blood culture
subculture on blood agar
α-haemolytic
Ht
- Penicillin resistant
- Penicillin + gentamicin
Prevention
Amoxicillin or Ampicillin
to prevent SBE
Bacteraemia (ID pt.)
Dental plaque = Biofilm
Damaged Ht Valve
Prosthetic Ht Valve
SBE
Dental Caries


G+ve cocci
Streptococci
G+ve cocci in pairs or chains
Catalase -ve
Fastidious
enriched medium
classification
Lancefield
CHO Ag A → U
Blood agar
β = complete haemolytic
α = partial haemolytic
Non = γ haemolytic
xxx
Strept. pyogenes
Strept. agalactiae
(Non Typable)
Viridans streptococci
Strept. pneumoniae = pneumococci
S
Bacitracin Sensitivity
R
(GAs)
(GBs)
R ← optochin sensitivity → S
R ← Bile solubility → S clear
-ve ← Quelling test → +ve
-ve ← latex agglutination test → +ve
Flora
- Mouth
- GIT
- Vagina
Glycocalyx
Tonsillectomy or Trauma to oral mucosa
endogenous Inf
Diagnosis
Blood culture
subculture on blood agar
α-haemolytic
Ht
- Penicillin resistant
- Penicillin + gentamicin
Prevention
Amoxicillin or Ampicillin
to prevent SBE
Bacteraemia (ID pt.)
Dental plaque = Biofilm
Damaged Ht Valve
Prosthetic Ht Valve
SBE
Dental Caries

Faculty of Medicine
Cairo University
(Second Year)

2022

Medical MicroBiology



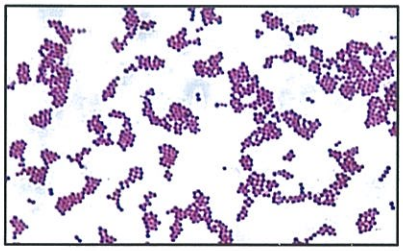
Cardiovascular (CVS) - (207) module

Staphylococcus

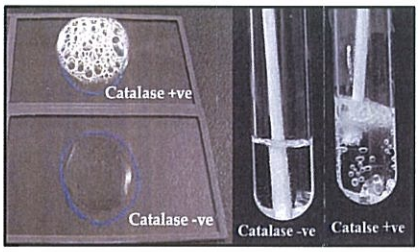
CVS (Module 207)

Characters of the genus Staphylococcus:

Gram-positive cocci arranged in grape-like **clusters**



Catalase positive



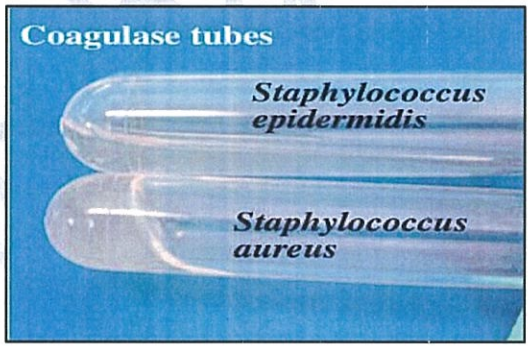
Opaque, pigmented colonies are usually produced on agar

The ability to produce **staphylo-coagulase** divides the genus into two groups

Coagulase-positive staphylococcus
(***S. aureus***)

- Has the greatest pathogenic potential
- The most medically important species

Coagulase-negative staphylococcus
(***S. epidermidis*** & ***S. saprophyticus***)
→ less pathogenic



Staphylo-coagulase

Extracellular protein → convert plasma **fibrinogen to fibrin** → **fibrin barrier** is formed → this leads to:

1. **Protection** from phagocytic and immune defences
2. **Localization** of infection

Coagulase Positive Staphylococci

Staphylococcus aureus

Morphology: like other staphylococcus, are Gram-positive **cocci** (1µm in diameter) arranged in **irregular grape-like clusters**.

