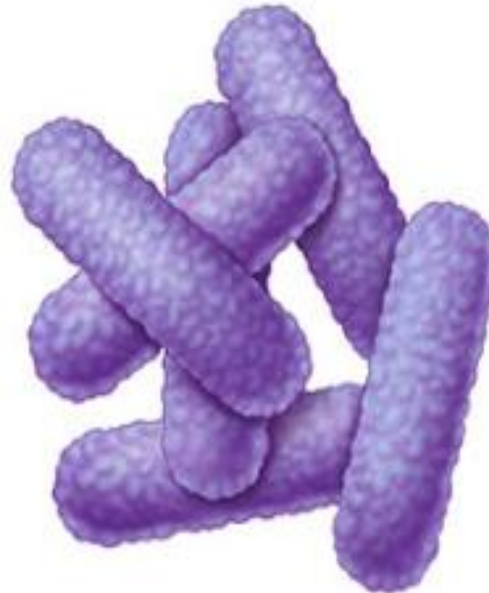


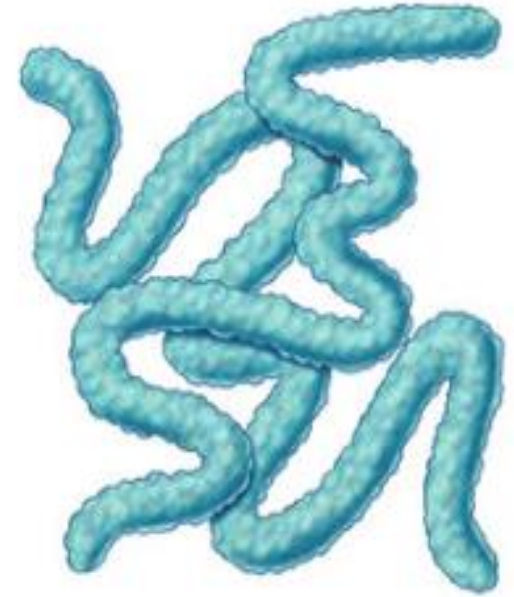
# Bacteria



Sphere-shaped  
(cocci)



Rod-shaped  
(bacilli)



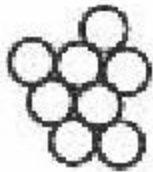
Spiral-shaped  
(spirochetes)

# 格蘭氏染色 and 形狀

|    | 格蘭氏陽性            | 格蘭氏陰性             |
|----|------------------|-------------------|
| 球菌 | 格蘭氏陽性<br>球菌..... | 格蘭氏陰性<br>球菌       |
| 桿菌 | 格蘭氏陽性<br>桿菌      | 格蘭氏陰性<br>桿菌 ----- |

