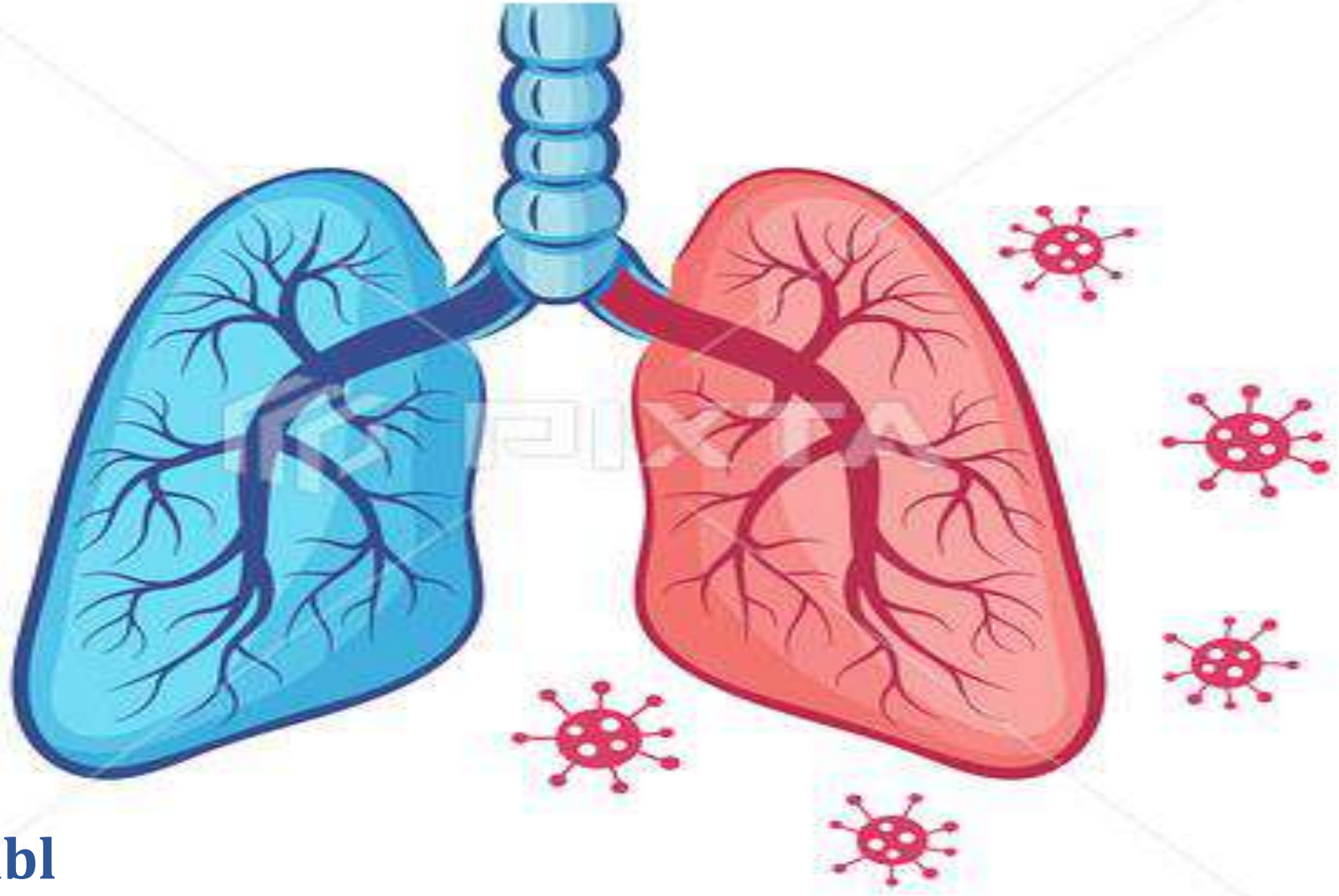
Microbiology Most important

الشغلات اللي حكت الدكتورة عنهم مهم ،عليهم هايلايت احمر

RESPIRATORY TRACT INFECTIONS



By
Prof. Hala Tabl

GROUP A, BETA- HAEMOLYTIC STEREPTOCOCCI (STREPTOCOCCUS PYOGENES)

VIRULNCE FACTORS:

A) Adherence factors: promotes adherence to epithelial cells.

1- Fibronectin- binding protein (protein F) and lipoteichoic acids (LTA).

2- M protein: hair like projections covering the cell wall **(more than 80 types).**

B) Anti-phagocytic factors:

1- M protein: it is a **major virulence factor** that resist phagocytosis.

2- Hyaluronic acid capsule: acts as immunological mask.

3- C5a peptidase: breaks down C5a complement.

C) Spreading factors: Group of enzymes that break down the normal host tissues:

1- Streptokinase (Fibrinolysin):- Dissolves fibrin in clots

2- Streptodornase (Deoxynuclease)(DNase):- Degrades DNA

} **used in treatment of emboli**

3- Hyaluronidase.

D) Toxines:

1- Streptolysins (Hemolysins) (pore forming cytotoxin):

a) Streptolysin O: (oxygen labile), **antigenic**, antibody to it (ASO) develops after infection.

b) Streptolysin S: (oxygen stable), not antigenic (**β-hemolysis** on a blood agar plate).

2-Pyrogenic exotoxins e.g. erythrogenic toxin: It causes the **rash** in scarlet fever.

Diseases caused by Streptococcus Pyogenes:

1) Streptococcal pharyngitis (Strep throat) (Acute follicular tonsillitis):-

- Affect mainly children (5-15 ys).
- Red swollen tonsils with **purulent patches & streaks of pus.**
- High fever & Enlarged and tender cervical lymph nodes, painful swallowing.

2) Scarlet fever (scarlatina):-

- Affect children < 10 years.
- Caused by streptococci that produce **erythrogenic toxin** (strains of S. pyogenes **lysogenized by a bacteriophage** carrying the gene for the toxin).
- It is characterized by **fever, sore throat**, and a **scarlet erythematous rash**.
- A **"strawberry" tongue** is a characteristic lesion seen in scarlet fever.

3)Post-streptococcal diseases :

- The inflammation is caused by **autoantibody against streptococcal M proteins** that cross-react with human tissues.
- Occur **weeks** (time to produce sufficient antibodies) after a local infection with group A streptococci.
- **Acute Rheumatic fever:** Follows **pharyngitis (not skin infection).**
- **Acute Glomerulonephritis (AGN):** Follows **skin infections** rather than pharyngitis.

DIAGNOSTIC LABORATORY TESTS: Throat swab

b) Gram stained smears: are not useful (S. viridans are members of the normal flora).

c) Culture: on blood agar show: **β hemolytic** colonies which is **catalase negative** and **bacitracin sensitive**.

d) Antigen detection tests: ELISA or agglutination tests used for **rapid** antigen detection.

e) ASO test: diagnosis of post-streptococcal diseases, ASO titers high soon after infections.

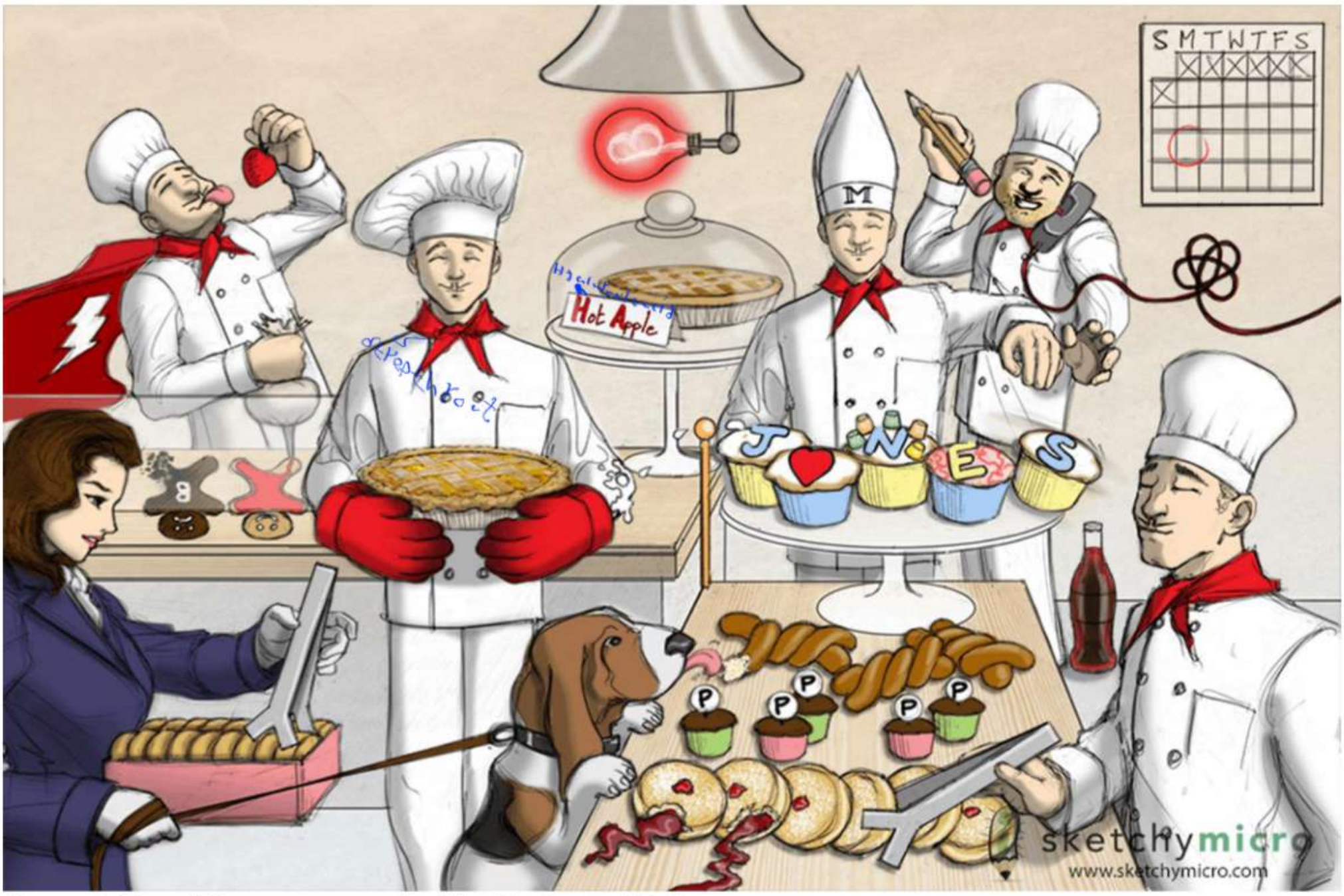
Treatment of scarlet fever:

