

Bacteria causing respiratory tract infections



Objectives :

- Recognize signs & symptoms of different bacterial respiratory tract infections
- Be able to come up with a short differential to relevant cases & identify the most likely causative organism
- Discuss the diagnosis & treatment of different bacterial respiratory tract infections
- Explain the laboratory work up of important respiratory pathogens & be able to interpret microbiological laboratory results

We recommend you to study these 3 lectures before studying this file;

1- URTI

2- TB

3- CAP

Color index:

- Important
- Doctor Notes
- Extra, TN



Gram stain

+VE
Purple/blue

-VE
Pink/red

Cocci

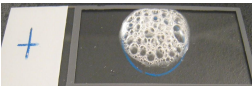
Bacilli

Cocci

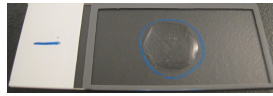
Bacilli

Catalase test

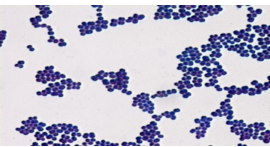
+VE Bubbles



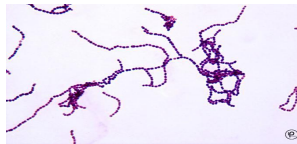
-VE No reaction



Staphylococcus
In clusters



Streptococcus
In chains or pairs



Hemolysis

Alpha hemolytic



Colonies surrounded by partial hemolysis with greenish color

Beta hemolytic



colonies are surrounded by a clear zone of haemolysis

Gamma hemolytic

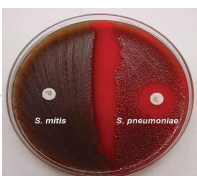


No haemolysis

Optochin test

Resistant (**Streptococcus viridans**)

Sensitive (**Streptococcus pneumoniae**)



Resistant

Sensitive

Bacitracin test

Resistant (Other beta haemolytic streptococci)

Sensitive (Group A also known as **streptococcus pyogenes**)

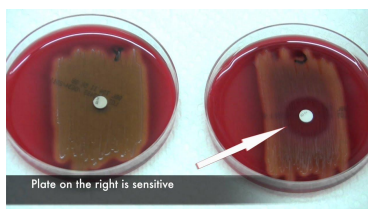


Plate on the right is sensitive

Bacitracin test

Not important

Principle:

- Bacitracin test is used for presumptive identification of group A - To distinguish between *S. pyogenes* (susceptible to B) & non group A such as *S. agalactiae* (Resistant to B)
- Bacitracin inhibits the growth of *S. pyogenes* giving a zone of inhibition around the disk

Procedure:

- Inoculate BAP with heavy suspension of tested organism
- Bacitracin disk (0.04 U) is applied to inoculated BAP
- After incubation, any zone of inhibition around the disk is considered as susceptible

* sensitive when the zone of growth inhibited.

Case 1:

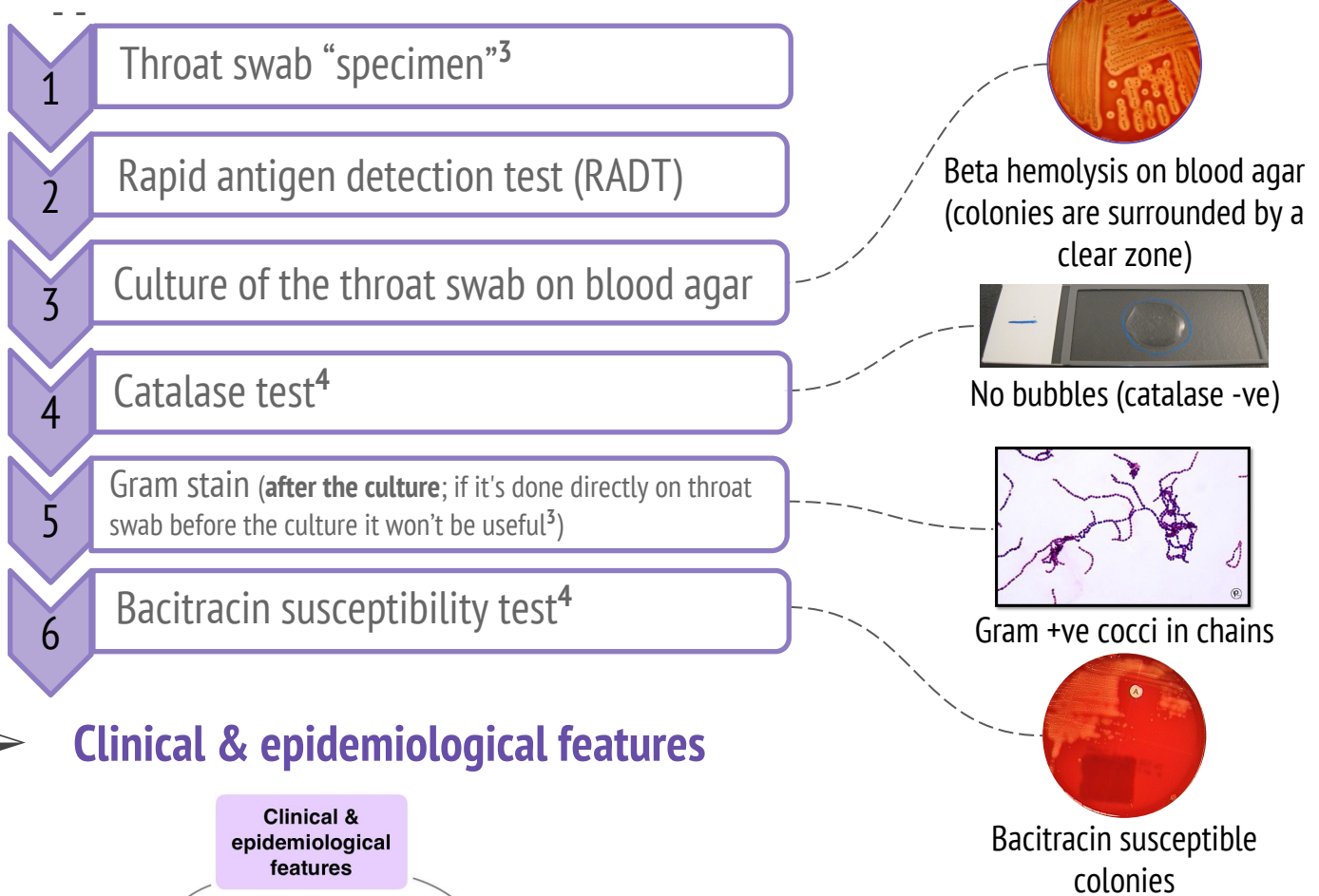
A **5 year boy** was brought to KKH, outpatient department complaining of **fever** and **sore throat**. His vaccination history is up to date. On examination his **temp. was 38.5°C**, the **tonsillar area and pharynx were obviously inflamed** with some **foci of pus**¹.



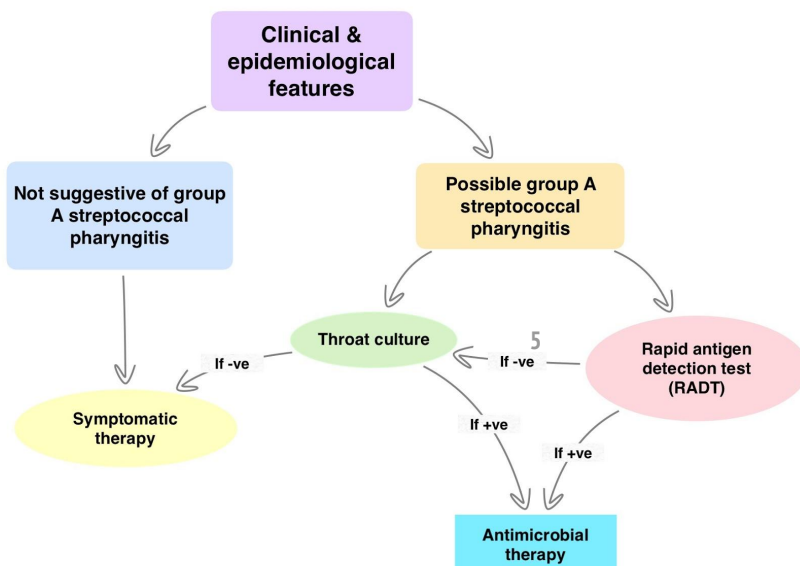
➤ What is your differential diagnosis²?

