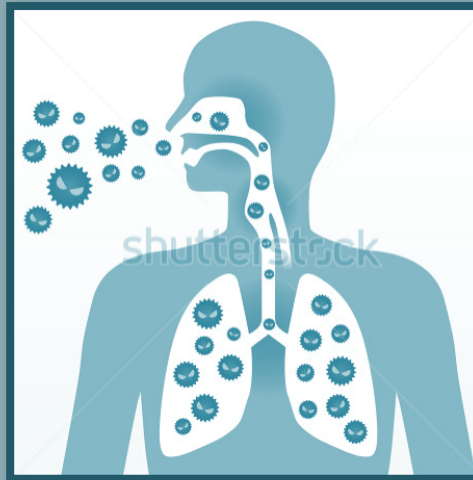
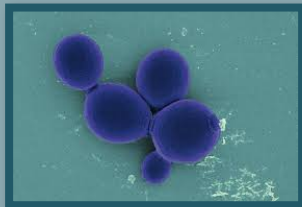


# Bacteria Causing Respiratory Tract Infections



**RESPIRATORY BLOCK**

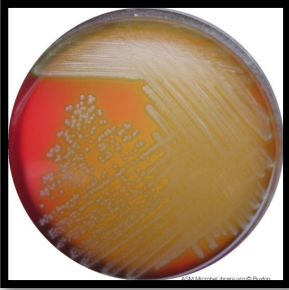

**Dr. Fawzia Alotaibi & Dr.  
Khalifa Binkhamis**







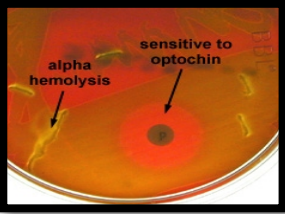

# Objectives

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

# Types of Haemolysis on Blood Agar

HAEMOLYSIS TYPE	DESCRIPTION	IMAGE
Alpha haemolysis	colonies surrounded by partial haemolysis with greenish color	 A petri dish containing a bacterial culture on blood agar. The medium is a deep red color. Numerous small, white, circular colonies are visible, each surrounded by a thin, translucent, greenish-yellow zone of partial haemolysis. The colonies are arranged in a streaked pattern across the surface.
Beta haemolysis	colonies are surrounded by a clear zone	 A petri dish containing a bacterial culture on blood agar. The medium is a deep red color. Numerous small, white, circular colonies are visible, each surrounded by a clear, colorless zone of complete haemolysis. The colonies are arranged in a streaked pattern across the surface.

# Different Tests Used in the Lab.

Test	Use	Positive	negative
CATALASE TEST	To differentiate between Staphylococcus & Streptococcus	 <p data-bbox="1116 558 1354 591">Staphylococcus</p>	 <p data-bbox="1534 558 1760 591">Streptococcus</p>
BACITRACIN SUSCEPTIBILITY	To differentiate between <i>Streptococcus pyogenes</i> (group A) & other beta haemolytic streptococci		
OPTOCHINSUSCEPTIBILITY	To differentiate between <i>Streptococcus pneumoniae</i> & other alpha haemolytic streptococci		