Antitoxin serum is given. It shortens the course of the disease & prevents the rash.

PREVENTION:

Rheumatic fever can be **prevented** by adequate treatment of strept. pharyngitis **for 10 days**.

Prevention of streptococcal infections (**usually with long acting penicillin**) in persons who have had rheumatic fever.



Group A Strep (Strep pyogenes) – The Pie Genies' Bakery

1. Pie in glass Capsule – Group A Strep is encapsulated
2. Hot Apple – Capsule made out of Hyaluronic Acid
3. Heating Lamp w/ "B" Light – Beta Hemolytic
4. 1st Baker
    a. Baker Holding Honey Crusted Pie – Impetigo
    b. Red Handkerchief – Strep throat, red inflamed throat
    c. Red Mittens on Baker - Erysipelas, red lesion with well demarcated borders, S Pyogenes is the most common cause.

2nd Baker w/ Cape – represents Strep Toxins 3 issues

5. Scarlett Fever
    a. Strawberry Tongue
    b. Red Handkerchief - Pharyngitis,
    c. Red Gingerbread Man - widespread rash that spares the face.
6. Cape w/Bolt - Toxic Shock Like Syndrome mediated by a super antigen – SpeA, SpeC
7. Burnt Gingerbread man - Necrotizing Fasciitis –SpeB

Master Chef – M Protein in GAS well main virulence factor for Rheumatic Fever, will interfere with opsonization, antiphagocytic, M Protein will mimic antibodies in heart and cause issues with Mitral Valve in heart

8. Chef Swatting away other chef – Antiphagocytic action
9. Miter hat - Very antigenic and elicits a humoral response, creating an antibodies to myosin in cardiac muscle (Molecular mimicry), damages mitral valves
10. Red Handkerchief – Pharyngitis precipitates RF, NOT IMPETIGO
11. Cupcakes w/ JONES on them
    a. J = Joints
    b. "Heart" = Heart Problems
    c. Nodules on extensor surfaces
    d. Erythema marginatum
    e. Sydenham's Chorea
12. Phone cord that looks like a glomerulus - Post Strep Glomerulonephritis, type III hypersensitivity reaction (deposition of antibodies in glomerulus)
    a. Puffy Cheeks – Puffy Cheeks w/ nephritis
    b. Bottle of Cola – Cola Colored Urine
    c. Calendar – Occurs 4 weeks after strep infection
    d. Can occur after pharyngitis and impetigo
    e. Pencil – TXT is penicillin
13. Baker on bottom Right 3 more virulence Factors
    a. O Shaped Donuts – Streptolysin O, allows Strep to be Beta Hemolytic, we generate ASO antibodies to this
    b. Phosphate Cupcakes – Streptokinase, converts plasminogen to plasmin.
    c. Twists – DNA'ases, depolymerize DNA
14. Basset hound – Bacitracin sensitive
15. Lady checking a box of donuts – Tongs are antibodies, check ASO titers to see if there was a Group A Strep Infection.

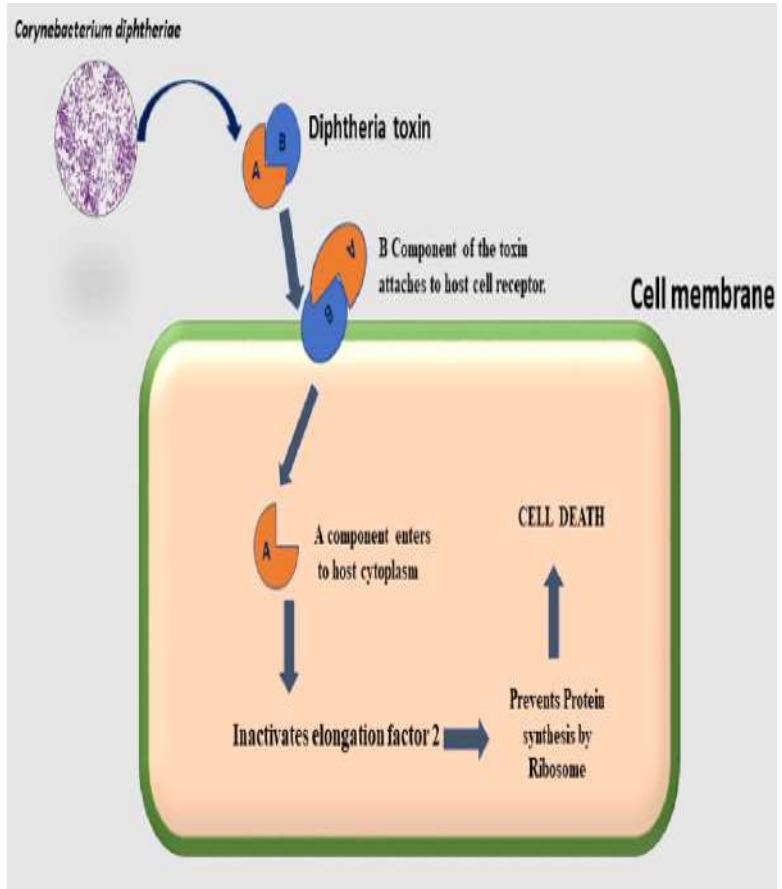
١- تذكر الطبق السيئ
٢- ٣ اسوأ
٣- ال Scarlet ← toxin ← Pyogenec
٤- وظائف ال M

CORYNEBACTERIUM DIPHTHERIAE

- Gram **positive rods, Non-spore-forming.**

VIRULENCE FACTORS:

- **Diphtheria toxin is the main virulence factor.**
- The toxin is produced **only** by strains of **C. diphtheriae** infected with **bacteriophage** which carry the gene for toxin production. So, only **lysogenic** strains of C. diphtheriae are **toxigenic** and **virulent.**
- Act by **inhibition of protein synthesis through Inactivation of elongation factor2.**



PATHOGENESIS: Tonsillar diphtheria:

- Is the commonest type and is transmitted by **droplets (from case or carrier)**.
- It's a very contagious, life-threatening disease that affect mainly small children but can affect adults. معدي
- The organism **does not invade** the deep tissue and **never** enters the blood stream. The organism **multiply locally**, releasing the toxin causing inflammation of the throat, local necrosis with fibrinous exudate resulting in formation of a spreading grayish white **pseudomembrane** .
- The **exotoxin** released **diffuses** to the blood stream causing **toxaemia** and affects the **heart**, **kidneys** & **nervous tissue**.

CLINICAL PICTURE & COMPLICATIONS:

- Mild fever and general ill health.
- The tonsils are covered with a **grayish pseudomembrane** which may extend to the larynx and cause **Suffocation**.
- **Irregularities of cardiac rhythm** indicate damage to the heart.
- Nerve involvement may lead to **difficulties in swallowing, speech, vision**.

DIAGNOSIS: **Mainly clinical diagnosis.**

- **Gram stained smears:** seen in a small proportion of cases (**negative result cannot exclude diphtheria**).
- **Cultures:** are made on **Loeffler's** serum and **blood tellurite** media.

TREATMENT:

1- Diphtheriae anti-toxin serum (given without delay)

- It **neutralizes the free toxin** (Not fixed toxin) before it causes irreversible damage.
- It is produced in **animals** (e.g. horse) (may cause **allergy**).

2- Chemotherapy:

Given **in association with anti-toxic serum** (inhibit local multiplications of C. diphtheria)

PREVENTION:

A- Isolation: Patients with diphtheria should be isolated.