Cultural characters:

- S. aureus is **facultative anaerobe**
- Usually produces **golden yellow endopigment**
- **Usually grown on**
  - ❶ **Nutrient agar** → producing **golden yellow endopigment**
  - ❷ **Blood agar** → producing **complete (ß-) hemolysis** due to production of **hemolysins**
  - ❸ **Mannitol salt agar** (**selective indicator** medium)
    - This medium facilities **isolation of S. aureus** (**salt tolerant 6.5%**) from specimens contaminated by other bacteria
    - Producing **yellow colonies** due to **mannitol fermentation**.

Staphylococcus aureus diseases:

A) Pyogenic diseases

- ❶ **Localized skin infections**
- ❷ **Staphylococcal pneumonia**
- ❸ **Invasive conditions**
  - More serious & usually occur in **immuno-compromised** individuals.
  - Invasion of bloodstream (**bacteraemia**) → spread to many body sites → **endocarditis**, meningitis & osteomyelitis.
  - Resulting **septicaemia** may be rapidly fatal

B) Toxin-mediated diseases

❶ **Staphylococcal food poisoning**	
❷ **Toxic Shock syndrome (TSS)**	▪ Due to infection or **colonization by TSST-1 producing** *S. aureus* ▪ It was first described in **young menstruating females** who use **vaginal tampons** that are left in place for extended period → however, it can also occur in any **individual suffering from TSST-1 producing *S. aureus*** infections anywhere in body ▪ **The disease is characterized by:** ① Sudden onset of **high fever, diarrhoea, vomiting** & **red rash** ② **Hypotension** with **cardiac** & **renal failure** due to **superantigen** action of TSST-1 ▪ **Mortality rate** may reach **10-15%** ▪ **The diagnosis usually depends on:** ① Clinical findings ② **Isolation of organism:** From suspected sites (e.g. wounds, vagina or from tampons) **By culture on mannitol salt sugar** ③ Detection of **TSST-1 in blood** by **ELISA**
❸ **Staphylococcal scalded skin syndrome (SSSS)**	

Coagulase Negative Staphylococci

Staphylococcus epidermidis

Morphology & Cultural Characteristics:

***S. epidermidis* is similar to *S. aureus* except in the following:**

❶ It gives white non-haemolytic colonies on blood agar
❷ It is mannitol non-fermenter

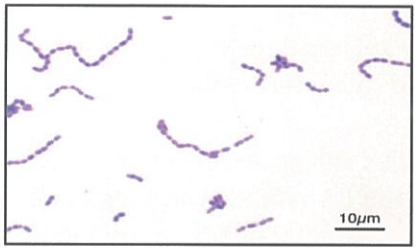
Pathogenesis:

- *S. epidermidis* is **part of the normal skin flora**, and it is often attached to **upper layer of skin (epidermis) or mucosa (carriage rate ~100%)**
- Almost all infections are **endogenous**, but **person-to-person transmission by contact may occur**
- *S. epidermidis* is **opportunistic pathogen** associated with **device-related infections** → e.g. Prosthetic valve endocarditis

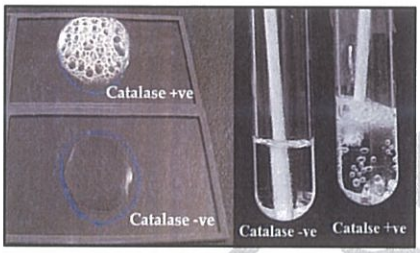
Streptococcus

Characters of the genus Streptococcus:

Gram-positive ovoid **cocci** arranged in **chains** or **pairs**



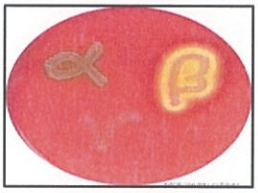
Catalase negative → key test for discriminating streptococci from catalase-positive staphylococci