# Case1



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

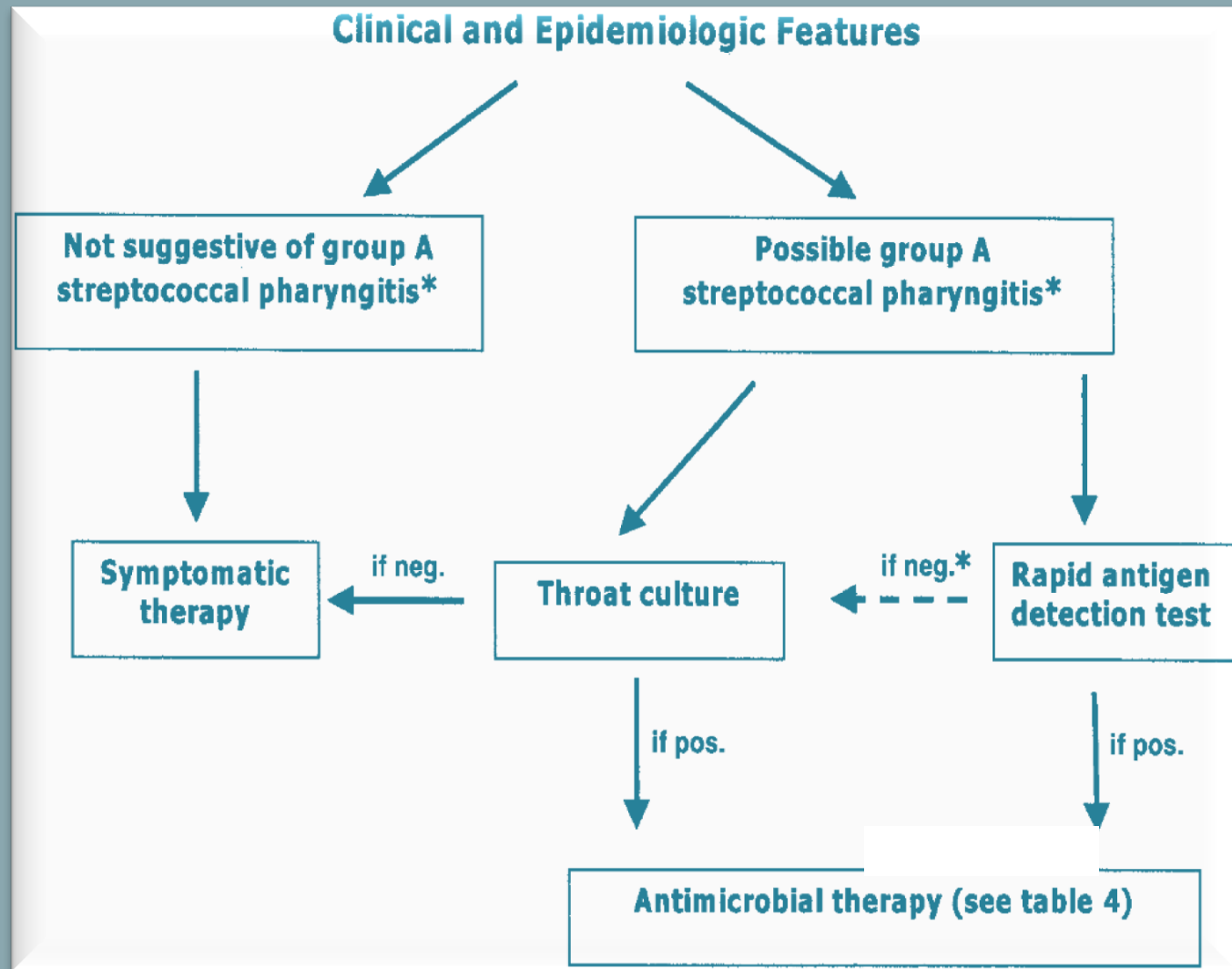
**1. What is the differential diagnosis?**