B- Active immunization (vaccine):

- Prepared from **Diphtheria toxoid** (Toxin with removed toxicity but retained antigenicity).
- Such toxoid is usually combined with tetanus toxoid and pertussis vaccine **(DPT).**

C- Passive immunization:

Anti-toxin serum is given to contacts of a case + A booster dose of toxoid.

FUSO-SPIROCHETAL DISEASE (Vincent's angina)

- Vincent's angina is **ulcero-membranous** pharyngitis and tonsillitis, caused by infection with two types of bacteria (Normal mouth commensals):

- Fusiform (Fusobacterium) gram -ve **anaerobic** bacilli.
- Spirochaetes (Borrelia vincenti) gram -ve spiral bacilli.

- Characterized by **unilateral pseud-omembrane**.
- It is more pronounced in **Immunocompromized** individuals.

Corynebacterium Diphtheria - Corazon de la Corrida

1. Purple Hues - Gram Pos, non-spore forming
2. Guy playing Morocco's that are blue and red – Bacteria is club shaped and y or v shaped, Metachromatic granules that stain with aniline dyes, Metachromatic granules will stain red and the rest of the cell will stain blue.
3. Zig Zag shape in the morocco - V or y shape the bacteria will form
4. 2 subunits A and B, A is active and B is binding
    1. Man playing an accordion wearing a bow tie - Toxin causes Ribosylation of elongation factor 2, this will inhibit ribosome function inhibiting protein synthesis leading to cell death
    2. Kids in the stand eating grey cotton candy wrapped with a plastic wrap - This will lead to pseudomembranous exudate that will be found in the oral pharynx
5. Bull extending its neck with droplets coming out of the mouth and nose - Found in throat and tonsils because the infection is transmitted by respiratory droplets, Can cause airway obstruction and lymphopathy, this will cause bulls neck (thickening of the neck)
6. Cape in the shape of a heart - Can lead to <u>myocarditis like arrhythmias and heart block</u>. Lethal effect of diphtheria
7. Man eating the sausage links - Will damage the myelin of nerve fibers, the sausage man eating the myelin having a neuropathy.
8. Television and kid laughing - Lab diagnosis -plate on Tellurite and Loeflers media (tele like television and loughlers will be the kid laughing like enjoying a show)
9. Bulls tongue sticking out and licking the matador - Eleks test – in-vitro assay that has antitoxin on it.
10. Why it's in another language - Immigrants most likely to get this
11. Syringes in the bull - DTaP vaccine is used, given with tetanus and pertussis. Toxoid Vaccine

١- معدي

٢- بخزيعي

٣- بروح لل larynx

٤- ال Gram ما بأثر لو كان negative

HAEMOPHILUS INFLUENZA

- **Gram negative coccobacilli**.
- Requires **X factor (hemin)** and **V factor (Coenzyme e.g. NAD).**
- Grows **Chocolate agar**.
- Grows Close to colonies of Staph aureus (**Satellitism**).

Virulence factors:

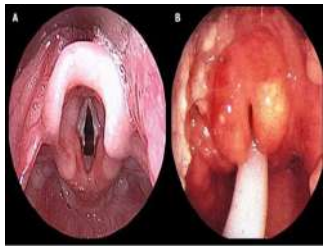
1) **Polysaccharide capsule:** **The major virulence factor (antiphagocytic activity)** classify capsulated strains into **6 types** (a-f).

- H. Influenzae **type b (Hib)** is the most pathogenic and its capsule composed of **(polyribitol phosphate)** (PRP).

2) **Outer membrane:** ↓↓ mucociliary clearance → colonization.

3) **IgA protease:** degrades secretory IgA.

Pathogenicity:



A. Capsulated types (invasive) particularly type b (Hib) cause:

1- Epiglottitis: This life-threatening disease of young children which can **obstruct the airway (medical emergency),** is caused almost exclusively by H. influenzae. A **swollen "cherry-red" epiglottis** is seen. **Tracheostomy or endotracheal intubation is life saving**.

2- Bacteraemia, Meningitis, Septic arthritis.

N.B. Asplenia is important risk factor for infection with encapsulated organisms.

B. The non-capsulated (non-typable) (non-invasive) strains cause:

1- Otitis media and sinusitis: (**next to** *Streptococcus pneumoniae*).

2- Tracheobronchitis & Pneumonia: in adults and elderly, in **presence of predisposing factors** e.g. viral infections, malignancy COPD, cystic fibrosis…

Laboratory diagnosis:

Microscopic examination: Gram-negative coccobacilli.

Detection and typing of capsule: **Positive Quellung reaction.**

Cultivation: on **chocolate agar**.

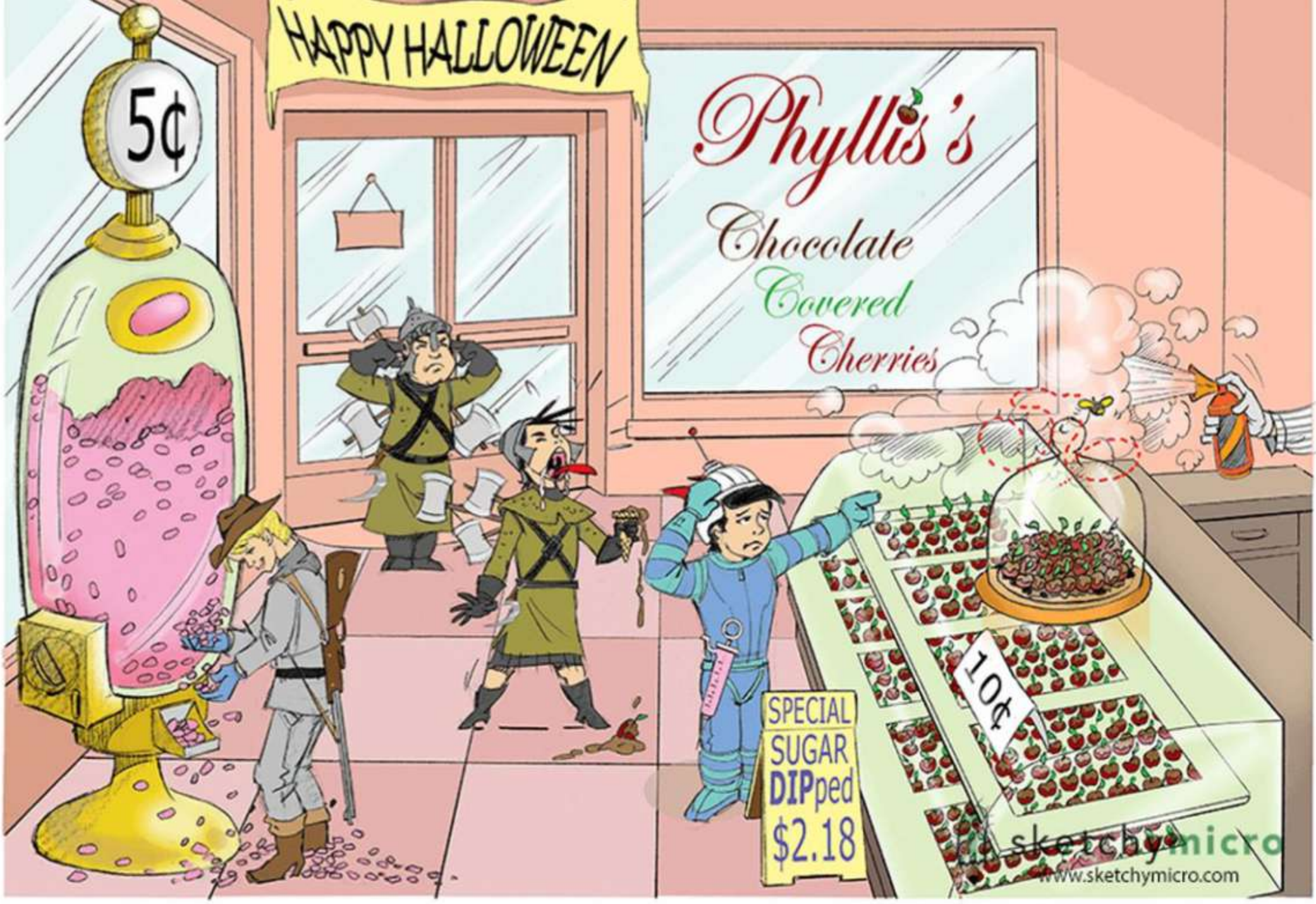
X&V factor test: (**It requires both factors**).

Prophylaxis:

- **H. influenza type b vaccine** **(Hib vaccine):**

1- Polysaccharide vaccine.

2- **Conjugate** vaccine (capsule + carrier protein).



Haemophilus Influenza - "Phyllis's Chocolate Covered Cherries"

1. Red Hues - Gram Neg
2. Shape of the candy machine and candy on top of the machine - Coccobacillary Shape
3. Chocolate sign – Grown in chocolate agar
4. 10 cent sign – Needs Factor 10 “Hemodin”
5. 5 cent sign - Grown on chocolate agar needs factor 5 (NAD, nicotinamide) and factor 10 (Hemodin) "hemoTEN"
6. Child Coughing and aerosol spray - Infection primarily moved by aerosol transmission leading to droplets going to respiratory track calling pneumonia
7. Child sticking out the red tongue screaming - Disease Epiglottitis - symptoms Drooling, inflamed epiglottis, strider, drooling
8. Cherries - "cherry red epiglottis"
9. Child plugging his ears - Otitis Media
10. Meningitis helmet and Bee flying around - Meningitides - only caused by type B capsular form.
11. Sickles attached to belts - Sepsis and Septic arthritis in patients without a spleen, hemophilic infections, especially sickle cell disease
12. Syringe and Capsule with the Bee flying around it - Vaccine for only the type B capsule is conjugated with diphtheria toxoid and haemophilus type B capsule

BORDETELLAE PERTUSSIS

Gram negative coccobacillus.