Growth requires **enriched media** containing **blood** or **serum**

Streptococcus is divided on the basis of:

❶ **Haemolysis on blood agar**



① **Complete** (**beta**) haemolysis
- *Streptococcus pyogenes* (Groups **A** Streptococci)
- *Streptococcus agalactiae* (Groups **B** Streptococci)

② **Partial** (**alpha**) haemolysis
- Viridans Streptococci
- *Streptococcus pneumonia* (Pneumococci)

③ **No** (**gamma**) haemolysis

❷ **Group-specific carbohydrate antigen (Lancefield classification)**

According to which streptococci are classified into groups **A to U** → **Antibodies against** these group antigens are used for **identification of streptococcal species**

Alpha-Haemolytic Streptococci

Viridans Streptococci

Normal inhabitants of:

1. Oral cavity
2. GIT
3. Female genital tract

Viridans streptococci play significant role in

- **Dental caries**
- 50%of cases of **subacute bacterial endocarditis (SBE)**

  - SBE may occur when **dental manipulations** or **trauma to mucosa of URT (tonsillectomy)** → lead to **bacteraemia**
  - Organisms can **adhere** to **cardiac valves**, especially in people with **underlying valvular disease** (prosthetic valve, deformed heart valve e.g. rheumatic or congenital heart, ...etc) → resulting in **endocarditis**

Laboratory diagnosis of SBE:

Carried out by **blood culture technique** → with **subculture on blood agar**
→ The isolated organism should be **discriminated from *S. pneumoniae***

Test	*S. pneumonia*	*Viridans strept.*
Growth inhibition by optochin	+	-
Solubility of colonies in bile	+	-
Capsular Ag detection (latex agglutination)	+	-
Quellung test	+	-

Treatment:

- *Viridans streptococci* are relatively **resistant to penicillin**
- Use of **synergistic combination** of **penicillin** & **gentamicin** in **life-threatening infections** (as endocarditis) is **essential**

Prevention:

Single large dose of **ampicillin** or **amoxicillin**
→ Should be given to **patients with abnormal heart valves prior to dental procedures** or **oral surgery**
→ To **prevent endocarditis**

Beta-Haemolytic Streptococci

Streptococcus pyogenes (Group A Streptococcus)

Morphology: **Gram positive cocci** in **chains**

Cultural characters:

- Produce **beta-haemolysis** on blood agar
- *S. pyogenes* growth is **inhibited by bacitracin**

Streptococcus pyogenes infections:

I- Localized infections

1. **Pharyngitis (sore throat, tonsillitis)**
2. **Scarlet fever**
3. **Skin & soft tissue infections**

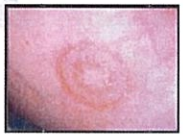
II- Invasive infections

1. **Puerperal fever**
2. **Acute endocarditis**
   Fatal condition can occur in individuals with **normal** or **damaged heart valves**
3. **Necrotizing faciitis**
4. **Toxic shock syndrome**
   - Due to infection or colonization by strains of *S. pyogenes* that produce pyrogenic exotoxins (**SPE-A, B & C**) → these toxins act as **superantigens** causing toxic shock syndrome, septicaemia & necrotizing faciitis
   - Begins with skin wounds or minor traumas & rapidly deteriorates → necrotizing soft tissue infections
   - **Complications**
     ① Shock
     ② Renal failure
     ③ Acute respiratory distress syndrome
   - **The diagnosis usually depends on:**
     ① Clinical findings
     ② **Isolation of organism** from infected wound

Post-Streptococcal Sequelae

- **Non-suppurative** inflammatory conditions → result of **immunologic response** to streptococcal antigens.
- Occur **weeks following** local **infection** with streptococcus
- Affect **organ** that was **not infected by streptococcus**
- **Some streptococcal M serotypes are:** **Rheumatogenic** → cause **acute rheumatic fever (ARF)**