**2. What investigations should be done?**

# LAB. TESTS

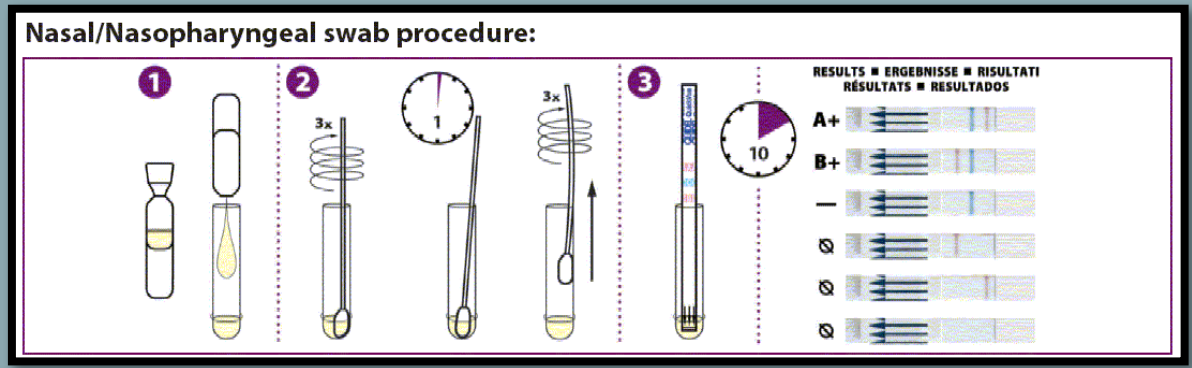
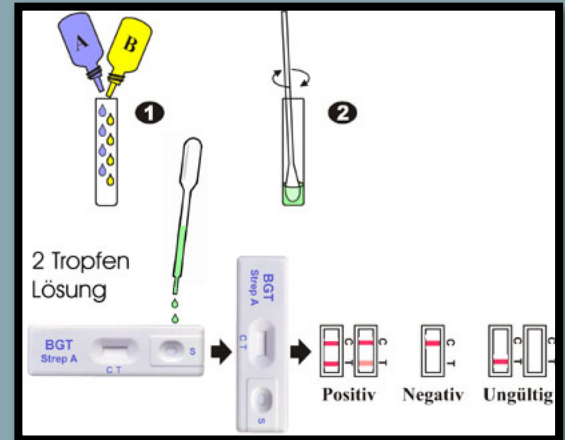
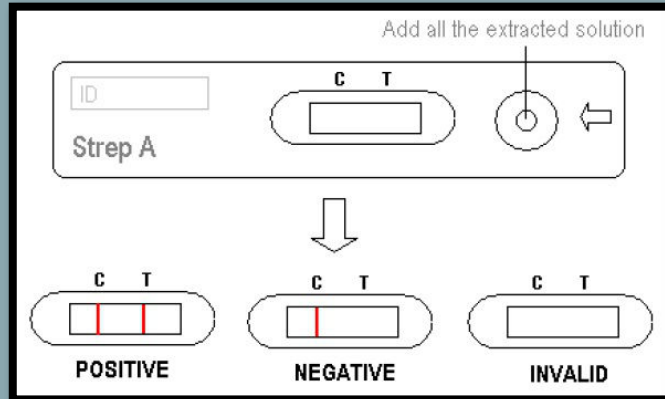
- Specimen => throat swab
  1. (Rapid Antigen Detection Test) RADT
  2. CULTURE ON BLOOD AGAR
    - ❖ Direct gram stain from throat swabs is not useful
- Culture work up
  1. CATALASE TEST
  2. GRAM STAIN
  3. BACITRACIN SUSCEPTIBILITY TEST

# ➤ Clinical and Epidemiologic Features





# ▶▶ RADT



## ▶ MICROSCOPIC APPEARANCE

### Gram stain From culture showed :

Gram positive cocci in Chains



## ▶ Culture

### Throat swab culture showed:

Beta haemolysis on blood agar  
(colonies are surrounded by a clear zone).