It does NOT require X and V factors.

Virulence factors:

- **Filamentous hemagglutinin (FHA):**

Promote attachment to the cilia of the epithelial cells.

- **Pertussis toxin (PTx):**

- It has **adenyl cyclase activity** → ↑↑cAMP → **edema** of the respiratory mucosa.

- **Tracheal cytotoxin (TCT):**

- **Necrosis (cell death) of ciliated cells** of the respiratory mucosa.

Whooping cough (Pertussis)

- It is highly communicable disease that occurs primarily in **infants and young children**.
- Infection transmitted by **droplet** infection.
- Disease occurs in three stages:

1- Catarrhal stage: (1-2 weeks): Fever, anorexia, malaise, rhinorrhea, sneezing.

2- Paroxysmal stage: (2-4 weeks): **Repetitive cough with explosive character** followed by a high-pitched intake of breath that sounds like "**whoop**". This may be associated with vomiting, cyanosis and convulsions. تشنج

3- Convalescent stage: Gradual recovery over weeks **(followed by long lasting immunity).**

- **Complications:** (pneumonia, subconjunctival or cerebral haemorrhage, encephalopathy, Rib Fracture).

Prophylaxis: Two types of vaccines:

A- Killed whole cell vaccine.

May cause **post-vaccine encephalopathy** (if given > 6 years of age)

B- Acellular vaccine: (**more safe than killed vaccine**), a combination of:

- Pertussis toxoid (genetically inactivated toxin).
- Filamentous hemagglutinin.
- Other virulence factors.

DTaP: administered in combination with toxoid of diphtheria and tetanus.

Bordetella Pertussis – Board and Care

1. Streamers to represent pili - Respiratory droplets are very infective using Pilus called filamentous hemagglutinin
2. Bow tie - Pertussis Toxin - Ribosylates Gi disabling it
3. GI uniform - Toxic inhibits GI, Disabled Gi (G inhibitor Protein)
4. Military Camp - Leads to a rise in cAMP
5. Popcorn, overabundance of white kernels - ADP Disables Chemokine receptors for lymphocytes leading to an overabundance of white blood cells in the blood stream, lymphocytosis
6. EF Shield - Adenylate cyclase toxin acts like the anthracis toxin edema factor, increases cAMP, Edema Factor, Most Virulent
7. Tractor on the middle road cutting the grass- Tracheal toxin damages ciliated cells in the epithelium, tractor cuts long cilia grass
8. Vet coughing vigorously - Catarrhal phase, limited symptoms nonspecific, most bugs, most contagious. 1-2 weeks
9. Whooping Horn - Paroxysmal - characteristic cough "Whoop"
10. 100 days war banner - Convalescence stage - final stage lasting 3 months with a cough, 100 day cough, most susceptible to secondary infections
11. Crow - Treatment Macrolides
12. Syringe with cell phone - DTaP - **acellular** vaccine using purified antigens
13. Red Hues - Gram Neg

PSEUDOMONAS AERUGINOSA

Virulence factors:

1- Pili (fimbriae).

2-Endotoxin (Lipopolysaccharide): causes septic shock.

3-Exotoxin A: Inhibit protein synthesis and causes tissue necrosis.

4- Extracellular enzymes: e.g., elastases, facilitate invasion into the blood.

5- Pyocyanin: damages the cilia and cause cell death.

6- Alginate (glycocalyx): (Mucoid strains) that forms adherent **Biofilm** protecting from antibodies, complement, and antibiotics.

7- Broad antibiotic resistance: (intrinsic and acquired).

Medical importance of P. aeruginosa:

- It flourishes in **simple aqueous solutions**, **withstand disinfectants**, can grow in soap solutions, in antiseptics, and in detergents.
- **One of the most important causes of nosocomial infections**
- P. aeruginosa is an **opportunistic pathogen** that causes infections in :
  - In whom skin host defenses are destroyed (e.g., **extensive burns**).
  - In those with chronic respiratory disease (e.g., **cystic fibrosis**).
  - In those who are **immunosuppressed**.
  - With **medical devices** e.g. catheters, ventilators, I.V line, ….
- **One of the top antimicrobial resistance threats world-wide, multiple drug resistant (MDR).**

Clinical findings:

1- Respiratory infections:

Hospital-acquired pneumonia (especially **ventilator-associated pneumonia** and in **cystic fibrosis** patients).

2- External ear infections:

Malignant otitis externa (esp. in diabetics), **swimmer's ear**.

3- Eye infections:

Corneal ulcer (frequently associated with contact lens use).

4- Skin infections: (e.g. Ecthyma Gangrenosum).

5- Urinary tract infections: in those with indwelling catheters.

Pseudomonas - The suiters of pseudo Mona

1. Red theme - Gram Negative rod
2. Bathtub - Thrives in aquatic environments, hot tub folliculitis
3. Blue Ring - Oxidase Positive
4. Cat - Catalase Positive -
5. Chronic Granulomatous Disease heightened risk
6. Blue Green on tub - Produces a blue green pigment when plated may even turn wounds blue. It's from Pyocyanin and pyoverdin
7. Grapes being eaten - Fruity grape like odor
8. Air bellow Billowing the flames - Obligate Aerobe
9. Nurse pouring chlorine to remind us of the dysfunctional channel of CF patients - Most common Gram Neg Nosocomial Pneumonia, respiratory failure in CF patients. Chlorine channels in CF
10. Nurse Coughing – Causes pneumonia
11. Mortar and pestle w/ Fish bones - Osteomyelitis in the IV drug users and Diabetics.
12. Glass Capsule - Encapsulated
13. Maid on fire - Burn patients are especially susceptible.
14. Chamber Pot - Indwelling catheter infections from UTI's, chamber pot, nosocomial UIT's
15. Pruritic folliculitis (Hot tub folliculitis)
16. Dalmatian Dog - Can lead to ecthyma gangrenosom (black spots on the Dalmatian)
17. ear trumpet maid listening - Otitis Externa (swimmers ear)
18. 1st suiter in green - Exotoxin A - Ribosolation of elongation factor 2, leads to inhibition of protein synthesis and cell death

STREPTOCOCCUS PNEUMONIAE
"PNEUMOCOCCI"

- **Gram-positive, diplococci (arranged in pairs).**
- On blood agar, **partial** zone of haemolysis with **greenish** discoloration **(Alpha haemolysis).**
- It is **sensitive to optochin** (Antibacterial agent).

Virulence factors

- **A polysaccharide capsule: The major virulence factor** (Anti-phagocytic).
- **IgA protease.**
- **Pneumolysin:** Pore forming toxin (the hemolysin that causes α-hemolysis).
- **Autolysin:** lyse the bacterial wall and release potentially lethal toxins.

Pathogenesis & clinical findings:

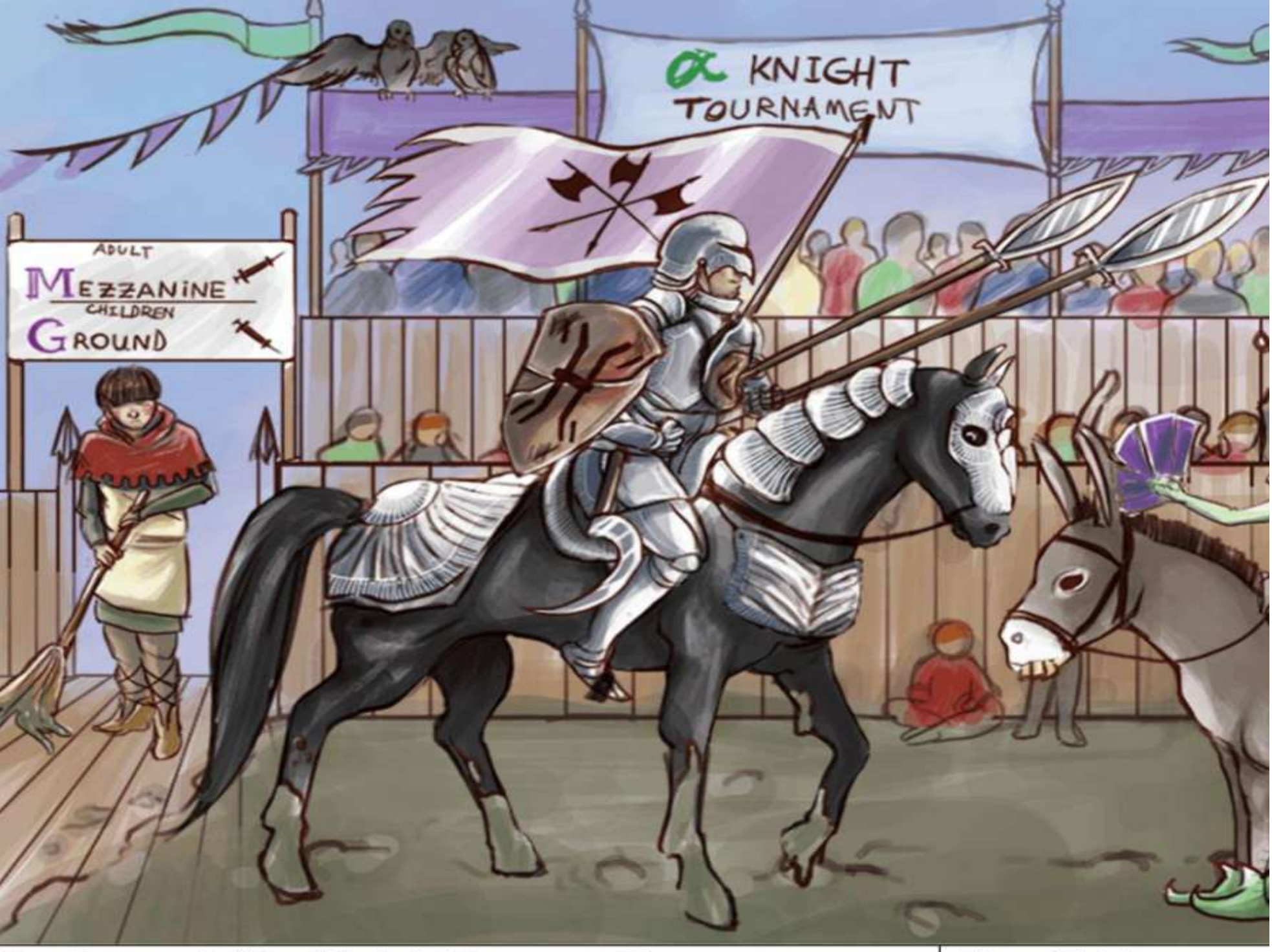
- Pneumococci are **the most common** cause of:
  - **Otitis media and sinusitis.**
  - **Community Acquired Pneumonia**. It is **typical lobar** pneumonia (Fever, chills, cough with red brown **"rusty"** sputum, dyspnea and tachypnea).
  - **Bacteremia.**
  - **Meningitis.**

- **Predisposing factors:**
  - Children < 2 ys and elderly > 65 ys.
  - Smokers and alcoholics (depress the cough reflex)
  - **Asplenia is important risk factor.**
  - Immunocompromized e.g., HIV, cancers,…
  - Abnormality of the respiratory tract (viral infections, chronic lung diseases,..)

Prophylaxis: Two types, for risk groups.

1) Capsular polysaccharide vaccine

2) Pneumococcal conjugate vaccine: (Capsular polysaccharides + protein carrier).



Strep Pneumonia "the alpha knight tournament"

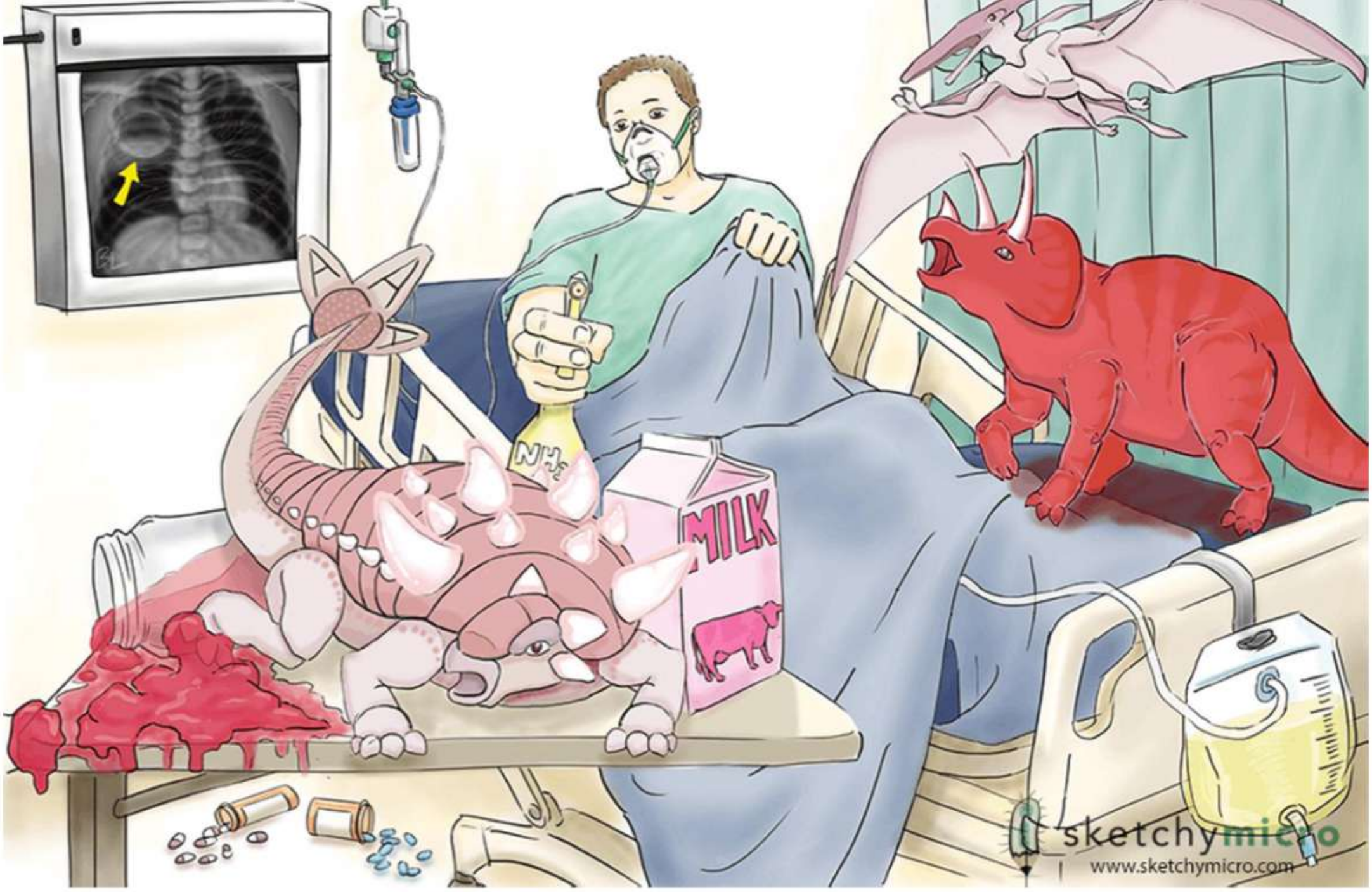
1. Purple Background - G+
2. α knight tournament – α hemolytic, partial hemolysis where the surrounding zone is a green hue
3. **Strep Pneumonia Knight**
4. Armor – Polysaccharide Capsule is major virulence factor
5. Chin is exposed – Optochin sensitive, optochin inhibits the growth of strep pneumo
6. Double Lance – Lancet shaped diplococci
7. Mud on horses legs - Bile soluble, meaning it does not grow in Bile
8. Rust Colored single lobe on chest – Rust colored sputum and lobar pneumonia
9. Squire mopping up muddy mess MOPS - Meningitides, Otitis Media, Pneumonia, Sinusitis
10. Number 1 sign – number one cause of all these diseases.
11. Cracked Shield with the symbol of IgA dimer molecule - Protease that cleaves IgA that allows invasion of mucosa reducing host defenses
12. Sickle - Removal of spleen leads to susceptibility of infection by encapsulated organisms like in sickle cell anemia.

Strep Viridians

1. No Armor – N
2. Jesters mask
   chin – optoch
3. Donkey with
   resistant
4. Foul Yellow te
   associated wi
5. Deck of cards
   Synthesizes D
   which allows
   any fibrin fro
   damaged in t
6. Strep Sanguin
   platelet aggre
   valves, most
   valve.

KLEBSIELLA PNEUMONIAE
"FRIEDLANDER's BACILLUS"

- It is **important cause of nosocomial infections**:
  - **Pneumonia** (sever form of **lobar** pneumonia which can progress to **abscess** formation & **empyema**). Sputum characterized by being thick, mucoid, bloody "**currant jelly sputum**".
  - **Urinary tract infections.**
  - **Bacteremia.**
- Isolates carry **high degree of antibiotic resistance**.