- Acute Pharyngitis and/or Tonsillitis.
 - Bacterial: **Group A streptococci**, Corynebacterium diphtheriae, Neisseria gonorrhoeae.
 - Viral: EBV "Epstein-Barr virus".

➤ What type of investigations (lab tests) should be the most helpful?



➤ Clinical & epidemiological features



- 1: If there's a production of pus then it is most likely to be a bacterial infection rather than viral.
- 2: In this question you have to write every possible organism that could cause your potential disease starting with the most likely one.
- 3: Not useful because the throat is filled with normal flora, it will show other bacteria besides the pathogenic one so it isn't specific.
- 4: These are further tests you could use to confirm your diagnosis.
- 5: If the RADT is -ve this does not exclude group A streptococcus you have to do a throat culture.

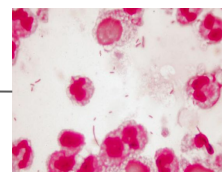
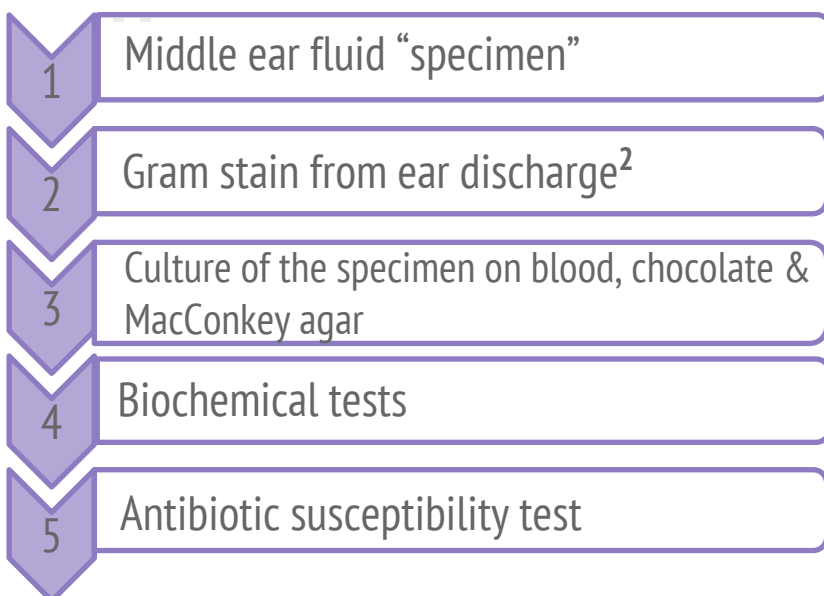
Case 1 cont':

- **What likely is the organism?**
 - Beta haemolytic Group A Streptococcus (streptococcus pyogenes)
- **What is the best antibiotic therapy for this child?**
 - Penicillin for 10 days. In case of Allergy, use Macrolides (Erythromycin).
- **If not treated what complication may this child have after 6 weeks period¹?**
 - Complication such as:
 - Rheumatic fever.
 - Acute glomerulonephritis.

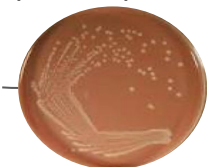
Case 2:

A 3-year-old girl is brought to the emergency room by her mother because she has a **fever** and complains that **her ear hurts**. She has no significant medical history. Her temperature is 38.8°C and is found to have **injected tympanic membranes**.