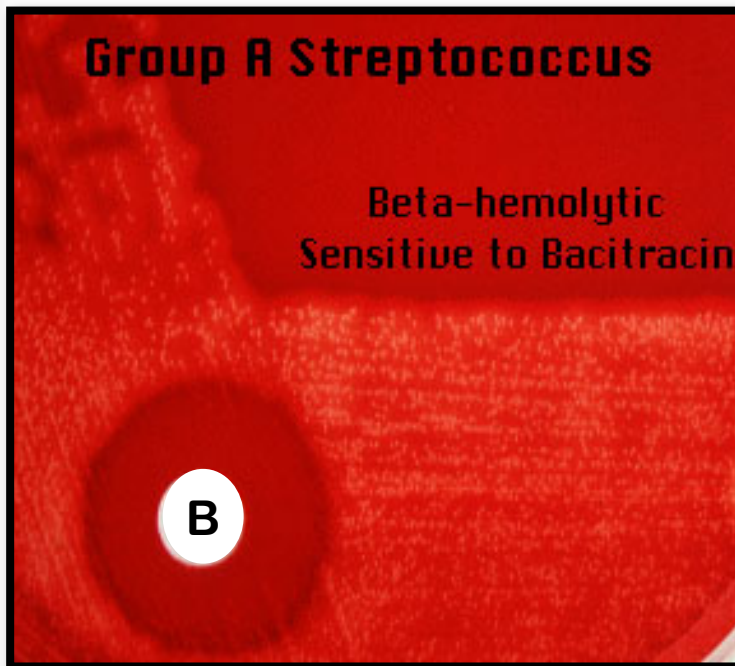
# ▶▶ CATALASE TEST



**Catalase -ve test**

# ▶▶ Bacitracin Susceptibility

## Bacitracin susceptible colonies







### 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 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

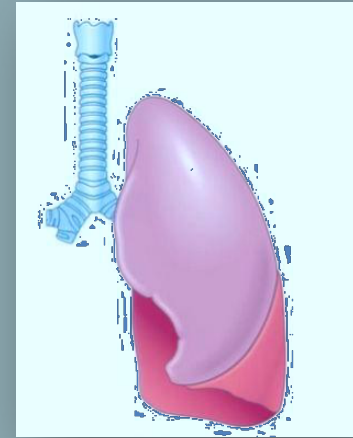
# Lab. Test Results (Summary)

TEST	RESULT	IMAGE
CULTURE ON BLOOD AGAR	Beta haemolysis (colonies surrounded with clear zone of haemolysis)	 A petri dish containing a bacterial culture on blood agar. The colonies are arranged in streaks and are surrounded by a clear, transparent zone of complete hemolysis.
CATALASE TEST	No bubbles → catalase negative	 A close-up of a catalase test. A blue liquid is being added to a white surface, and no bubbles are visible, indicating a negative result.
GRAM STAIN FROM CULTURE	Gram positive cocci in chains	 A micrograph showing Gram-stained bacteria. The bacteria are purple-stained cocci arranged in chains, characteristic of Gram-positive cocci.
BACITRACIN SUSCEPTIBILITY TEST	Bacitracin Susceptible colonies	 A petri dish showing a bacterial culture on a medium containing bacitracin. The colonies are surrounded by a clear zone of inhibition, indicating susceptibility to bacitracin. The text 'Group B Streptococcus Beta-hemolytic Sensitive to Bacitracin' is visible on the image.

*Streptococcus pyogenes*

- 1. What is the likely identity of the organism?**
- 2. What is the best antibiotic therapy for this child?**
- 3. If not treated what complication may this child have after 6 weeks period?**

# Case2



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  $38.8^{\circ}\text{C}$  and is found to have **injected tympanic membranes**.

**1. What is the differential diagnosis?**

**2. What investigations could be done?**



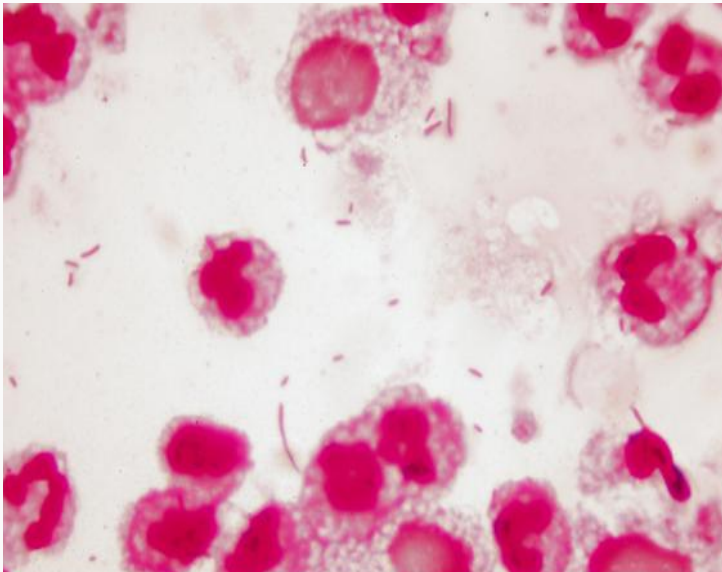
# LAB. TESTS

- Specimen => middle ear fluid
  1. Gram stain
  2. Culture of the specimen on blood, chocolate and MacConkey agar
- Culture work up
  1. Biochemical tests
  2. Antibiotic susceptibility test