Klebsiella, Enterobacter, Serratia

1. Red theme - Gram Neg
2. Oxygen Mask - Pneumonia
3. Urinary Bag hanging off the bed - UTI
4. In the hospital - Nosocomial infections
5. Pills on the ground – Multi Drug Resistant Carbopenam for treatment or Clindamycin
6. Milk Carton - **Ferment lactose** - turns it pink - along with E Coli - on **MacConkey's agar**
7. Enterobacter
    a. Very motile since pterodactyl is flying
8. Serratia
    a. Triceratops - very motile
    b. Red pigment when cultured like a pink ring around shower or bright red
    c. Catalase Positive
9. Kleibsiella - Ankylosaurs with club shaped tail - Immotile
    a. Three A's in the spikes –Alcoholics, Abscesses, Aspiration
    b. Thick shell like scales is like a polysaccharide capsule
    c. Knocked over jar of currant jelly, that is sticking him to the table - Current jelly like sputum that is a red color

BACILLUS ANTHRACIS

- **Gram positive spore forming bacilli**
- **Capsulated (Polypeptide capsule, "D-Glutamic acid"**
- **Medusa head colonies, liquefies gelatin (inverted fire tree appearance).**

Virulence factors:

A) Very powerful exotoxin. The toxin consists of 3 domains:

Protective antigen (PA): binds to specific receptor on host cell with its **proteolytic activity** producing membrane channel and permits entrance of:

Edema factor (EF) with its **adenyl cyclase activity** → loss of water → →edema.

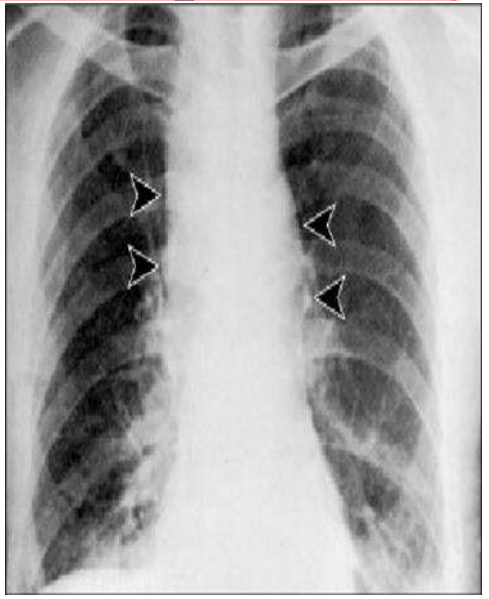
Lethal factor (LF) which cause **tissue necrosis**.

B) Protein capsule: Antiphagocytic.

PULMONARY ANTHRAX

"Wool sorters disease"

- It is a disease of farm animals e.g. cattle and sheep **(Zoonotic disease).**
- Man infected by Inhalation of spores.
- After inhalation, the organism moves rapidly to the mediastinal lymph nodes. Because it leaves the lung so rapidly, it is **not transmitted from person to person** by respiratory route (**not contagious**).
- This **rapidly** progresses to **hemorrhagic mediastinitis** (fever, chest pain, respiratory distress and **widened mediastinum on chest X-Ray**).



Prevention:

Active immunization:

a) Pasteur's vaccine & Live spore vaccine: given only to animals.

b) **Protective antigen vaccine:** It is used for humans. Given to people at high risk.

Bacillus Anthracis and Bacillus cereus – King Anthra's Axe

1. Vikings standing around red hot flames and black in the middle – Black Eschar with erythematous ring.
2. Viking ships lined up in the background - Large gram pos rods in chains
3. Leather armor – encapsulated, this one is made of a protein
4. D Belt Buckles - Capsulated with Poly –D glutamate
5. Air Bellow - Obligate Aerobe
6. walnuts – Bacillus anthracis is a spore forming bacteria allowing them to survive in very poor environments
7. Viking Camp Test - EF Toxin increases cAMP intercellularily this will cause fluid to go extracellular space leading to edema inhibiting host defenses and preventing phagocytosis
8. MAP with Lethal Factor Viking Burning it - LF (lethal Factor), exotoxin that acts as a protease and cleaves MAP Kinase, this is a signal transduction protein that is responsible for cell growth. This factor will lead to necrosis and black eschar
9. Sheep – pulmonary anthrax, wool sorters disease. Spores can get into wool and hide of animals and persist there. People will inhale the spores when the animal is handled.
10. Axe that is dripping blood – represent pulmonary anthrax that can move to mediastinal lymph nodes progressing to hemorrhagic mediastianitis
11. Viking ship with a mast supposed to look like a chest xray – widened mediastinum
12. Flower and Bicycle wheel on the ship – txt is fluoroquinolone or doxycycline

1. **Bacillus cereus**
2. Aerobic and spore forming
3. Viking reheating rice and vomiting - Associated with food poisoning – reheated fried rice

MYCOBACTERIUM TUBERCULOSIS

"Tubercle bacillus" "Koch bacillus"

- They are **obligate aerobe** (upper lobe of the lung).
- They are **slow growers**, growth appears after 4-6 weeks.

Virulence Factors:

1. **High lipid of cell wall (Mycolic acids),** responsible for:

   Resistance to: Antibiotics, acidic and alkaline compounds, Osmotic lysis via complement.

2. **Cord factor:** Virulent strains grow in a characteristic "Serpentine" cordlike pattern.

3. **Inhibit phago-lysosomal fusion.**

Resistance & Sensitivity:

***They are highly resistant to :**

- Dryness (survives in dried sputum for long periods).
- Chemicals, many acids and alkalis.
- Antibiotics.

***They are killed by:**

- Sunlight
- U.V. rays
- 5%phenol
- Heat (60°C for 20 min.) (**Pasteurization can kill them in milk**).

Pathogenesis:

- Tubercle bacilli do not contain or produce toxins.
- Their pathogenicity depends upon the fact that the organism **survives and multiplies in macrophage** and prevents phago-lysosomal fusion and so, escape the degradation by lysosomal enzymes.
- It is an intracellular organism.

Immunity Against Tuberculosis:

Cell mediated immunity (CMI) (Delayed-type = type IV hypersensitivity) (Granuloma formation) that leads to localization of bacilli, retards their multiplication, limits their spread.

Patients deficient in cellular immunity, such as AIDS patients, are more susceptible to disseminated (miliary) tuberculosis.

Human Tuberculosis (TB)

- **Human** type is transmitted airborne by **inhalation** of respiratory aerosol (<5µm).
- **Bovine** type is transmitted by **ingestion** of unpasteurized milk of infected cattle **(zoonosis)**.

Primary pulmonary tuberculosis:

- Mostly asymptomatic, tubercles heal leaving the person immune and hypersensitive **(tuberculin positive)**.

تلتئم الدرنات مما يترك الشخص محصنا

- Small foci containing **dormant viable** organisms **(Latent TB)**
- Only small % (immunocompromised) progress into active or disseminated T.B.

Secondary pulmonary tuberculosis:

- It may be: **reactivation** of old primary lesion or **reinfection.**
- Occurs mainly in **immunocompromised,** debilitated or diabetic patients.
- 1) Local spread: -To other parts of the lungs, **cavity formation, (Open TB).**

  2) Hematogenous spread: which result in **miliary T.B.**

Laboratory Diagnosis

1- Direct microscopic examination: Z.N stain:

-Positive film is highly suggestive, **negative film does not exclude T.B**.

2- Culture: the **gold standard and the most conclusive** method.

3- Polymerase Chain Reaction (PCR): Rapid & sensitive.

4- Tuberculin Test "Mantoux test"

Principle: It is skin allergic test used to detect **cell mediated immunity** to tubercle bacilli which become detectable **few weeks** after natural infection or BCG vaccine.

Procedure: Intradermal injection of 0.1ml of **PPD (Purified Protein Derivative).** Measure the diameter of **the induration"** after **48-72 hours**.

Interpretation of Tuberculin test

طيب اذا المريض الpapule حجمها من 10-15 فهاد المريض راح نعتبر عنده TB اذا كان هو واحد من هالخمس نقاط

An induration of 5 or more mm	An induration of 10 or more mm	An induration of 15 or more mm
Considered positive for: high risk **1. People with previous history of TB.** **2. Close contacts of TB patients.** **3. People with HIV infection.**	**Considered positive for:** **1. People in endemic areas where TB is common.** **2. Healthcare workers.** **3. People with certain medical conditions such as diabetes.** **4. Unvaccinated children younger than 4 years old.**	**considered positive even in absence of any risk factor for TB.**

طيب اذا كانت الpapule حجمها من 5-10 راح نعتبر المريض عنده TB بهدول التلات

اذا الpapule حجمها أكتر من 15mm فهاد المريض عنده TB على الأكيد

يعني هاد الtest ما بميزلنا اذا المريض عنده active TB أو بس أنه البكتيريا موجود بجسمه و قاعدة هادية و ساكتة

Positive Tuberculin dose not differentiate between active or latent T.B

➢ Negative Test:

A negative test means that there is no infection at all or a very old healed one.

Tuberculin is a good negative test.

➢ False Negative Test:

1. Anergy: is the inability to react because of a weakened immune system, e.g. Severe T.B, **HIV infection**, Some viral infections or cancer.

2. Recent T.B: it takes 2-10 weeks for tuberculin test to become positive.

➢ False Positive Test:

1-Infection with other non-tuberculous mycobacteria.

2- **BCG vaccine** (The test reactivity induced by vaccine wanes with time).

Treatment of TB should be:

1-Long Duration:

Response of tuberculosis to treatment is slow, this is due to the facts that:

- Intracellular location of the organisms.
- High lipid & Caseous material interferes with penetration of the drugs.
- The slow growth of the organism.
- Metabolically inactive "persisters" within the lesion in chronic cases which may not be eradicated easily by antit-uberculous drugs (source of reactivation in the future).