## Cocci

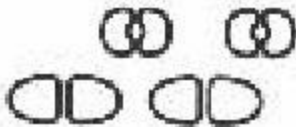
Gram-Positive



In clusters



In chains



In pairs **G (-)**



In tetrads

## Bacilli

Gram-Negative



Coccobacilli



Bacilli of various sizes  
**G (+)**



Fusiform bacilli



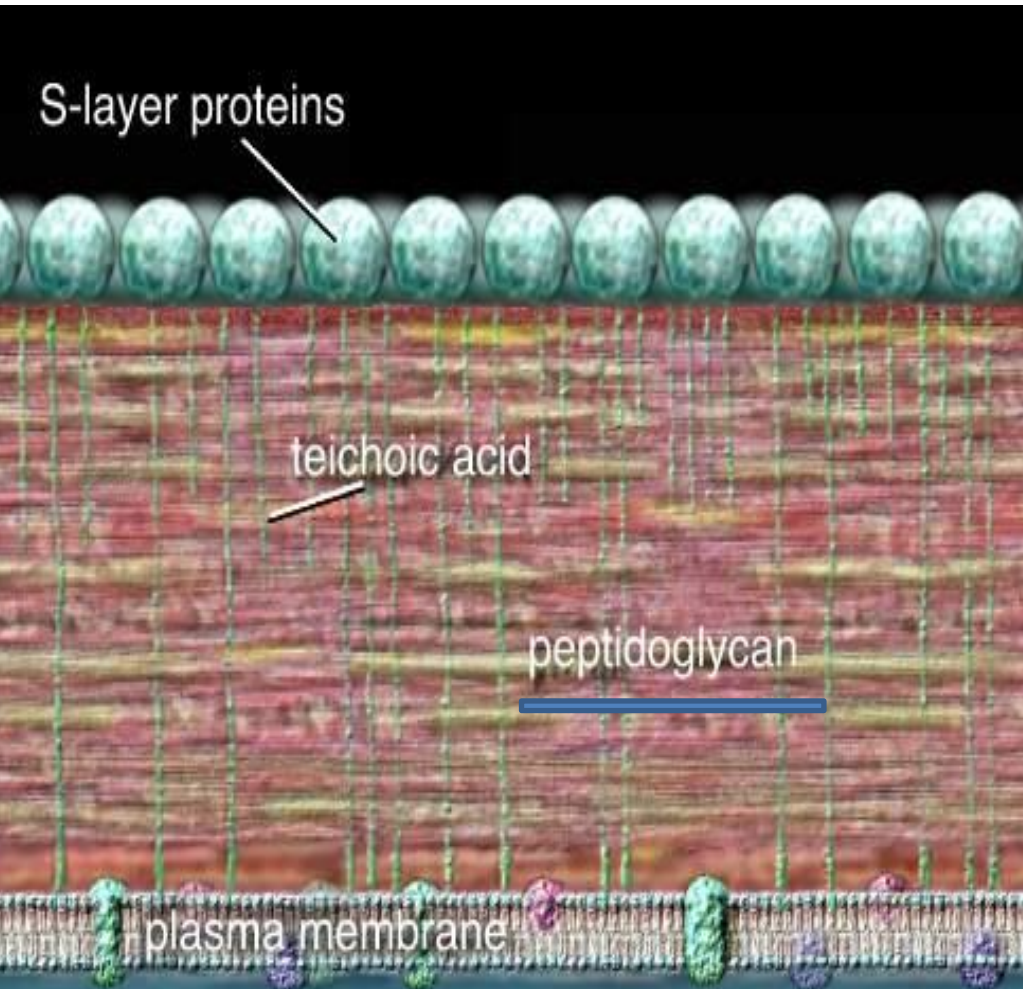
Palisading **G (+)**

## Spirochetes



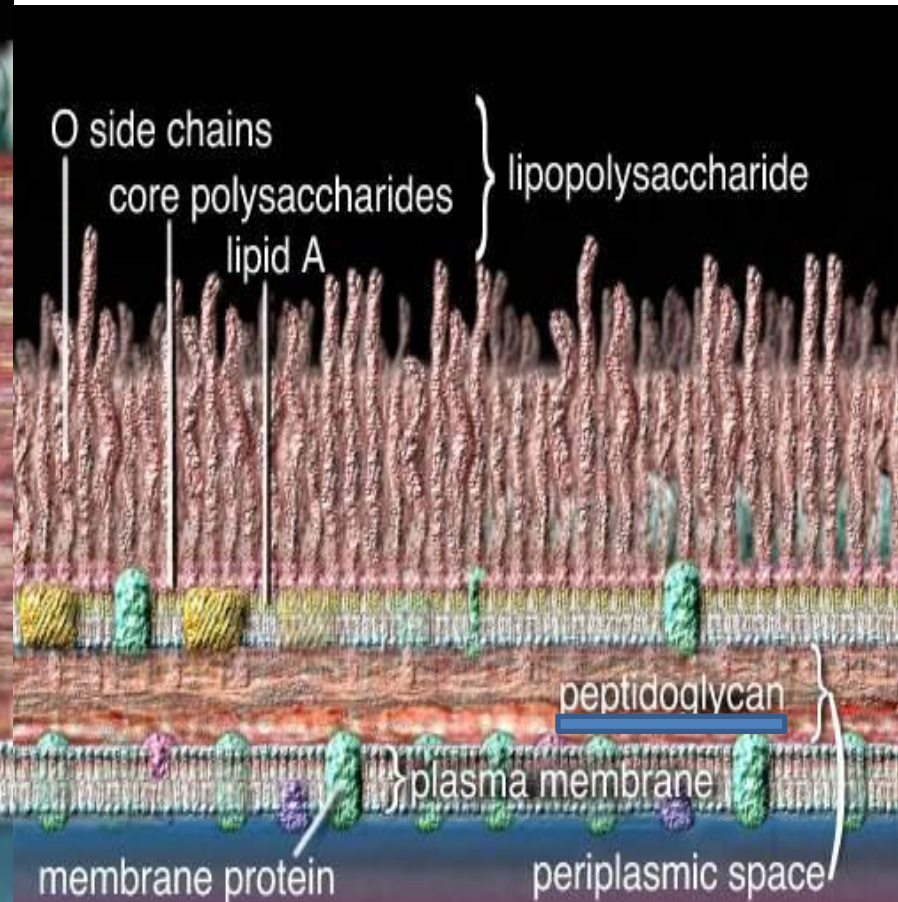
**Vibrio**

## Cell wall of G(+) bacteria



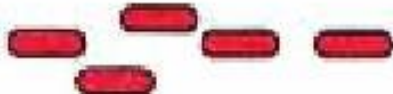
Russell Kightley  
rkm.com.au

## Cell wall of G(-) bacteria



Russell Kightley  
rkm.com.au

# Gram Stain Morphotypes

| <b>Gram Positive</b><br><i>Staphylococcus aureus</i> | <b>Gram Negative</b><br><i>Escherichia coli</i>                                       |
|------------------------------------------------------|---------------------------------------------------------------------------------------|
| Step 1 Crystal Violet                                |    |
| Step 2 Gram Iodine                                   |    |
| Step 3 Decolorizer<br>(alcohol, Acetone)             |   |
| Step 4 Safranin red                                  |  |

格蘭氏陽性

# 革蘭氏陽性 球菌.....

## 葡萄球菌-Staphylococcus

- Staphylococcus aureus
- Staphylococcus epidermidis
- Coagulase negative staphylococcus (CoNS)

## 鏈球菌 - streptococcus

- Streptococcus pneumoniae (pneumococcus)
- Viridans streptococcus ( $\alpha$ hemolytic)(綠色)
- Group A streptococcus ( $\beta$  hemolytic) (全溶血) & Group B, C, G...
- Group D streptococcus
- Enterococcus

# *Staphylococcus aureus*

## 金黃色葡萄球菌

- 存在 -- 前鼻腔, 皮膚, 雙手, 器械
- 臨床 -- 蜂窩組織炎/ 毛囊炎/ 傷口/ cvp / 心內膜炎/關節炎/骨髓炎/
- 治療 -- OSSA : Oxacillin 2 gm i.v. Q4~6h

(50-200mg/Kg)

Cefazolin 1 gm i.v. Q8h

- ORSA: Vancomycin 500 mg ivd q 6~8h  
Teicoplanin 400mg ivd QD

# *Staphylococcus epidermidis* and CoNS

- 存在 -- 皮膚, 雙手, 器械
- 臨床 – 肺炎 / 人工植入物 / 免疫力差的患者
- 治療 -- OSSE : Oxacillin 2 gm i.v. Q4~6h

(50-200mg/Kg)

Cefazolin 1 gm i.v. Q8h

- ORSA: Vancomycin 500 mg ivd q 6~8h  
Teicoplanin 400mg ivd QD

# *Streptococcus pneumoniae* (pneumococcus) 肺炎雙球菌

- 存在 -- 口腔,
- 臨床 – 肺炎 / 菌血症
- 治療 -- PSSP : penicillin 3mu iv q4~6h  
或者 ampicillin 或者 amoxicillin/clavulnate
- PRSP: Vancomycin (或者 Teicoplanin) +  
Ceftriaxone (Rocephin)

# Viridans streptococcus (草綠色鏈球菌)

- 存在 -- 口腔, 腸胃道
- 臨床 – 心內膜炎 / 腹腔內感染
- 治療 -- penicillin 3mu iv q4~6h  
( 或者 amoxicillin/clavulanate )  
+ Gentamicin

# Group A (B,C,G) streptococcus ( $\beta$ hemolytic)

- 存在 -- 皮膚
- 臨床 – 蜂窩性組織炎 / 淋巴腺炎
- 治療 -- penicillin 3mu iv q4~6h  
( 或者 ampicillin )  
+ clindamycin ( cleocin )

# Enterococcus sp

- 存在 -- 腸胃道
- 臨床 – 腹腔內感染/心內膜炎/尿道感染
- 治療 -- ampicillin 2g iv Q6h 或者  
Vancomycin (Teicoplanin)  
( + Gentamicin )

# Group D streptococcus

- 存在 -- 腸胃道
- 臨床 – 腹腔內感染/心內膜炎/大腸癌
- 治療 -- ampicillin 2g iv Q6h 或者  
Vancomycin (Teicoplanin)

# 格蘭氏陽性桿菌

- Bacillus sp ( anthrax,.....
- Lactobacillus sp
- Clostridium sp ( tentaus, botulism, difficle, perfringens, septicum.....) ( anaerobic )

格蘭氏陰性

# 格蘭氏陰性球菌

- Neisseria sp ( meningitidis, gonorrhea...)
- Moraxella sp ...
- Veillonella sp...

# 格蘭氏陰性桿菌 (I)

- **Enterobacteriaceae** –
  1. (E-coli )
  2. (Klebsiella sp/ Enterobacter sp/ Serratia sp)
  3. (Proteus sp/ Morganella sp)
  4. ( Citrobacter sp)
  5. (Salmonella sp / shigella sp )
- **Vibrionaceae** – Vibrio sp/ Aeromonas sp/...
- **Fastidious GNB**–Haemophilus sp/HACEK

# 格蘭氏陰性桿菌 (II)

- Nonfermenting GNB –
  1. Pseudomonas sp/
  2. Acinetobacter sp/
  3. Stenotrophomonas sp
- Anaerobic GNB – bacteroid sp

# Enterobacteriaceae(I)

- E-coli –
  1. UTI / BTI / 腹腔內感染/ 骨髓炎
  2. 治療– amoxicillin/clavulnate/ Tazocin/ cephalosporin/ carbapenem / baktar/ GM
- *Klebsiella pneumoniae* (KP) –
  1. UTI / BTI / 腹腔內感染/ 肺炎/ Liver abscess(DM,Taiwan)
  2. 治療–cephalosporin/ carbapenem / ciproxin / baktar/ GM