Post-Streptococcal Sequelae

	Acute rheumatic fever (ARF)
Age	Affect **any age** (but mostly **4-30 years**)
Onset	Develops **2-3 weeks** following **streptococcal pharyngitis** (but not skin infection)
Pathogenesis	Occurs due to formation of **antibodies to streptococcal M protein** → cross react with antigens (epitopes) of **joints, heart** & **brain tissue** (**autoimmune reaction**)
Characterized by	❶ Fever ❷ Migrating poly-arthritis ❸ Carditis ❹ Chorea
Recurrence of Strept. infection (Reinfection)	▪ Immunological process is **exacerbated** by **recurrence** of streptococcal **pharyngitis** → **valvular damage** ▪ Therefore, **long-term antibiotic prophylaxis** using **penicillin** is **recommended** following single attack
Diagnosis	▪ **No single test** is diagnostic. ▪ **Diagnosis** is usually based on **modified Jones criteria** ▪ Diagnosis requires evidence of **recent *S. pyogenes* infection** together with **2 major criteria**, or **1 major** & **2 minor criteria** **Evidence of recent streptococcal infection** **Any of the following** ❶ History of **acute tonsillitis** (or **scarlet fever**) ❷ **+ve throat swab** culture for ***S. pyogenes*** ❸ **Elevation** of anti-streptolysin O (**ASO**) titre **above 200 units** (titre up to 200 units is considered normal) **Major criteria** ❶ Migratory poly-arthritis ❷ Carditis ❸ Chorea ❹ Subcutaneous nodules ❺ Erythema annulare  **Minor criteria** ❶ ↑↑ ESR, +ve CRP or ↑↑ WBC count ❷ Fever ❸ Prior history of RF
Prevention	Rheumatic Fever is preventable if patient is **treated within the 1st 10 days** following onset of acute pharyngitis

	ARF
Pathogenesis	**Anti-M** protein **antibodies cross-react** with **epitopes on heart**
Age	Mostly between **4-30 years**
***S. pyogenes* strains**	**Rheumatogenic**
Precipitating inf.	**Pharyngitis** (but not skin infection)
Recurrence	**Common**
Chemoprophylaxis	**Essential**
Sequelae	**Heart disease**
Early ttt of precipitating inf.	**Prevents** the condition
Serological test	**ASO**

Treatment & prevention:

- **Penicillin** → still uniformly **effective** in treatment of *S. pyogenes* infections.
- **Long acting penicillin**
  Used as **chemoprophylactic agent** against recurrent *S. pyogenes* infections → to prevent repeated rheumatic attacks.
- **Erythromycin** is used as alternative for **penicillin-allergic patients**

Enterococcus

Characters of the genus *Enterococcus*:

- ***Enterococci* are similar to *streptococci* in the following:**
  1- They are **Gram positive cocci** that occur in pairs or in short chains.
  2- They are **facultative anaerobes**
  3- They are **catalase negative**
  4- Most strains react with the **streptococcal Lancefield group D anti-serum**

- ***Enterococci* differ from *streptococci* in being able to:**
  1- Grow at **45°C**
  2- Grow in broth containing **6.5%NaCl (salt tolerant)**
  3- **Tolerate bile salts** → this allows **survival** of *enterococci* in **bowel & gall bladder**
  4- **Hydrolyze the polysaccharide esculin** → producing **black colonies on esculin-containing media**

- The **common species** → ***Enterococcus faecalis*** & ***Enterococcus faecium***

Infections caused by *enterococci*:

❶ Bacteraemia ❷ Endocarditis

Enterococcus faecalis is most commonly isolated from **healthcare-associated infections rather than community-acquired infections**