- **What is your differential diagnosis?**
 - Bacterial:- **Haemophilus influenzae**, S.aureus, Streptococcus Pneumoniae, Moraxella catarrhalis (all of them cause **otitis media**).
 - Viral
- **What type of investigations (lab tests) should be the most helpful?**



Gram -ve pleomorphic coccobacilli



Chocolate agar



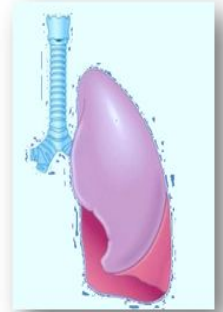
Nutrient agar with X and V factors: Haemophilus influenzae grow around the disc containing X and V factors

1: there are 2 types of complications: Suppurative (happens right after the infection) e.g., Peritonsillar abscess, parapharyngeal space abscess. And Non-suppurative (happens from 1-6 weeks after the infection) e.g., rheumatic fever, acute glomerulonephritis.

2: using Direct gram stain on the ear discharge because the middle ear is sterile, whatever the stain shows it is the definitive organism.

Case 3:

A 28 year old female presented to the accident and emergency of KKUH with sudden onset of **fever, right sided chest pain and a productive cough** of **purulent sputum**. On examination her temperature was 39 °C. There were **rhonchi**¹ and **dullness** on the right side of the chest. X-ray showed massive **consolidation** on the right side of the chest.

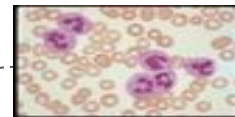


➤ **What is your differential diagnosis?**

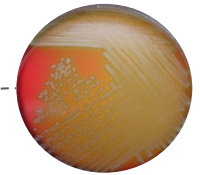
- **Streptococcus Pneumoniae**, S.aureus, Haemophilus influenzae. All of them causes Chest infection (Lobar pneumonia = Typical pneumonia = Community acquired pneumonia).

➤ **What type of investigations (lab tests) should be the most helpful?**

- 1 CBC
- 2 Sputum "specimen"
- 3 Culture on **blood**, chocolate² and MacConkey³ agar
- 4 Catalase test
- 5 Optochin susceptibility test
- 6 Antibiotic susceptibility test



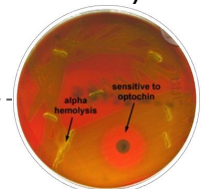
45,000/ ml 90% of the cells were neutrophils



Alpha haemolysis on blood agar (colonies surrounded by partial haemolysis with greenish color)



No bubbles (catalase -ve)



Optochin susceptible colonies

The chest X- ray showed **massive (lobar) consolidation** on the right side of the chest.



1: Wheezes.

2: if it is Haemophilus influenzae it won't grow on the blood agar.

3: If it is gram -ve it will grow on the MacConkey agar.

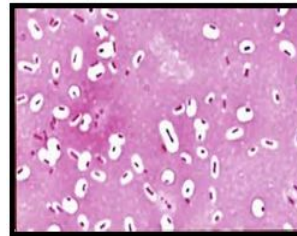
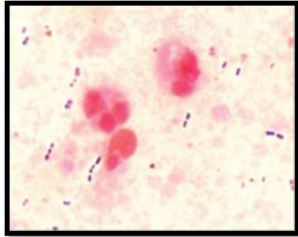
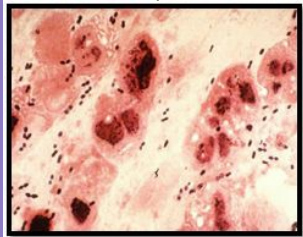
Case 3 cont':

Microscopic appearance :

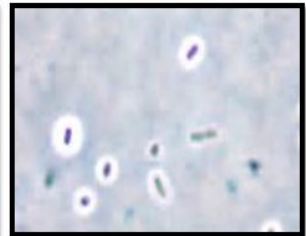
Gram stain from sputum showed

Gram positive diplococci
(arranged in pairs)

Negative Stains showing
capsule



Capsule stain



India ink stain

➤ What is the most likely organism?

Streptococcus pneumoniae.

➤ What should have been the empirical therapy for this case and why?

Ceftriaxone + azithromycin + ciprofloxacin, Because the organism may be Penicillin resistant.