## Enterobacteriaceae(II)

- Enterobacter sp / Serratia sp /Citrobacter sp – 感染免疫力差的患者, 需用後線抗生素
- **Proteus sp— UTI (結石)/ 腹腔內感染**
- Morganella sp-- 腹腔內感染 ,
- Salmonella sp– typhi & non-typhoid ,治療– Ampicillin/Baktar/Rocephin/ciprofloxacin
- shigella sp – 痢疾, 治療– Ampicillin/Baktar/cephalosporin/ciprofloxacin

# Vibrio sp & Aeromonas sp

- Liver cirrhosis / Steroid abuse/ malignancy / (antacid ?)
- 1. 壞死性筋膜炎 ( necrotizing fasciitis ) / 腹膜炎 (spontaneous bacterial peritonitis)/ 敗血症 (Septicemia)→病程很快,48小時內死亡)
- 2. 治療– 第三代cephalosporin+doxycyclin 或者 ciprofloxacin (+ 清創手術)

# Haemophilus influenzae

- COPD 病患, pneumonia
- 治療 – Augmentin/ Unasyn / cefuroxime....
- *Haemophilus influenzae*, type B – baby and little children meningitis

## Nonfermenting GNB (I)

- 院內感染, 感染免疫力差的患者, 需用後線抗生素
  1. *Pseudomonas aeruginosa*
  2. *Acinetobacter baumannii*
  3. *Stenotrophomonas maltophilia*
  4. *Burkholderia pseudomallei*
  5. Other ...

# Nonfermenting GNB (II)

## (Pseudomonas aeruginosa)

- *Pseudomonas aeruginosa* – 綠膿桿菌
  1. Leukopenia 的病人 (Hema/oncology)
  2. 骨髓炎 – Intravenous drug abuser
  3. Folliculitis – water pool
  4. Ecthyma gangrenosum – bacteremia with vasculitis
  5. Malignant otitis externa
  6. Bronchiectasis, cystic fibrosis
  7. Nosocomial infection
- Treatment: anti-pseudomonas agents

# Nonfermenting GNB (III)

## *(Acinetobacter baumannii)*

- *Acinetobacter baumannii* – 不動桿菌
  1. Water
  2. Dry surface – survive more than 14 days
  3. Nosocomial infection
- Treatment:
  1. Sulbactam (+ Ampicillin / Cefperazone / anti-pseudomonas agents),
  2. Carbapenem (+/- sulbactam)

# Nonfermenting GNB (IV)

## (*Stenotrophomonas maltophilia* )

- *Stenotrophomonas maltophilia*
  1. Nosocomial infection
  2. Pneumonia – most common infection site
  3. Resistant to carbapenem
- Treatment:
  1. Baktar(TMP/SMZ)
  2. Minocycline

# Nonfermenting GNB (V)

## ( *Burkholderia pseudomallei* )

- *Burkholderia pseudomallei* – 類鼻疽
  1. 糖尿病
  2. 泥土 -- 泰國北部,越南,華南,臺灣南部
  3. 肺炎,肝脾膿瘍,攝護腺膿瘍,骨髓炎,
- Treatment:
  1. Ceftazidime (Fortum) +Baktar
  2. Augmentin
- Recurrence

# Anaerobic GNB

- *Bacteroid fragilis*
- 腹腔内感染
- Treatment –
  1. Metronidazole / meropenem / Imipenem/ Augmentin/ Tazocin/ flumarin /clindamycin
  2. Surgical intervention as need

# 其 他

- Spirochetes
- Atypical pneumonia pathogen
- Rickettsial diseases
- Mycobacterium

# Spirochetes

## 格蘭氏陰性螺旋菌

- Syphilis 梅毒 – penicillin
- Leptospirosis – 泥巴, 老鼠, 狗, 豬.....  
penicillin / tetracycline
- Lyme disease – doxycycline

# Atypical pneumonia pathogen

- *Chlamydia pneumoniae* – 鳥類
- *Legionella pneumophila*– COPD, steroid, malignancy , 較嚴重, 與水有關
- *Mycoplasma* – 沒有細胞壁
- 治療–Erythromycin (Klaricid/azithromycin) / quinolone (levofloxacin)/ tetracycline

# Rickettsial diseases

- 台灣有下列三種
  1. Scrub typhus – 恙蟲病 (chigger, mite)
  2. Q-Fever – 山區, 牛, 羊, 貓.....
  3. Murine typhus – 老鼠跳蚤(少見)
- Treatment:
  1. Tetracycline
  2. Quinolone

# Mycobacterium – 分枝桿菌

- TB – (肺)結核病
- NTM (MOTT) – 非結核分枝桿菌, 海水, 泥土, 表淺層感染, 毒性更低
- MAC (*Mycobacterium avium* complex) – 感染AIDS 患者

# 感染(Infection)

- 微生物在身體的組織產生侵入或繁殖
- 臨床上有時症狀會不明顯
- 但會經由競爭代謝, 分泌毒素, 在細胞內繁殖, 或產生抗原抗體反應, 而造成局部的細胞傷害

# 移生現象(Colonization )

- 微生物存在體表並繁殖
- 但不侵犯組織
- 也不引起炎症反應

# Gram-Positive Cocci

## Streptococcus-like

Cocci in singles, diplococci, chains

1. *Streptococcus*
2. *Enterococcus*
3. *Peptostreptococcus*
4. *Gemella*
5. *Leuconostoc*
6. *Pediococcus*