GRAM -VE BACILLI

Salmonella choleraesuis

Septicaemia

- The condition is commonly caused by ***S. choleraesuis***
- It usually occurs in **immunocompromised individuals**
- After **ingestion of salmonellae**, the **organisms invade intestinal mucosa** & **invade bloodstream early without intestinal lesions** → **bacteraemia** results in **metastatic infections** as **osteomyelitis**, **arthritis**, **pneumonia** & **meningitis**
- **Blood culture** is usually **positive** particularly **during the high fever**

Bloodstream infections

- Occur **when infectious pathogen reaches bloodstream** by:
  1. Direct invasion into blood vessels
  2. Via lymphatic vessels draining focus of infection (e.g. abscess)
  3. Through vascular devices as needles or catheters

- **Bacteremia or fungemia:** denotes presence of viable bacteria or fungi in bloodstream, with or without clinical symptoms & detected by blood cultures

- **Toxemia:** term used when **bacteria remain fixed at site of infection** but **release toxins into blood**

- **Viremia:** refers to presence of virus or viral component in bloodstream & detected by culture or molecular methods

Common causes of bacteremia:

1) Gram positive organisms	2) Gram negative organisms
1. *Staphylococcus aureus* 2. Coagulase-negative staphylococci (CoNS) 3. *Streptococcus pyogenes* 4. *Streptococcus pneumoniae* 5. *Viridans streptococci* 6. Enterococci spp.	1. Enterobacteriaceae (*E. coli*, *Klebsiella* spp.....etc) 2. *Pseudomonas aeruginosa* 3. *Acinetobacter* spp. 4. *Salmonella choleraesuis* (septicemia) 5. Neisseria spp.

Endocarditis

(Microbial **infection of endothelial lining of heart**, usually including **heart valves**)

Types: Endocarditis can be classified into:

I) Infective endocarditis (May occur in **subacute form** or as **acute, rapidly progressive disease**)	II) Non-infective endocarditis
a) Subacute infective (bacterial) endocarditis **Slowly progressive** form of disease occurs in **patients with damaged heart valves** & usually **caused by relatively avirulent organisms** as ***viridans streptococci*** (50% of subacute bacterial endocarditis) **b) Acute infective endocarditis** ▪ **Fulminating infection**, characterized by **high fever**, **leukocytosis** & **rapid destruction of heart valves** → 2ry to a bacteremia from remote site & is usually **caused by virulent organisms** ▪ **The commonest organisms include:** 1. *Staphylococcus aureus* 2. Coagulase-negative staphylococci 3. *Streptococcus pyogenes* 4. *Enterococci* spp. ▪ **Laboratory diagnosis of acute endocarditis:** By **blood culture technique** with **subculture on blood agar**	Include **rheumatic endocarditis** (**post-streptococcal sequelae**)

Toxemia

(Term used when bacteria remain fixed at a site of infection but release toxins into blood)

Common causes of toxemia:

❶ *Staphylococcus aureus* → causes staphylococcal toxic shock syndrome (STSS)
❷ *Streptococcus pyogenes* → causes streptococcal toxic shock syndrome
❸ *Corynebacterium diphtheriae* (toxic myocarditis)
❹ *Bacillus anthracis* (anthrax)
❺ *Clostridium perfringens* (gas gangrene)
❻ *Clostridia tetani* (tetanus)
❼ *Clostridia botulinum* (botulism)

Fungemia

(**Presence of viable fungi in bloodstream**, with or **without clinical** symptoms and **detected by blood cultures**)

Common causes of fungemia: ❶ Candida spp. ❷ Aspergillus spp.

Candidiasis

Candidiasis (moniliasis) is most frequently caused by ***Candida albicans*** & rarely due to infection by other species, e.g. C. stellatoidea, C. krusei.. etc.

Candida albicans is present as **normal flora** in **oral cavity**, **vagina** & **intestine**

Predisposing factors to candidiasis include:

❶ Diabetes
❷ Broad-spectrum antibiotic treatment (superinfection)
❸ Steroid therapy
❹ Immunosuppression
❺ Old age & pregnancy
❻ Prolonged exposure to water

Clinical features of candidiasis:

① **Cutaneous:** Affecting skin and mucous membranes

② **Systemic:** Affecting **lung or kidney**
→ usually **complicates underlying disease** as TB, malignancy or immunosuppression.