2- In Combination: 2-4 drugs simultaneously to:

- Reduce development of resistance.
- Reduce toxicity of the drugs.

هاي البكتيريا عندها آلية لتعمل resistance of antibiotics من خلال تحول البكتيريا ل
(تقريبا بتعمل حالها ميتة لتخدع المضادات الحيوية) inactive metabolite
حطوا ببالكم أنه المضادات الحيوية ما بتقدر تهاجم البكتيريا الا اذا كانت active

Prevention:

Vaccination: BCG "Bacillus of Calmette-Guérin" vaccine:

- This is a **living attenuated** vaccine prepared from a **bovine** strain.
- It is given as a **single dose** by intradermal injection in the left deltoid region.
- It is given to all children during the first month of life.
- It is also given to adults exposed to infection e.g. nurses, doctors and contacts of the case.
- It should **NOT** be given to immunocompromised people.
- It loses its effectiveness over time, usually within 5 to 15 years

البكتيريا اللي جاي من المطعوم بظل فعالة لمدة 15-5 سنة فبهاد الوقت اذا عملنا tuberculin test راح يطلع positive
اما اذا عملنا الtest بعد هاي المدة المفروض يكون negative (تذكروا ال false positive test)

Mycobacterium tuberculosis - Shoot out at the TB Corral

1. Pink Gun leaving a pink finish - Acid fast is represented by the mycolic acids (carbol fuschien stain), ie the 2 branched tassels representing mycolic acids.
2. Lowenstein General Store - Lowenstein Medium
3. Billows - Obligate Aerobe
4. Cart - Transmission - Human to Human respiratory droplets and proliferates in macrophages
5. Cart - Macrophage Cage
6. Glycolipid are responsible for Clumping of bacteria into a serpentine formation – Virulence factor - called cord factor
7. Lasso wrapping up the driver of the macrophage cart - Cord factor will Increases granuloma formation by increasing TNF-a activating other macrophages walling itself off in a granuloma – this will protect the bacteria
8. Spurs kicking up Dust clouds behind cowboy - Sulfatides - prevent phagolysosome fusion. Allow TB to survive in macrophages by creating incompetent secondary lysosomes preventing fusion to hydrolyzes
9. Cactus with holes in the middle lobe and red cactus fruit near hilum, Gun complex - Primary infection - healed infection, Affects lungs and will form a GHON complex, visual calcification, right middle lobular, Hilar lymph node involvement.
10. Carts that are broken down - Caseation Granulomas - tubers - tuberculosis resides in broken down necrotic macrophages (Langerhans giant cells)
11. Sick Child in burlap sack- Primary infection symptoms, long fever and in children, resolves by fibrosis (burlap sack)
12. Shovel with Dirt - Test for TB with PPD, BCG vaccine will always show positive skin test
13. Millet seed pouring out of the cart and cow skull- Milliary TB – Multi-organ failure - Millet seeds from the macrophage cart - Lethal
14. Guy strapped to barrels of TNF - Latent Infection - Associated with immunosuppression through downregulation of TNF-a release
    Immune system is defenseless if TNF is inhibited. Always screen for PPD before using a TNF inhibitor like infliximab
15. Right Cactus with holes in upper lung scene takes place at night- Reactivation is on the upper lungs, look for cough, night sweats, Bloody cough hemoptysis
16. Prisoner in the MΦ cage - Reactivation occurs in macrophages
17. Coughing out blood on handkerchief - Promotes body wasting
18. Broken Pots - Pots disease is demineralization of the bone, spinal weakness,
19. Bullet hole going through the hat - CNS involvement is also seen as meningitis or tuberculoma. "Hat being shot off"
20. Treatment - combination of RIPE, rifampin, isoniazid, Pyrazinamide, ethambutol
21. Prophylaxis - Rifampin or isoniazid - 9 months

ATYPICAL MYCOBACTERIA

Non-tuberculous mycobacteria "NTM"
Mycobacteria other than tuberculosis "MOTT"

- They normally found in soil and water.
- Transmission is from the environment. **NO** person to person transmission.
- They are of **low pathogenicity** for man but occasionally they cause **opportunistic** infections especially in **immunocompromised** persons.
- They cause pulmonary diseases which are **indistinguishable** clinically, radiologically and histologically from that caused by the human tubercle bacilli, but tend to be **more chronic and difficult to be eradicated.**
- e.g. **M. Avium Complex (MAC)** (M. avium, M. intracellulare, M. chimera).

Typical pneumonia	Atypical pneumonia
Sudden onset, severe course commonly require hospitalization	Gradual onset, mild course (do not usually require hospitalization) and self resolution.
Lower respiratory tract involvement	Upper and lower respiratory tract involvement
High fever, dyspnea, chest pain and productive cough	Mild fever, sore throat, fatigue and dry cough
Lobar consolidation on chest radiography	Patchy or interstitial infiltrate
The causative organisms can be isolated on routine media in the diagnostic laboratory	The causative organisms cannot be isolated on routine media in the diagnostic laboratory
Respond to B-lactams	Responded differently to antibiotics
Streptococcus pneumonia Hemophilus influenza Staphylococcus aureus,…	**Mycoplasma pneumonia, Chlamydia pneumonia, Chlamydia psittaci, Legionella pneumophila, Coxiella burnetii**

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The causative organisms can be isolated on routine media in the diagnostic laboratory	The causative organisms cannot be isolated on routine media in the diagnostic laboratory
Respond to B-lactams (EXP: penicillins, cephalosporins)	Responded differently to antibiotics
Streptococcus pneumonia Hemophilus influenza Staphylococcus aureus,...	**Mycoplasma pneumonia, Chlamydia pneumonia, Chlamydia psittaci, Legionella pneumophila, Coxiella burnetii**

المريض بكون very sick و بكون bed ridden وغالبًا بحتاج إلى المستشفى

Characters of typical pneumonia

ساعات ممكن يحتاج ينحط على ventilator في الحالات الsevere

مش productive

Lobar consolidation

غالبًا تستجيب للcommon used antibiotics زي ال

Most common

Organisms that causes Atypical pneumonia

الorganism بتاعها ، في صعوبة انه احنا نعمللها isolation بالroutine methods ، مفيش ولا وحدة منهم بتطلع على الagars زي ما راح نشوف blood , chocolate, mac...

مش كل البكتيريا اللي بسوا ال Atypical بستجيبوا لل B - lactams زي ما رح نحكي تحت

دول يتحفظوا كويس ؛ لأنه هما أصلاً محتوى محاضرتنا اليوم إن شاء الله

على عكس ال typical

أول اشي قرأت لحد الmild course بعدين حكت :

الgeneral conditions تاعت الpatient بتكون كويسة ، يعني بكون قادر يتحرك ، يروح شغله ، مش بيبقى bed ridden ومش بيحتاج hospitalization ولا desease بصفة عامة بيحصله self limiting

طالما بصير فيها sore throat فغالبًا رح نلاقي upper respiratory tract لل involvement

بالنسبة لل radiology على مستوى الX-Ray ، حتلاقي انها هي متبقاش واخدة كدة زي الtypical ، لا هي بتكون scattered بنسميها grounded glass ، patchy or interstitial infiltrate appearance

بالنسبة للمسمى تاعها اللي هو ال(grounded ...) مش متأكدة منه بس أنا هيك سمعت الدكتورة نطقته .

ايضًا يُتبع للصورة تحت

الشكل الtypical لل pneumonia هي اللي caused by streptococcus pneumonia واحنا قلنا قبل كدة انها طبعًا the most common cause of pneumonia with its clinical and radiological characters أو ممكن أي تكون بسبب أي organism associated with typical pneumonia

بتكون involving the lung without upper respiratory involvement

لو أنا عملت radiological investigation ، ال typical pneumonia بتكون characteristically lover هبص ألاقي بيظهرلي اللي هو typical lobar consolidation ، بيبقى involving lobe كامل من الlung فص كامل من الlung فيه consolidation فيه opacity

بقدر أعملها على ال isolation زي ال routine media ال blood agar or chocolate agar و أقدر أعملها بال diagnosis routine diagnostic method

ايضًا يُتبع للصورة تحت

MYCOPLASMA PNEUMONIA

متعدده الاشكال

- **Lack a rigid cell wall** and thus they are: Highly pleomorphic, Can not stained with Gram, Completely **resistant** to penicillins and cephalosporins.
- The only bacterial membrane that contains **Sterol.**
- **Require cholesterol for growth** (medium supplemented with sources of cholesterol e.g. **Eaton's agar**) giving characteristic **"Fried egg"** colonies.

Pathogenesis & Clinical findings:

- Mycoplasma pneumonia is **the most common cause of atypical pneumonia** and accounts for about 5-10% of all community-acquired pneumonia and **the most common cause of pneumonia in people between the ages of 5 to 15 years, "walking pneumonia".**
- During Mycoplasma pneumonia infection, **autoantibodies (IgM)** are produced against red cells **(cold agglutinins).**
- The binding of antibodies to erythrocytes is **triggered by a lower temperature** in the extremities and **causes hemolysis**.