***Streptococcus pneumoniae* (Pneumococcus)**

Case 4:

Abdulkarim is a 65 year old Saudi man who was admitted to KKUH with a 2-3 month history of **loss of appetite, weight loss**, and **on and off fever** with attacks of **cough**. On examination Abdulkarim looked weak with a temperature of 38.6 °C. CVS and Respiratory system examination was unremarkable. Two days before admission **he coughed blood (haemoptysis)**. Abdulkarim is diabetic (for the last 5 years). His father died of tuberculosis at the age of 45 yrs.

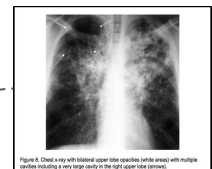


➤ What is your differential diagnosis?

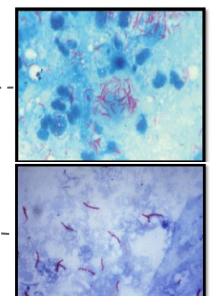
Chronic Pulmonary infection (bacterial: Mycobacterium tuberculosis, viral, fungal)

➤ What type of investigation should be the most helpful?

- 1 X-ray showing cavities
- 2 Ziehl-neelsen stained smear from sputum
- 3 Sputum culture on L.J is medium
- 4 Skin test (PPD)
- 5 The ESR was increased (85 m /hour).



chest x-ray showed multiple opacities and cavities



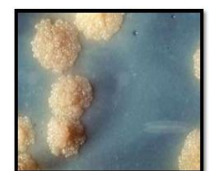
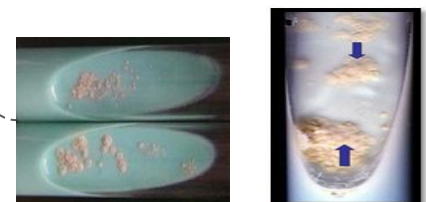
Acid – Fast Bacilli AFB

➤ What is the probable diagnosis?

Pulmonary tuberculosis

➤ How can the diagnosis be confirmed?

- 1- Measurement of Interferon-Gamma (IFN γ).
- 2- If the morphology on LJ media showed **buff, rough** and **tough** colonies.
- 3- If the growth occurred at 37°C and produced 5-10% CO₂.



showing growth of Rough, Tough and Buff colonies (Culture description)

Mycobacterium tuberculosis

Case 5:

A 5 year-old boy was brought to the emergency department complaining of **sore throat** , **fever (38.5°C)**, and was found to have **pharyngeal pseudomembranes**



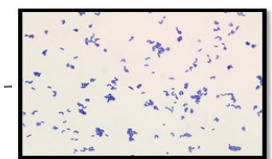
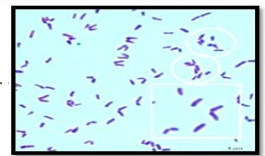
➤ What is your differential diagnosis?

Diphtheria pharyngitis

- Bacterial: *Corynebacterium diphtheriae*, Group A streptococci.
- Viral

➤ What type of investigation should be the most helpful?

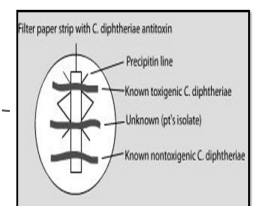
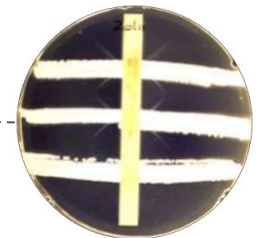
- 1 Gram stain From culture
- 2 Throat swab culture on blood tellurite
- 3 ELEK's test (toxin detection test)



Gram positive bacilli



Black color colonies



Toxin from culture of *C. diphtheriae* diffuses and reacts with the diphtheria antitoxin diffused from the strip and produces precipitation lines → positive test (Diphtheria exotoxin production)

➤ What is the likely identity of the organism?

Corynebacterium diphtheriae

➤ What is the best antibiotic therapy for this child? 1. Anti-toxin

2. Penicillin. In case of allergy, Erythromycin

➤ What complication may this child develop?