1



2



1

*S. pneumoniae*

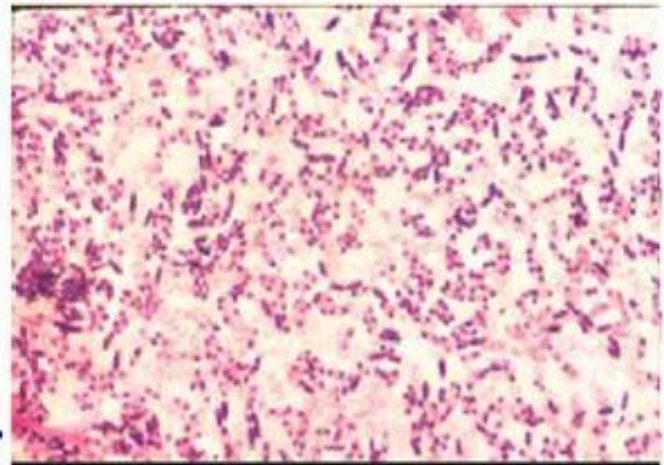
# ***Gram-Positive Rods***

**Large, square-ended, as pairs or short chains**

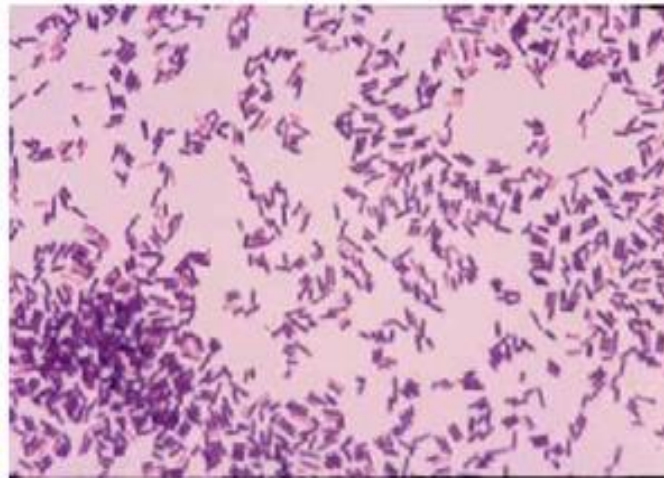
**1. *Bacillus***

**2. *Clostridium***

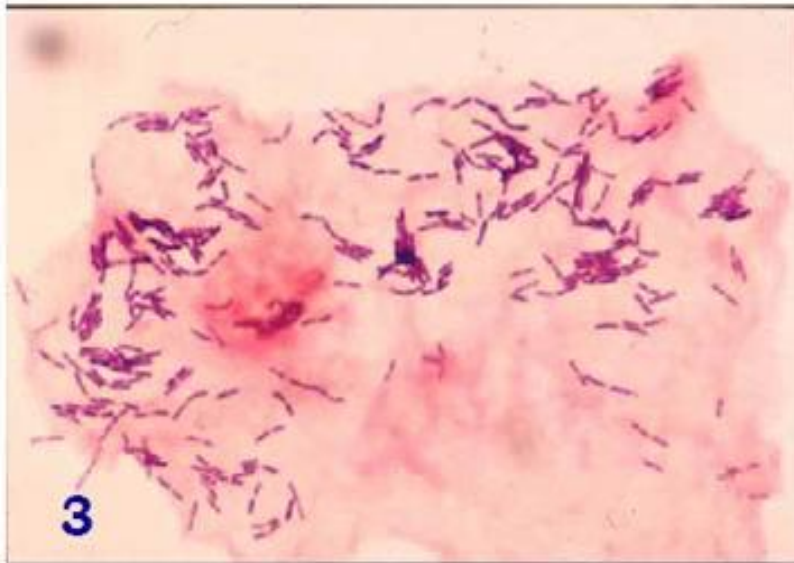
**3. *Lactobacillus***



**1**



**2**



**3**

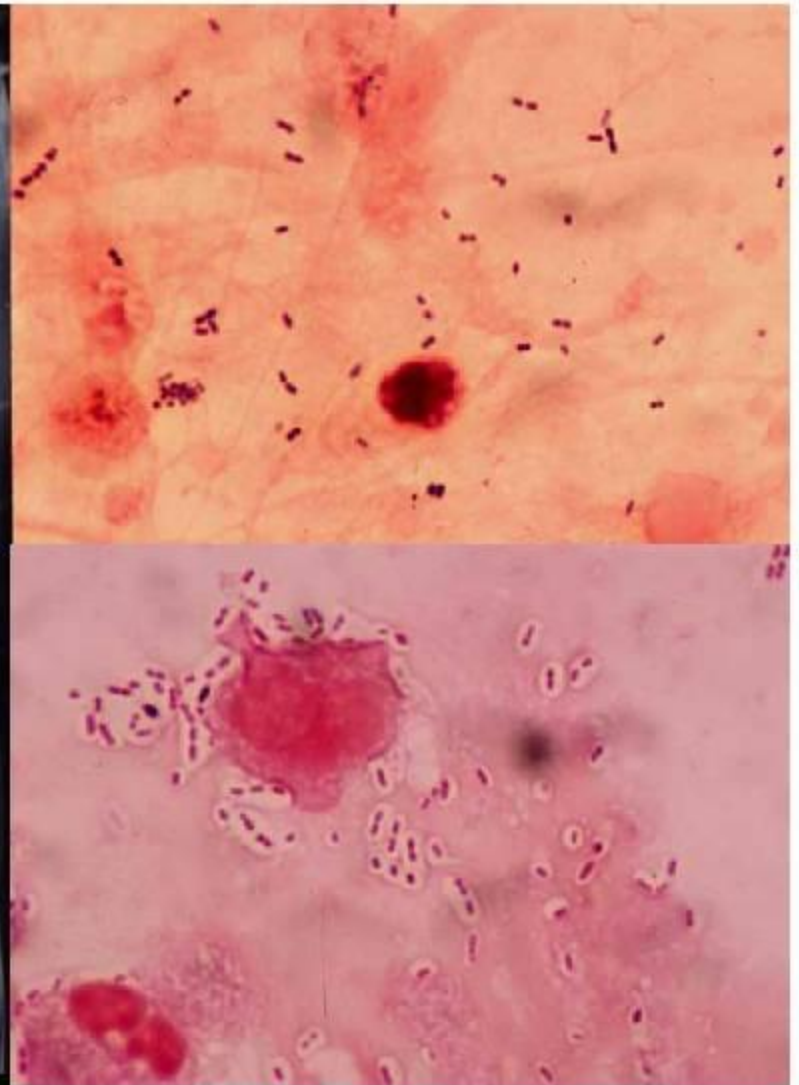
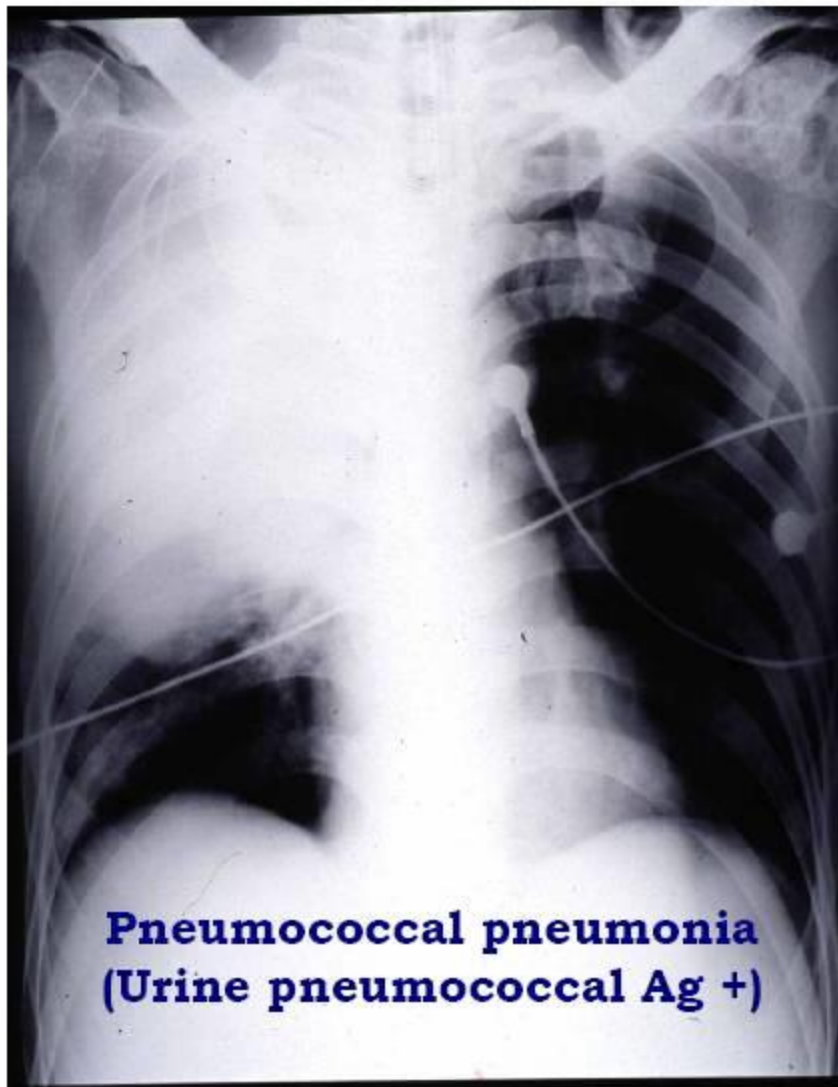
# Community-Acquired Pneumonia