Aspergillosis

Caused by ***Aspergillus fumigatus***,
→ **rarely by** *A. niger* & *A. flavus*

Spores are **found in air**
& are **continuously inhaled**

Aspergillosis may present as:

Invasive infections: e.g. pneumonia or meningitis → may occur in **severely immunocompromised patients** especially those with **neutropenia**

Viremia

(Presence of **virus or viral component in bloodstream** & **detected by culture or molecular methods**)

Common causes of viremia

❶ Hepatitis B virus
❷ Human immunodeficiency virus
❸ Polio viruses
❹ Measles virus
❺ Rubella virus
❻ Herpes viruses → varicella-zoster virus, Epstein-Barr virus and cytomegalo-virus
❼ Arboviruses → yellow fever, dengue fever, Zika fever, West Nile and Rift Valley fever viruses
❽ Roboviruses → Lassa fever virus and Hanta viruses
❾ Filoviruses → Ebola and Marburg viruses

ARBOVIRUSES

Arthropod-borne viruses
→ i.e. they are
transmitted by arthropods

Collective name for large group of diverse viruses belonging to different families

In general, they are named either for:
❶ **The diseases** they cause (e.g. yellow fever virus), or
❷ **The place** where they were first isolated (e.g., West Nile virus)

Most arboviruses are classified in 3 families:

❶ Flaviviridae
❷ Togaviridae
❸ Bunyaviridae

① Flaviviridae

Enveloped ssRNA viruses

Members of medical importance include:

❶ Yellow fever virus
❷ Dengue fever virus
❸ West Nile encephalitis virus
❹ Zika virus

N.B.:

Hepatitis C virus is member of **Flaviviridae** but is **not transmitted by arthropods** → (i.e. **not arbovirus**)

❶ *Dengue Fever* (has the **same MOT as yellow fever " mosquito bite"**)

Disease occurs in 2 clinical forms:

① **Classic dengue ("breakbone fever")**

- **Begins suddenly** with **influenza-like manifestations** with **severe pains in bones** & **muscles**
- **Complete recovery** is the rule

② **Dengue haemorrhagic fever**

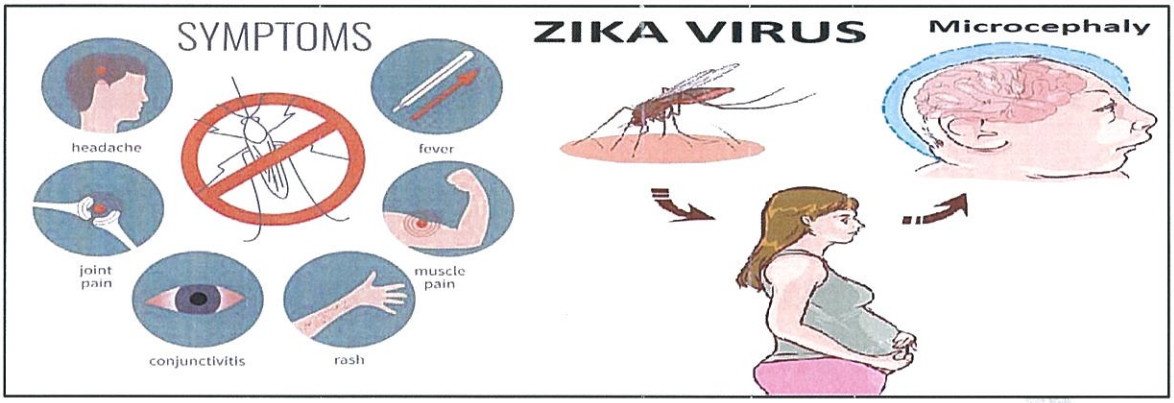
- **Much more severe disease** affecting **mainly children**
- Acute onset of fever is accompanied by **gastrointestinal haemorrhage**, **renal involvement** & **shock** with case **fatality rate of 50%**