## ▶ MICROSCOPIC APPEARANCE

### Gram stain From ear discharge showed :

Gram negative coccobacilli

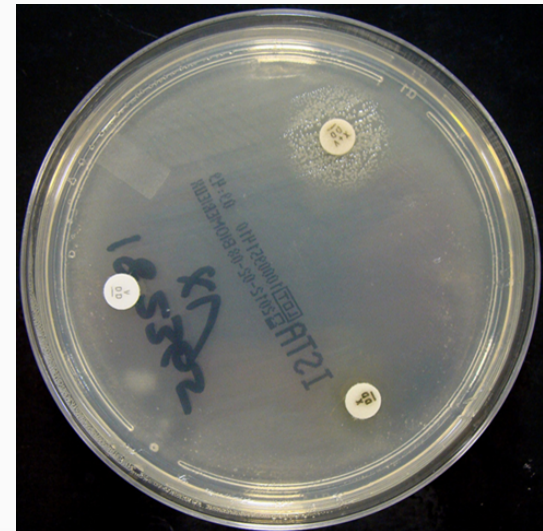


### Culture on chocolate agar

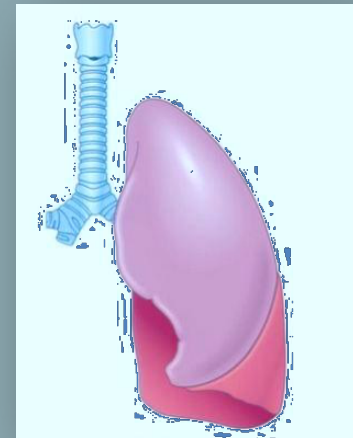


### Nutrient agar with X and V factors:

*Haemophilus influenzae* grow around the disc containing X and V factors



# Case3



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 and dullness on the right side of the chest. X-ray showed massive consolidation on the right side of the chest.

**1. What is the differential diagnosis?**

**2. What investigations should be done?**

# LAB. TESTS

- Blood work: CBC
- Sputum specimen :
  1. Gram stain
  2. Culture on blood, chocolate and MacConkey agar
- Culture work up
  1. Catalase test
  2. Optochin susceptibility test
  3. Antibiotic susceptibility test

## ▶▶ X - Ray

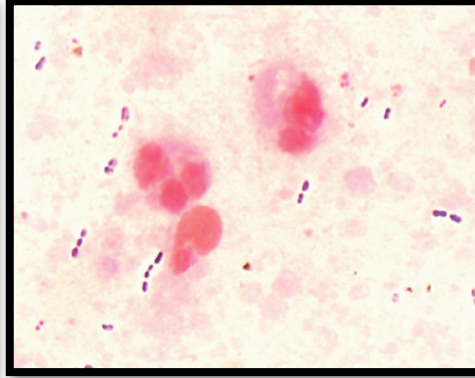
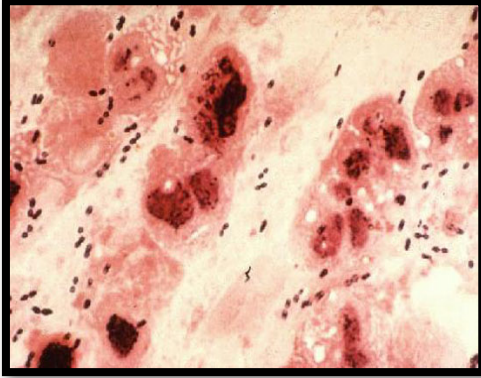
The chest X- ray showed massive consolidation on the right side of the chest.