## Etiology and morphotypes

---

| Etiology                                 | Morphotype     |
|------------------------------------------|----------------|
| <i>Streptococcus pneumoniae</i>          | GPdC, capsules |
| <i>Staphylococcus aureus</i>             | GPC, clusters  |
| <i>Klebsiella pneumoniae</i>             | GNB, plump     |
| <i>Haemophilus influenzae</i>            | GNCB           |
| <i>Moraxella catarrhalis</i>             | GNdC           |
| Mycoplasma, Legionella, Chlamydia, virus |                |

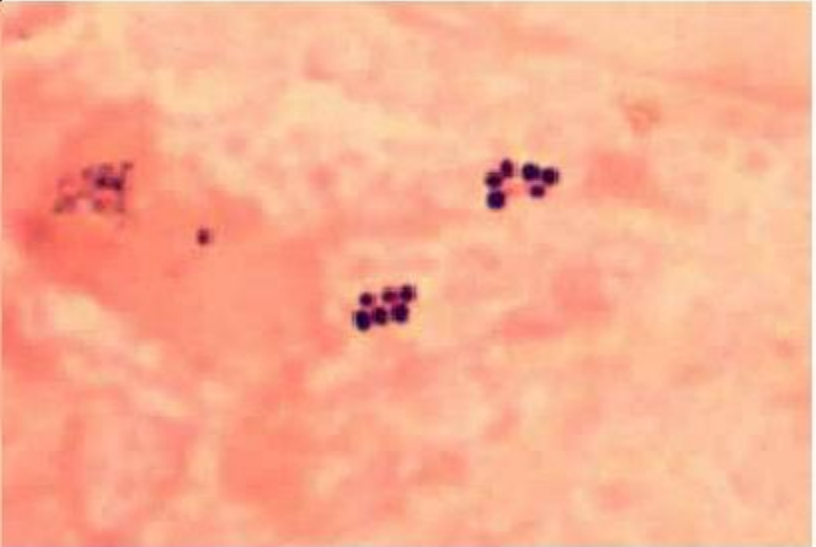
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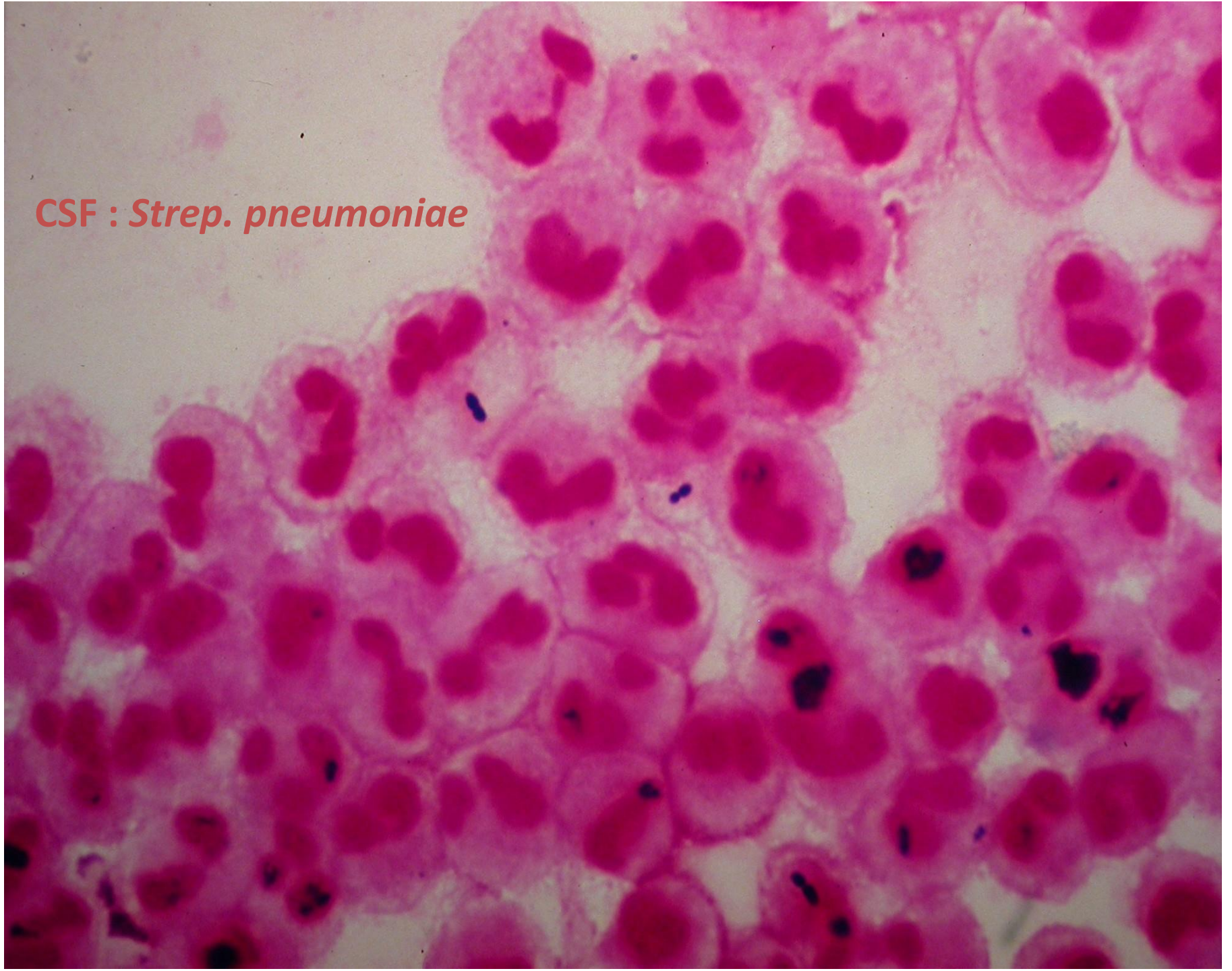