❷ *Zika Fever*

- *Zika virus* is primarily spread by **bite of infected mosquitos (*Aedes aegypti*)** like yellow fever & dengue fever viruses
- However, **sexual** & **blood-borne transmission** of *Zika virus* has also been documented

After **inoculation of virus into human skin**, virus **spreads to LNs** & then enters **bloodstream**

- **Most cases have no symptoms, but when present they are usually mild & may include:**
  ❶ Fever ❷ Red eyes ❸ Joint pain ❹ Headache ❺ Maculopapular rash
- **Symptoms** generally **last less than seven days**
- **Infection during pregnancy** may cause **microcephaly** & other **foetal brain malformations**
- Infection in adults has been **linked to Guillain-Barre syndrome**



There is **no specific treatment** & **prevention** is by **protection against mosquito bites**

② Bunyaviridae

Enveloped ssRNA viruses

Members of medical importance include:
1. California encephalitis virus
2. Rift Valley fever virus
3. Hantaan virus

Rift Valley Fever

Rift Valley fever virus is primarily **pathogen of sheep & domestic animals**

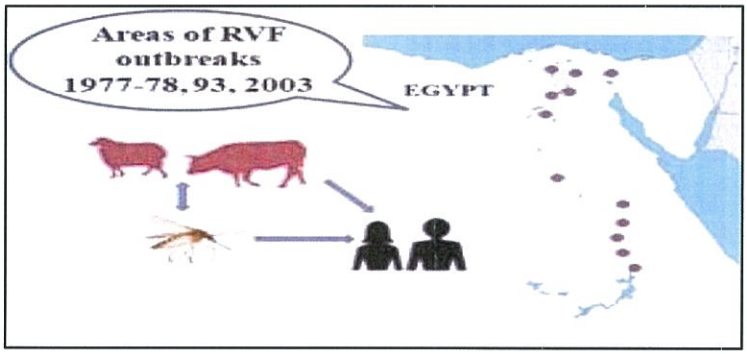
Man is infected through:
1. Contact with infected animals
2. Mosquito bite

Disease **in humans** is usually **mild febrile illness** with **complete recovery**

Complications
1. Haemorrhagic fever
2. Encephalitis

Outbreak of Rift Valley fever occurred **in Egypt** during **1977** & caused **600 human deaths**

Living attenuated vaccine is used for animal immunization



Roboviruses

(Rodent-borne viruses that are **transmitted directly from rodents to humans without arthropod vectors)**

Medically important members include:

❶ **Lassa fever virus** → which belongs to **Arenaviridae**
❷ **Hantaviruses** → which belong to **Bunyaviridae**

① Lassa fever virus

- Lassa fever virus is the **most important member of Arenaviruses** which are **enveloped ssRNA viruses**
- It **causes haemorrhagic fever** with **high mortality rate**

- **The virus is shed with rodent excreta, and is transmitted to humans by:**
  ❶ Inhalation of contaminated aerosol
  ❷ Ingestion of contaminated food
  ❸ Contact with contaminated soil

- **Man-to-man transmission** occurs **especially in hospitals**

② Hantaviruses

- Most **important member of Hantaviruses** is **Hantaan virus** which **causes Korean haemorrhagic fever**
- They are **transmitted to humans** by **inhalation of aerosols of infected rodent excreta**
- There is **no person-to-person transmission**
- **Other members** of Hantaviruses cause **Hantavirus pulmonary syndrome** which is **associated with high mortality**

FILOVIRUSES

- Filoviruses are **enveloped ssRNA viruses**
- They **appear as filaments of varying lengths**