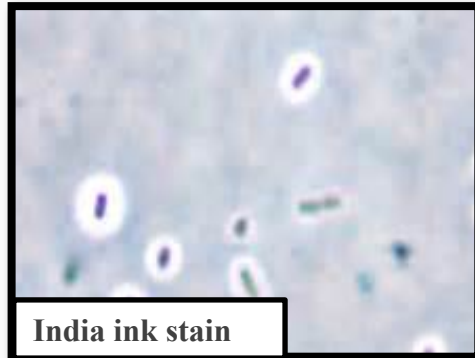
**What should have been the empirical therapy  
for this case and why?**

## ▶ MICROSCOPIC APPEARANCE

**Gram stain From sputum showed :**  
Gram positive diplococci (arranged in pairs)

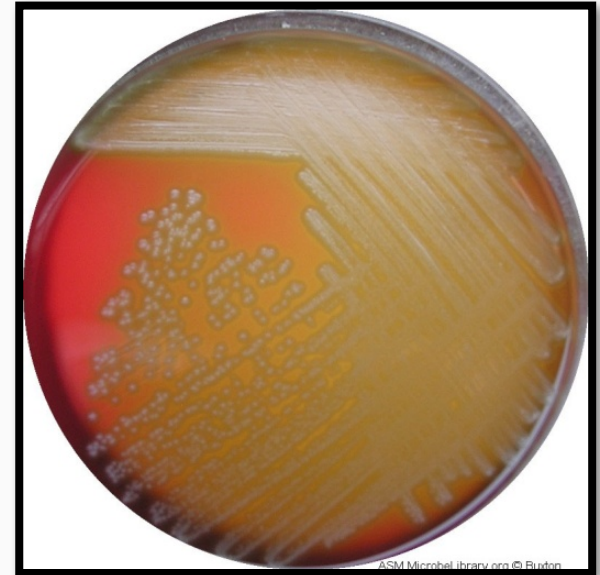


**Negative Stains showing capsule:**



## ▶ Culture

**Sputum culture showed:**  
Alpha haemolysis on blood agar  
(colonies surrounded by partial haemolysis with greenish color).





# ▶▶ CATALASE TEST



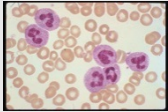


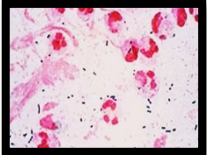
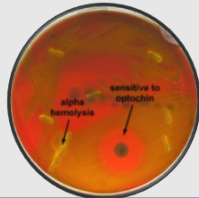
**Catalase -ve test**

# ▶▶ Optochin Susceptibility

## Optochin susceptible colonies



# Lab. Tests Results (Summary)

TEST	Result	
CBC	45,000/ ml 90% of the cells were neutrophils	
CULTURE ON BLOOD AGAR	Alpha haemolysis (colonies surrounded by partial haemolysis with greenish color)	
CATALASE TEST	No bubbles → catalase negative	
GRAM STAIN	gram positive diplococci in pairs	
Optochin SUSCEPTIBILITY TEST	Optochin Susceptible colonies	

*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.

**1. What is the differential diagnosis?**

**2. What investigation should be done?**

# ▶▶ X - Ray

The chest X-ray showed multiple opacities and cavities



Figure 8. Chest x-ray with bilateral upper lobe opacities (white areas) with multiple cavities including a very large cavity in the right upper lobe (arrows).

*Mycobacterium tuberculosis*

- The chest X- ray showed multiple opacities and cavities.
- The ESR was increased (85 m /hour).

**What further tests should be done?**

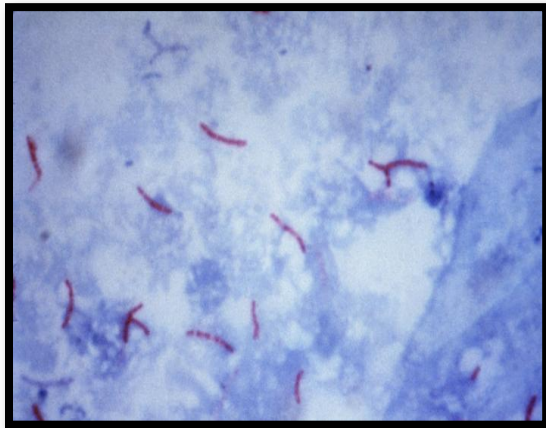
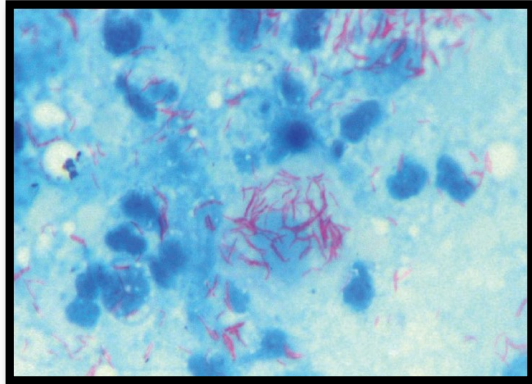
# LAB. TESTS