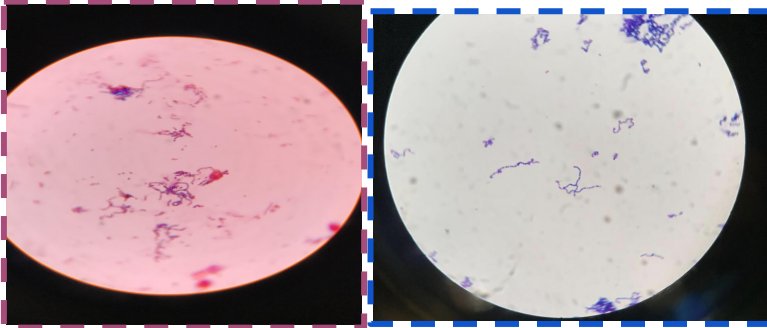
- **Myocarditis** (Damage to the heart muscle)
- **Neuritis**
- Local complication (descent of pseudomembrane)
- adrenal infarction
- Blocking of the airway

Corynebacterium diphtheriae

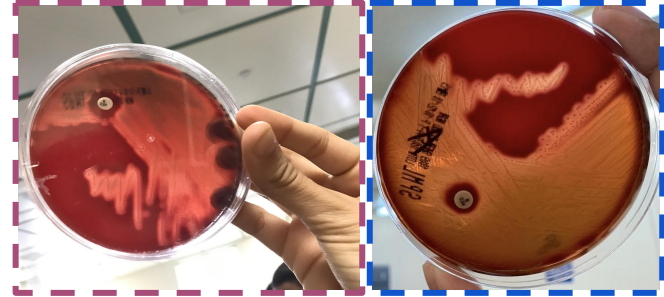
lab pictures

Female's Pic
Male's Pic

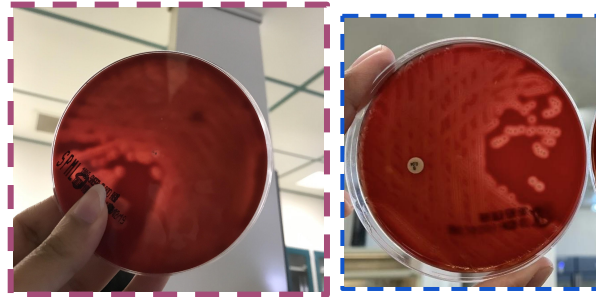
Case 1:



Gram stain from culture
Gram positive cocci in chain
e.g. *Streptococcus pyogenes* = GAS