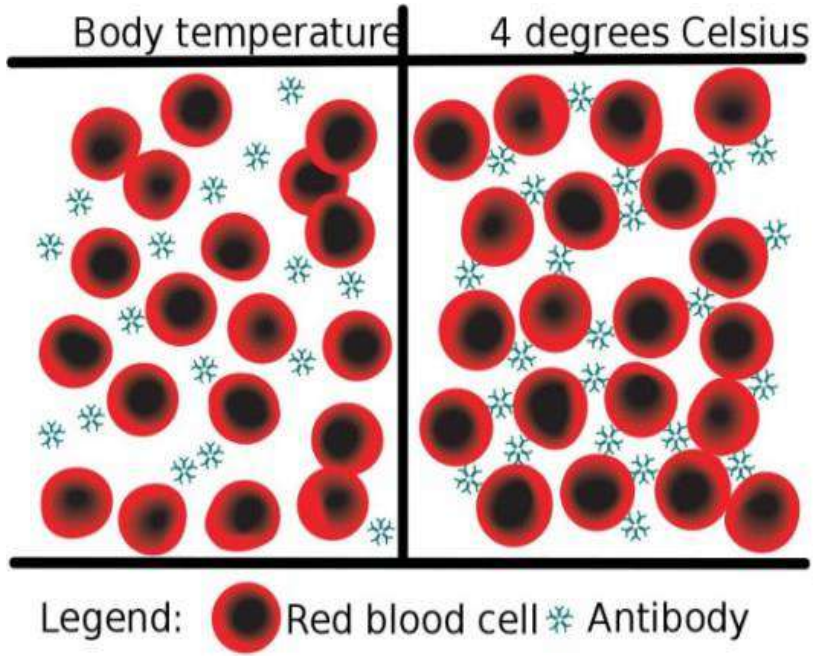
Laboratory diagnosis:

Serologic testing: is the **mainstay** of diagnosis.

a) Fourfold or greater rise in **specific IgM** antibody titer.

b) **A cold-agglutinin test:**

- Patient serum + human group "O Rh –ve" RBCs and incubated at 4°C.
- Positive result shows clumping of RBCs, which dissociated at 37°C.
- The test is positive in 50-70% of patients.
- The test is **nonspecific** (false-positive results occur in influenza virus and adenovirus infections).



LEGIONELLAE PNEUMOPHILA

- Stain **faintly** with the standard Gram stain, best stained with **silver stains**.
- Grow on **buffered charcoal -yeast extract agar (BCYE)**, special medium supplemented with iron and cysteine.

تفشي

- Outbreaks of pneumonia in hospitals due to **inhalation** of aerosols of contaminated air-conditioning systems, sinks, water taps and shower heads.
- Despite airborne transmission, **NO person to person spread**.
- The typical candidate for Legionnaires' disease is **an old man who smokes** and **immunocompromised**.

Clinical findings:

Legionnaire's disease Atypical pneumonia + GIT and Neurological symptoms.

Pontiac fever Mild, flulike illness that does not result in pneumonia.

Laboratory diagnosis:

- **Direct fluorescent antibody test (FAT).**
- **Urinary antigen test:** Enzyme immunoassay for detection of L. pneumophila antigens in the urine is a rapid means of making a diagnosis.
- Polymerase chain Reaction (PCR)
- **Culture:** On BCYE agar

CHLAMYDIA

- Chlamydiae are **obligate intracellular** (i.e., **grow only within living cells**).
- Can not stained with gram, best stained with **Giemsa**.
- Chlamydiae appear as **intracytoplasmic inclusion body** within the host cell.

Chlamydophila psittaci (Psittacosis)

- Psittacosis is a **disease of birds** (e.g., parrots, pigeons, and poultry).
- Man is infected **(Zonoosis)** usually by **inhaling** dust contaminated by **dry bird feces**.
- In human psittacosis, there is **NO person to person transmission.**

Chlamydophila pneumonia

- C. pneumonia infects **only human** and transmitted **from person to person** by **inhalation**.

Laboratory diagnosis:

- **Direct fluorescent antibody test** (FAT) of specimen.
- **Culture:** Chlamydiae can be grown in **cell cultures**, **cytoplasmic inclusions** can be seen with special stains (e.g., **Giemsa stain**).
- Polymerase chain Reaction (PCR)

Coxiella Burnetii & Q Fever

- **Obligate intracellular** organisms, therefore, must be grown in **cell culture**.
- They **stain poorly with Gram stain**, best stained with **Giemsa**.
- Two antigenic forms, **phase I (virulent) & phase II (avirulent).**
- Q fever is a **zoonosis**. Infections transmitted by **inhalation of animal aerosols** (especially urine, feces, placental tissue, and amniotic fluid).
- Q fever is usually an **occupational hazard**. People at high risk include farmers, abattoir workers and veterinarians as well as laboratory personnel.

Clinical findings

- **Acute Q fever: (phase II antigen)**

  Combination of pneumonia and hepatitis should suggest Q fever.

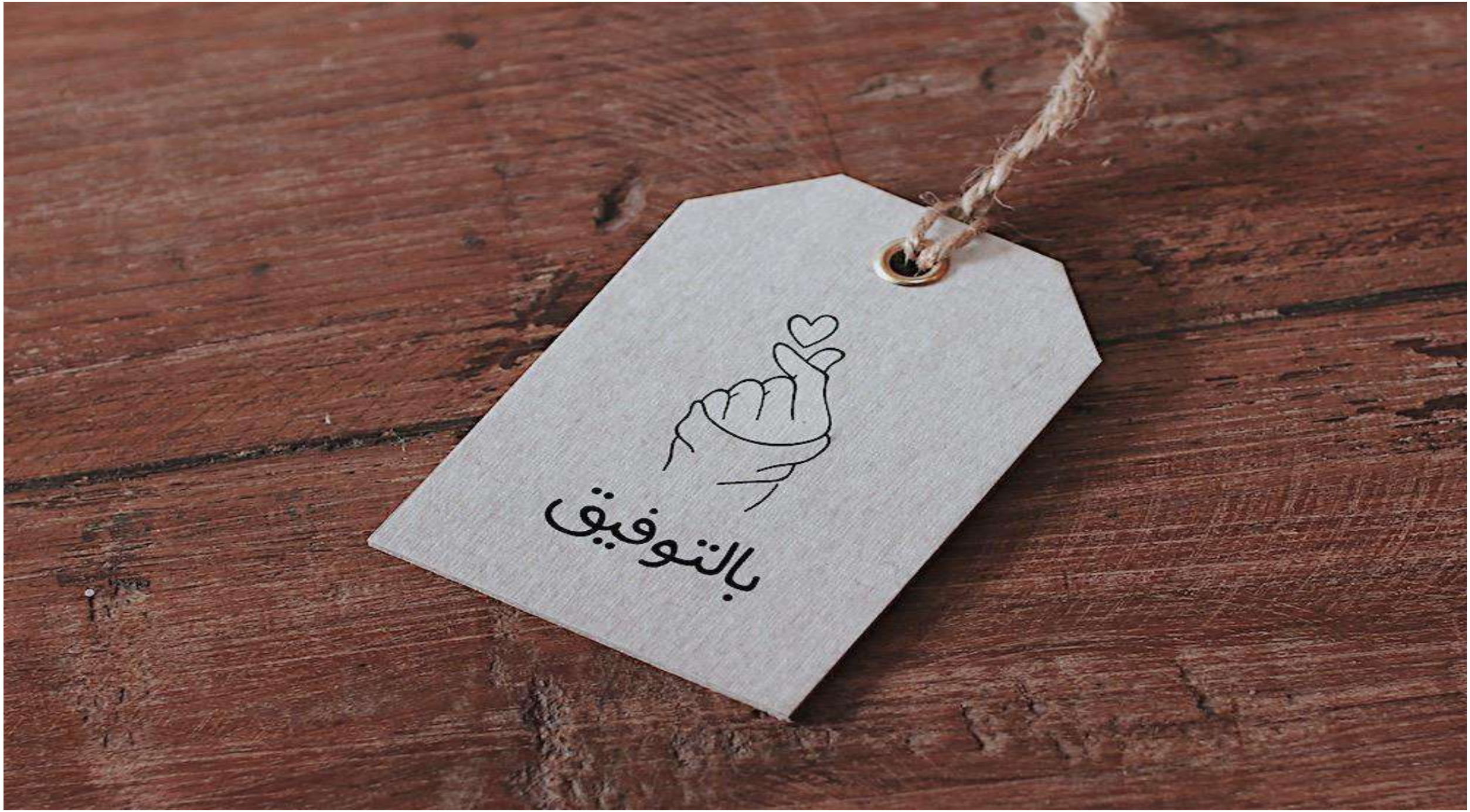
- **Chronic Q fever: (phase I antigen)**

  Characterized by chronic cough, intermittent fever, frequent headache and can be complicated with life-threatening **endocarditis**.

Laboratory Diagnosis:

- **Serology:** The **mainstay** of diagnosis. Detection of specific antibodies against phase I & II antigens.
- **PCR.**

Prevention: vaccination of occupationally exposed (**killed vaccine**).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