- Specimen => sputum
  1. Ziehl-Neelsen (ZN) stain
  2. Culture on L.J medium ( selective for mycobacteria)



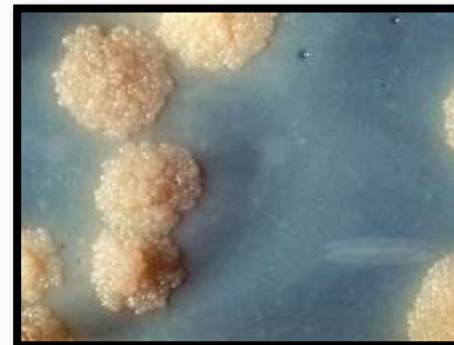
## ▶ MICROSCOPIC APPEARANCE

**Ziel – Neelsen Stained Smear**  
**From Sputum Showing:**  
**Acid – Fast Bacilli AFB**

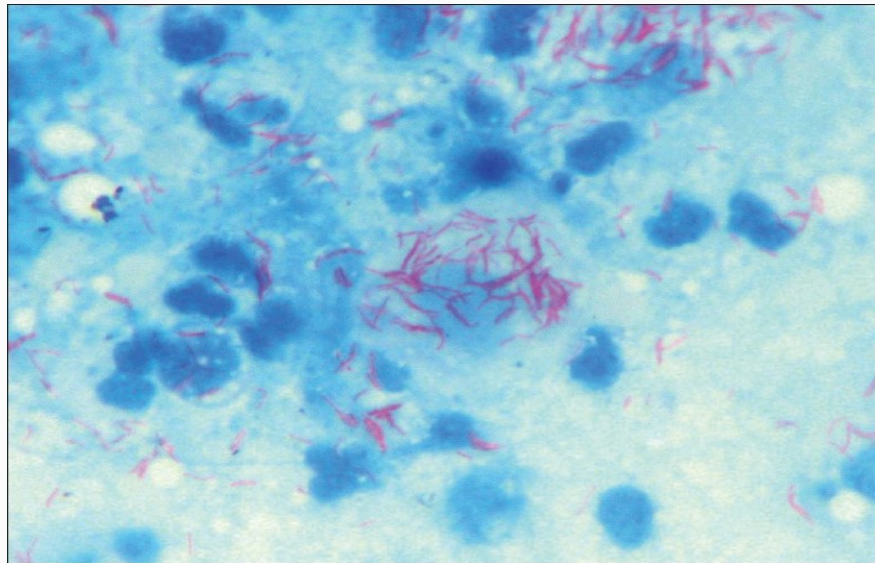


## ▶ Culture

**Sputum culture on Lowenstein–Jensen medium (selective for Mycobacteria) showed:**  
showing growth of Rough, Tough and Buff colonies



1. What is the probable diagnosis?
2. How can the diagnosis be confirmed?



*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**

**1. What is the differential diagnosis?**

**2. What investigation should be done?**

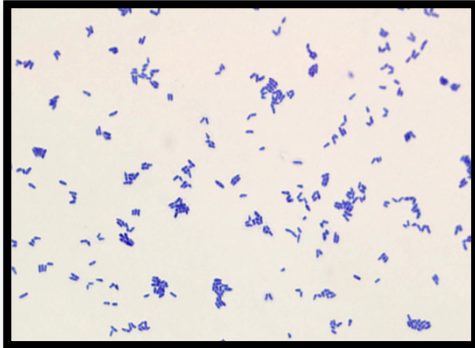
# LAB. TESTS

- Specimin => throat swab
  1. Culture on blood tellurite
    - ❖ Direct gram stain from throat swabs is not useful
- Culture work up:
  1. Gram stain From culture.
  2. ELEK test
    - To confirm toxin production