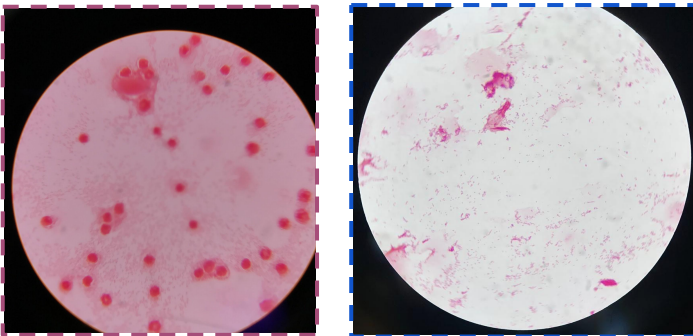


Bacitracin susceptibility
GAS, *Streptococcus Pyogenes*

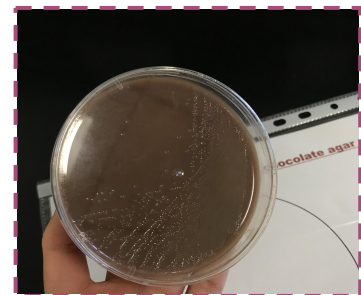


Throat swab culture on blood agar
Beta hemolytic colonies
e.g. GAS

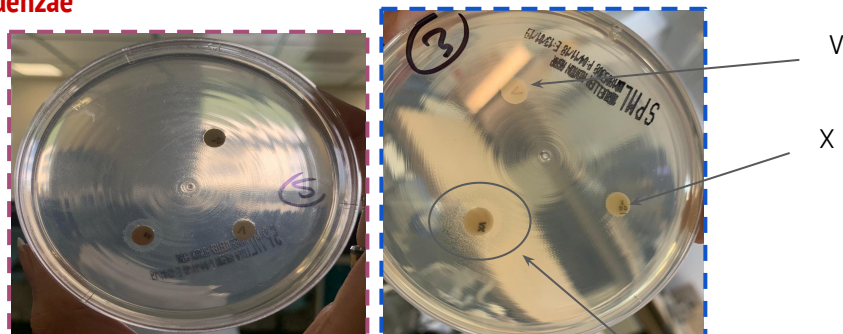
Case 2:



Gram stain from ear discharge
Gram negative coccobacilli
Haemophilus influenzae



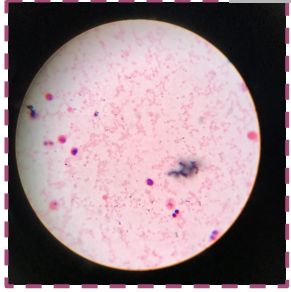
Ear discharge cultured on
chocolate agar
Haemophilus influenzae



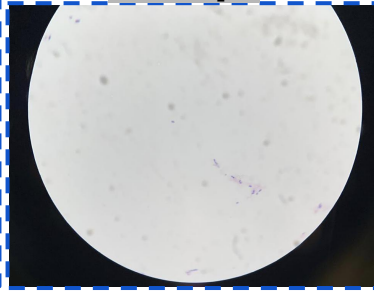
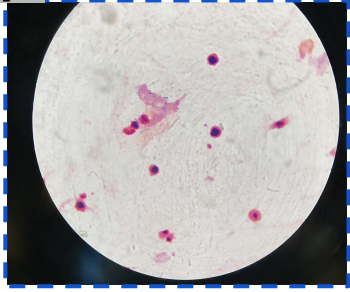
Nutrient agar with X and V factors
H. influenzae
X / V factors requirement test

Case 3:

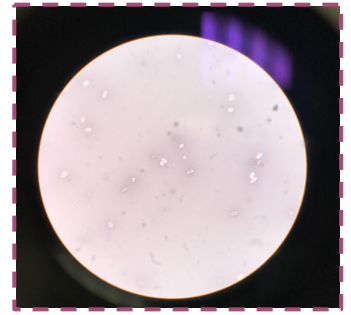
With pus



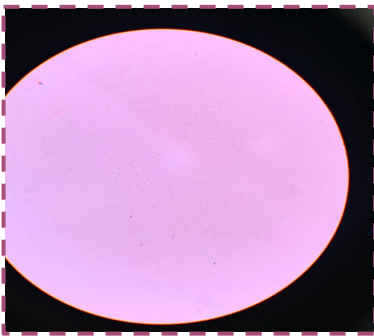
Without pus



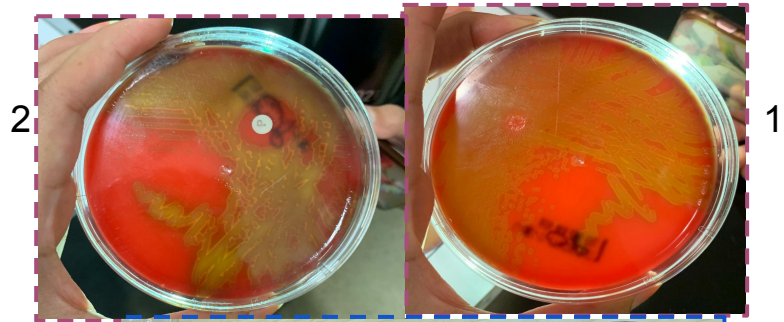
Gram stain from culture
Gram positive diplococci
Streptococcus pneumonia