**34 year-old female**

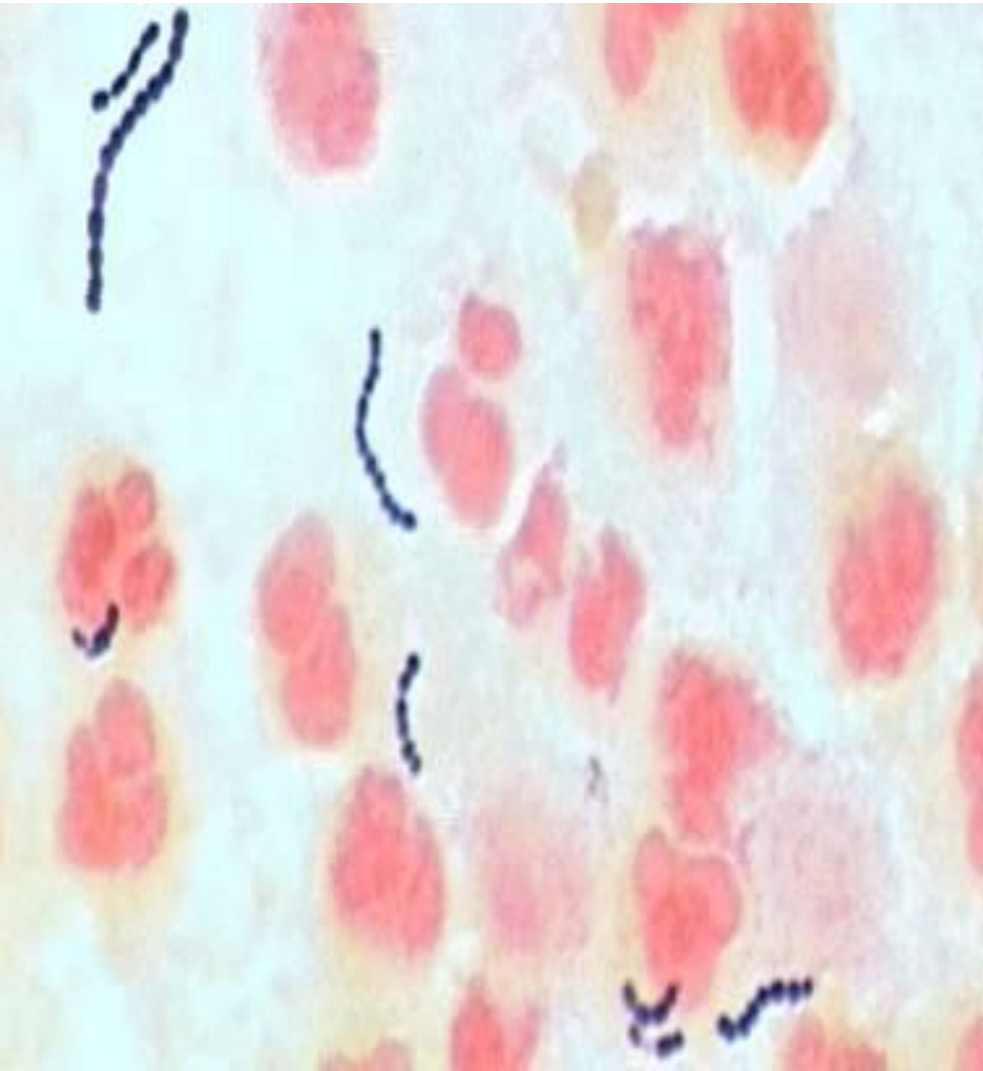
***Staphylococcus* spp.**



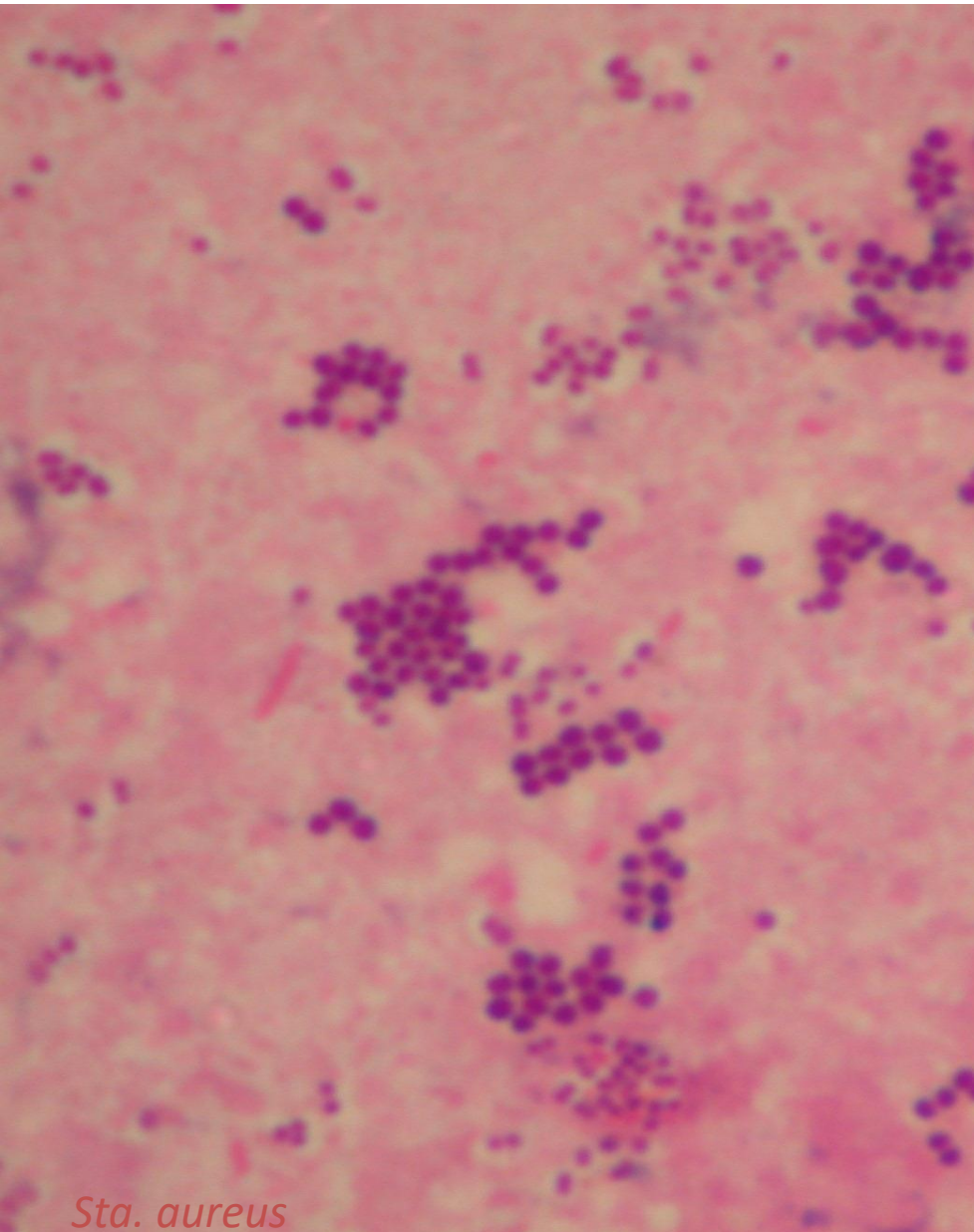
CSF : *Strep. pneumoniae*



***Group A streptococcus may cause wound infection, cellulitis, fasciitis in a variety of sites.***



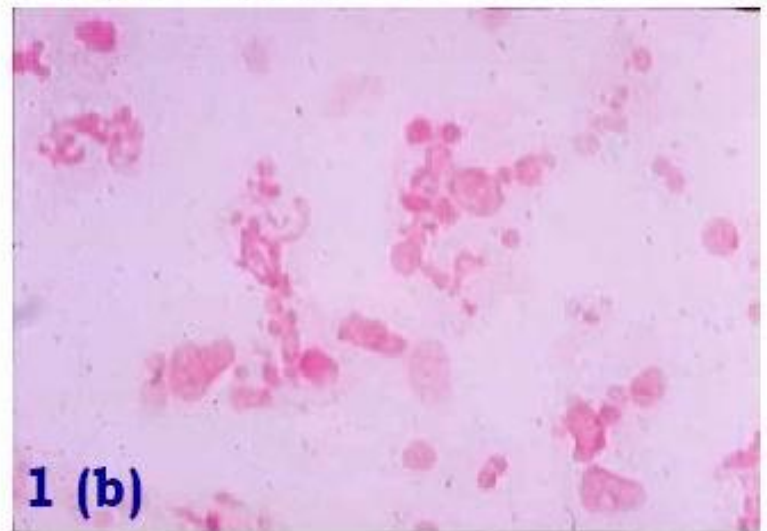
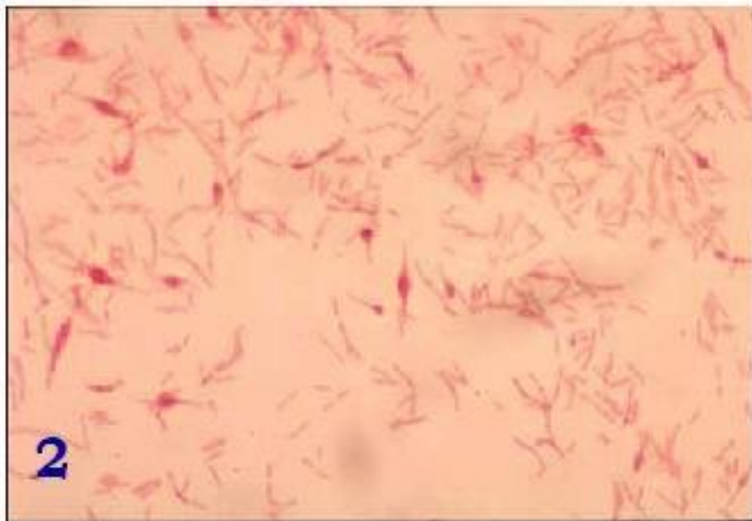
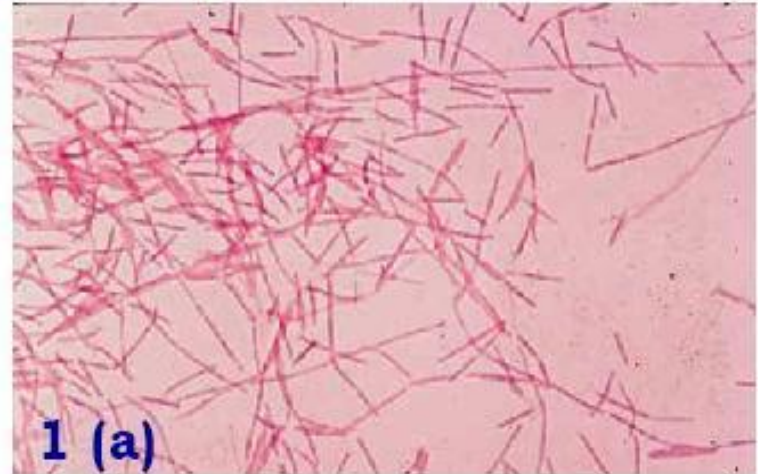