- **Medically important members include:** ❶ Ebola virus ❷ Marburg virus

- Both viruses **cause severe haemorrhagic fever** characterized by **widespread bleeding into the skin, mucous membrane, visceral organs** and **gastrointestinal tract**

- **Mortality rate** is **high** and may **reach up to 90%**
- Although the **natural reservoir of these viruses is unknown**, they **can be transmitted to humans from infected monkeys or by exposure to blood or other body fluids** from **infected patient → medical staff** is especially **at risk**

- In **2014, epidemic of Ebola killed many thousands** mostly in **west African countries**

Systemic vasculitis

Inflammation of blood vessel walls that can lead to **narrowing, ischemia** or **development of aneurysms**
→ *Rickettsia spp.* are the **commonest cause of infectious vasculitis**

RICKETTSIA

Characteristic features:

❶ Rickettsia species are **small obligate intracellular bacilli** → they are **unable to make sufficient ATP** for **independent life**
❷ They have **Gram-negative cell wall structure** → Rickettsiae are best **stained by Giemsa stain**
❸ They **cannot grow on artificial laboratory media**, but can be **isolated by inoculation of laboratory animals or tissue cultures**
❹ Organisms are **maintained in nature by arthropods transmission**

Rickettsia species:

Group	Organism	Disease	Arthropod vector	Mammalian reservoir	Geographic distribution	Clinical severity
Typhus group:	*R. prowazekii*	Epidemic typhus	Louse	Human	South America, Africa	++
	R. typhi	Endemic typhus	Flea	Rodents	Worldwide	-
	Orientia tsutsugamushi	Scrub typhus	Mite	Rodents	Far East	++
Spotted fever group:	*R. rickettsii*	Rocky Mountain spotted fever	Tick	Dogs, rodents	Rocky Mountain states, Eastern USA	+
	R. akari	Rickettsial pox	Mite	Mice	Asia, Far East, USA	-
	R. conorii	Mediterranean Spotted fever	Tick	Dogs	Mediterranean	+

Mode of transmission:

- Transmission of infection by **infected louse or flea** occurs by **rubbing faeces of vector into broken skin**
- Transmission of infection by **infected tick or mite** occurs **via vector bite**
- In case of **epidemic typhus**, the **infected lice are eventually killed by the infecting bacteria** → accordingly, this **disease is not maintained in lice population** → i.e. there is **no louse-to-louse transmission** and **human infection is obligatory stage in the cycle**.
- **Ticks & mites can transmit the organism transovarially to their progeny** → & so, the organism can be maintained in tick or mite population without mammalian host for many years.

N.B.:
All rickettsial diseases are **considered to be zoonosis except epidemic typhus** which **occurs only in humans**

Pathogenesis and clinical manifestations:

- Rickettsiae **infect the endothelial lining of the blood vessels** → leading to **vasculitis**
- **Damage to vessels of skin** results in **characteristic rash** & in **oedema & haemorrhage**
- Rickettsial disease is **usually accompanied by fever**, **headache** & **skin rash**
- In **severe cases**, **rickettsial encephalitis** with **coma**, **convulsions** & **pulmonary oedema** are **grave conditions that are often fatal**
- In some cases of **epidemic typhus**, **rickettsiae are not eliminated from the body** on **clinical recovery** and **remain in lymph nodes** → as much as 50 years later, infection can be reactivated to cause **Brill-Zinsser disease** (i.e., **endogenous infection**), and the **patient once again acts as source of infection** for any louse that may be present

Laboratory diagnosis:

Indirect immunofluorescent test is used to **demonstrate anti-rickettsial antibodies**

Treatment:

Tetracycline is the drug of choice → and **chloramphenicol** is alternative

Prevention:

Prevention is based on **reducing exposure to arthropod vector** (e.g., delousing in case of epidemic typhus) & **personal hygiene**

End Of Papers
(Module CVS - 207)
With My Best Wishes
Dr. Hesham Esmat