Negative stains (india ink stain)
Capsule
e.g. **streptococcus pneumoniae**

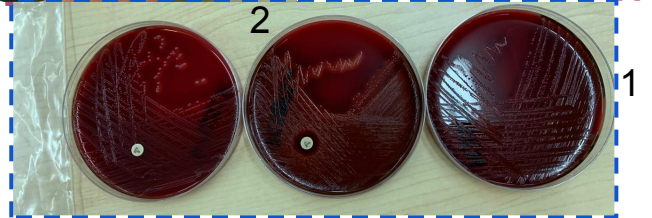


Negative stains (capsule stain)
Capsule
e.g **Strep. Pneumonia**

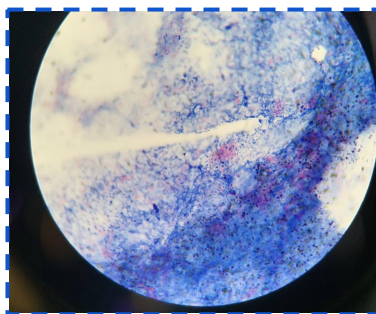
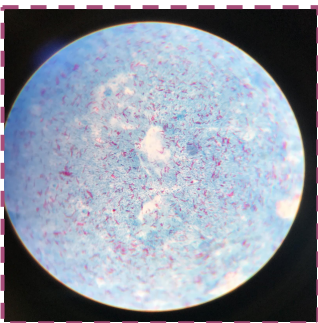


2- Optochin susceptibility (sensitive).
Pneumococcus

1- Sputum culture on blood agar
Alpha hemolytic colonies
e.g. pneumococcus

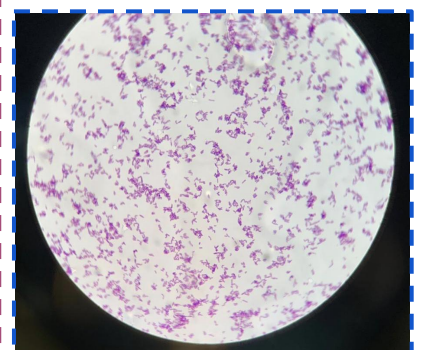
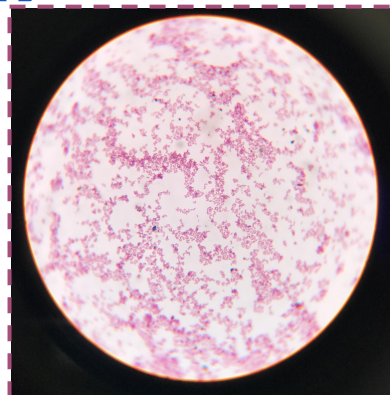


Case 4:

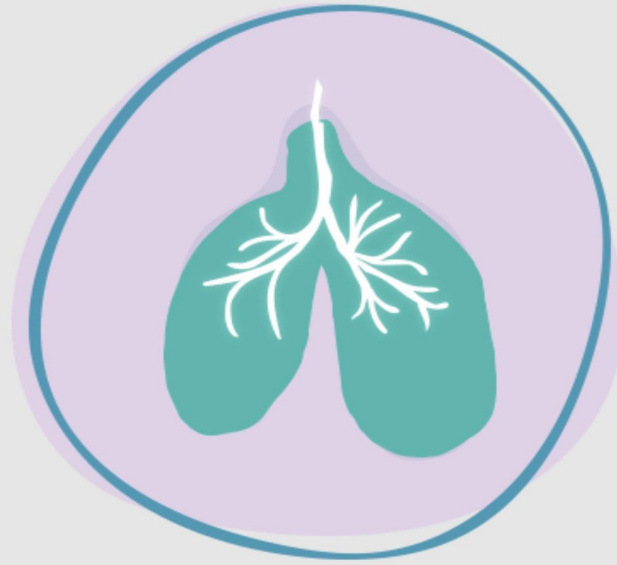


Ziehl-Neelsen stained smear
from sputum
Acid - Fast bacilli AFB
Mycobacterium tuberculosis

Case 5:



Gram stain from culture
Gram positive bacilli
Corynebacterium diphtheriae



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