# *Staphylococcus aureus*



# **Gram-Negative Rods**

**Medium-to-long, fusiform, pleomorphic**

- 1. *Fusobacterium***
  - a. *F. nucleatum***
  - b. *F. mortiferum***
- 2. *Capnocytophaga***



# **Gram-Negative Cocci**

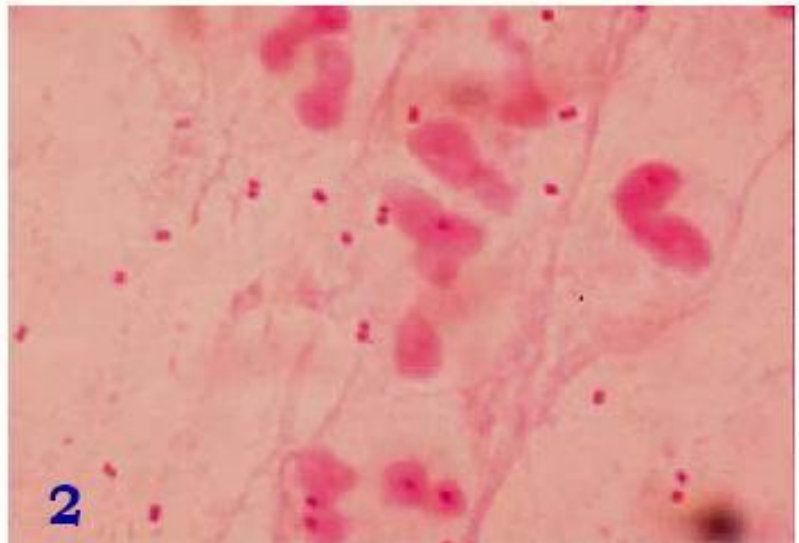
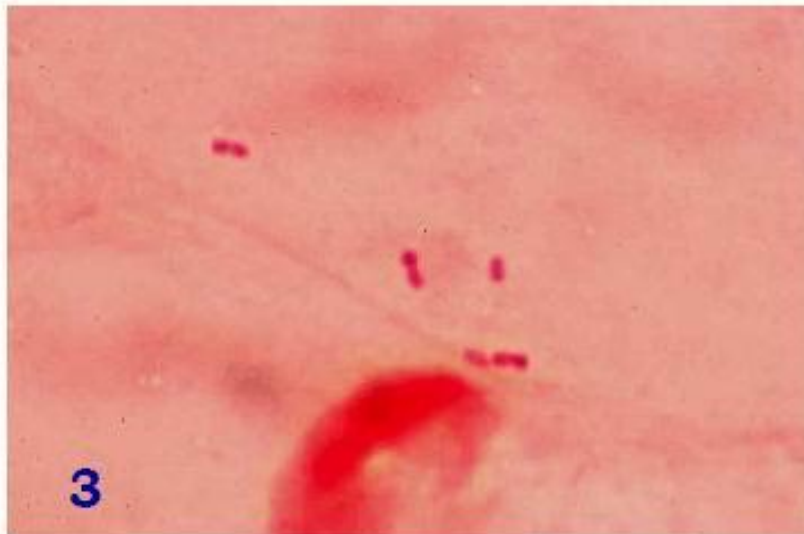
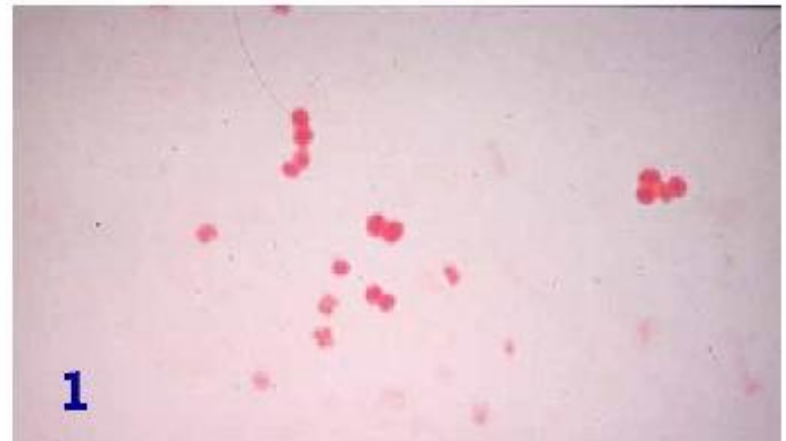
Cocci as singles, diplococci