## ▶ MICROSCOPIC APPEARANCE

### Gram stain From culture showed :

Gram positive bacilli (Chinese letter appearance)



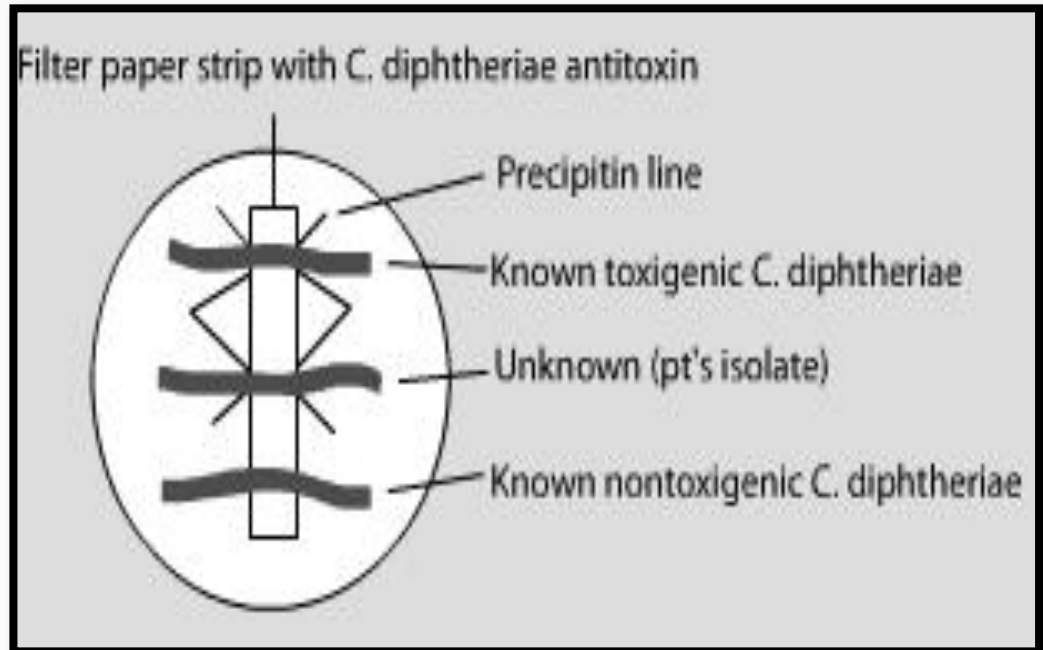
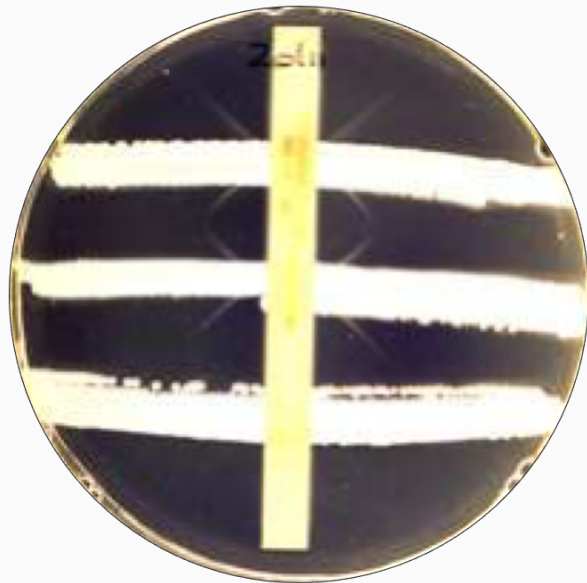
## ▶ Culture

### Throat swab culture on blood tellurite showed: Black color colonies



*Corynebacterium diphtheriae*

# ▶▶ ELEK TEST



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)

- 1. What is the likely identity of the organism?**
- 2. What is the best antibiotic therapy for this child?**
- 3. what complication may this child develop?**