1. *Neisseria*

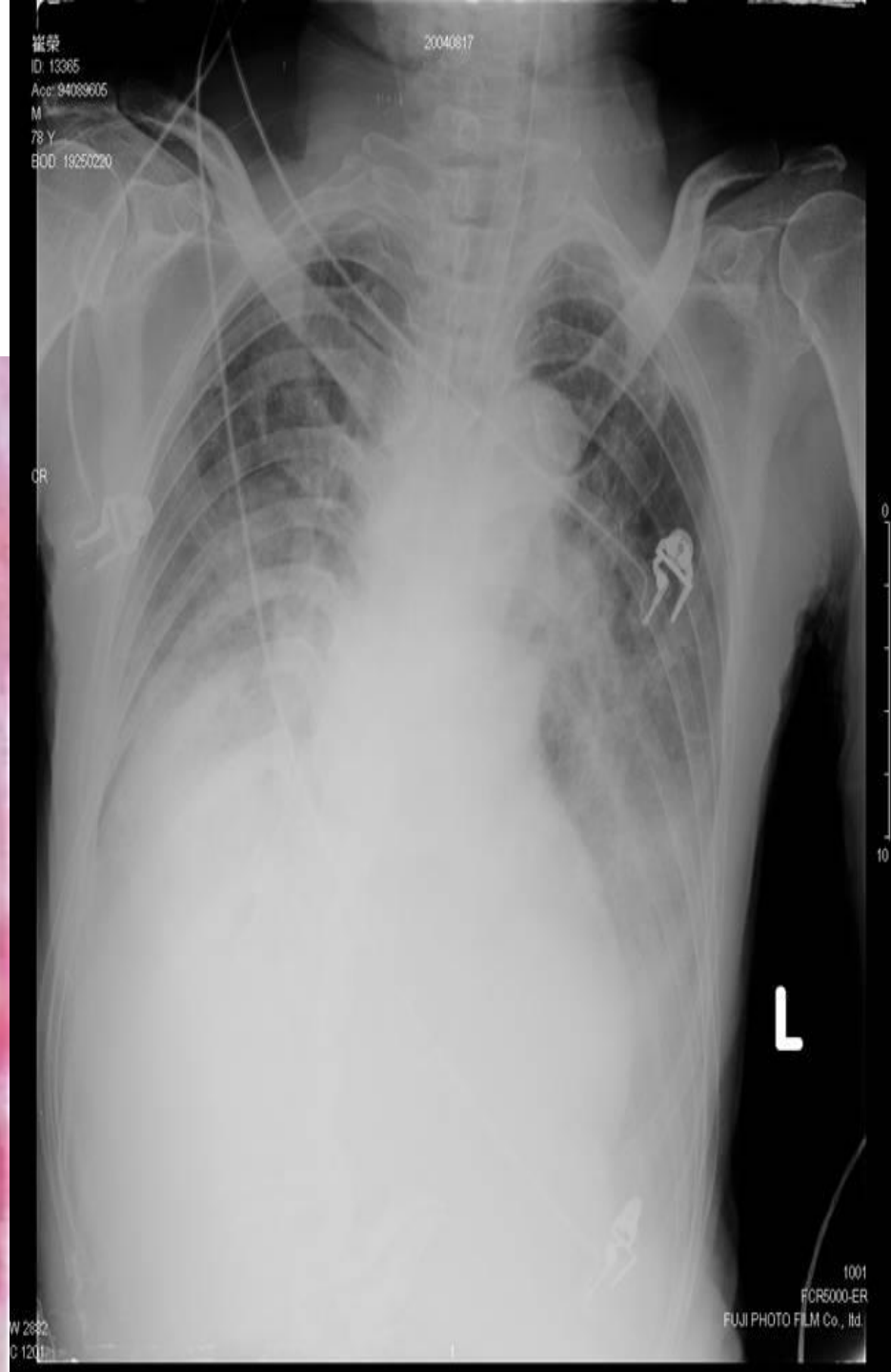
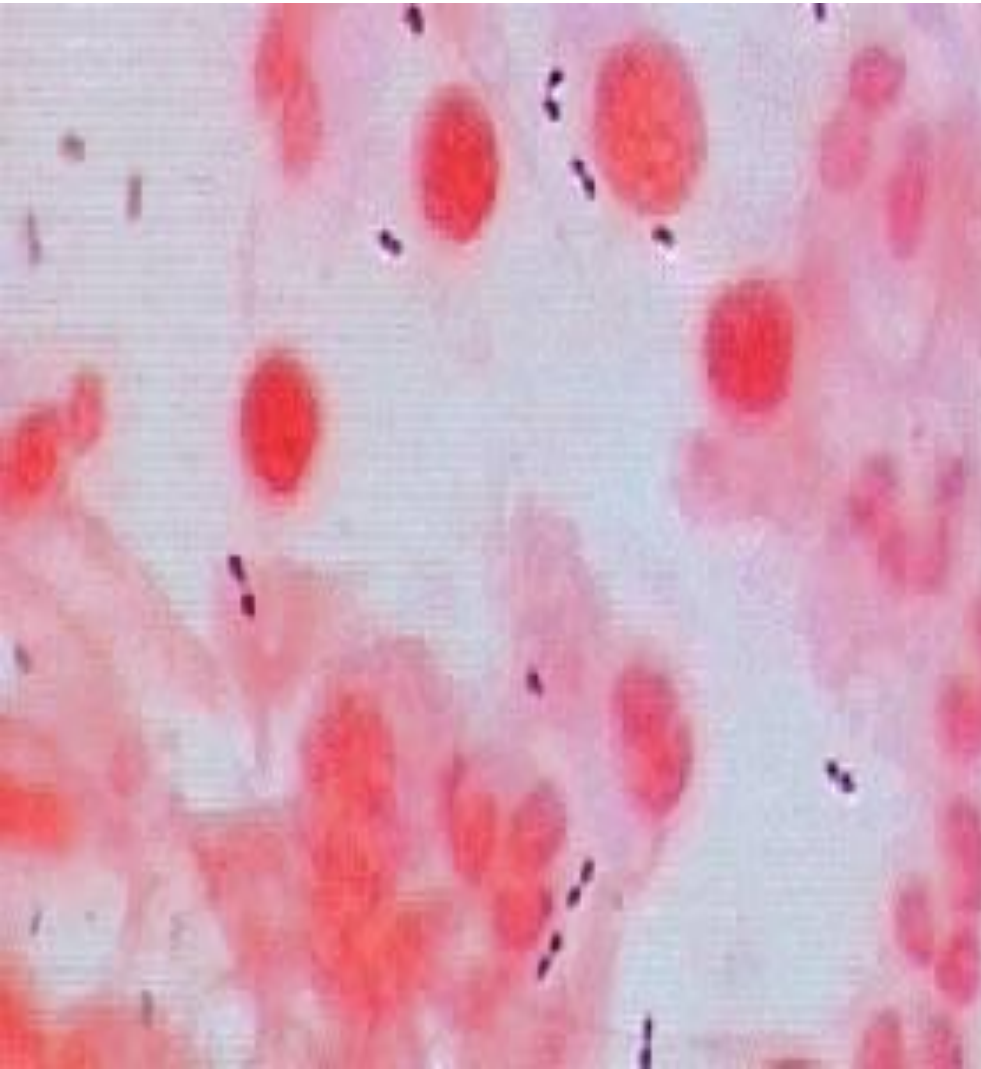
2. *Moraxella*

3. *Acinetobacter*

4. *Veillonella*



***Strep. pneumoniae* is the most common bacteria that cause community-acquired pneumonia.**



郭先生 9564958 37 歲 男性 無業 住澎湖縣

主訴意識不清一天

五天前有車禍, 電腦斷層正常



IP: >200

WBC: 1130

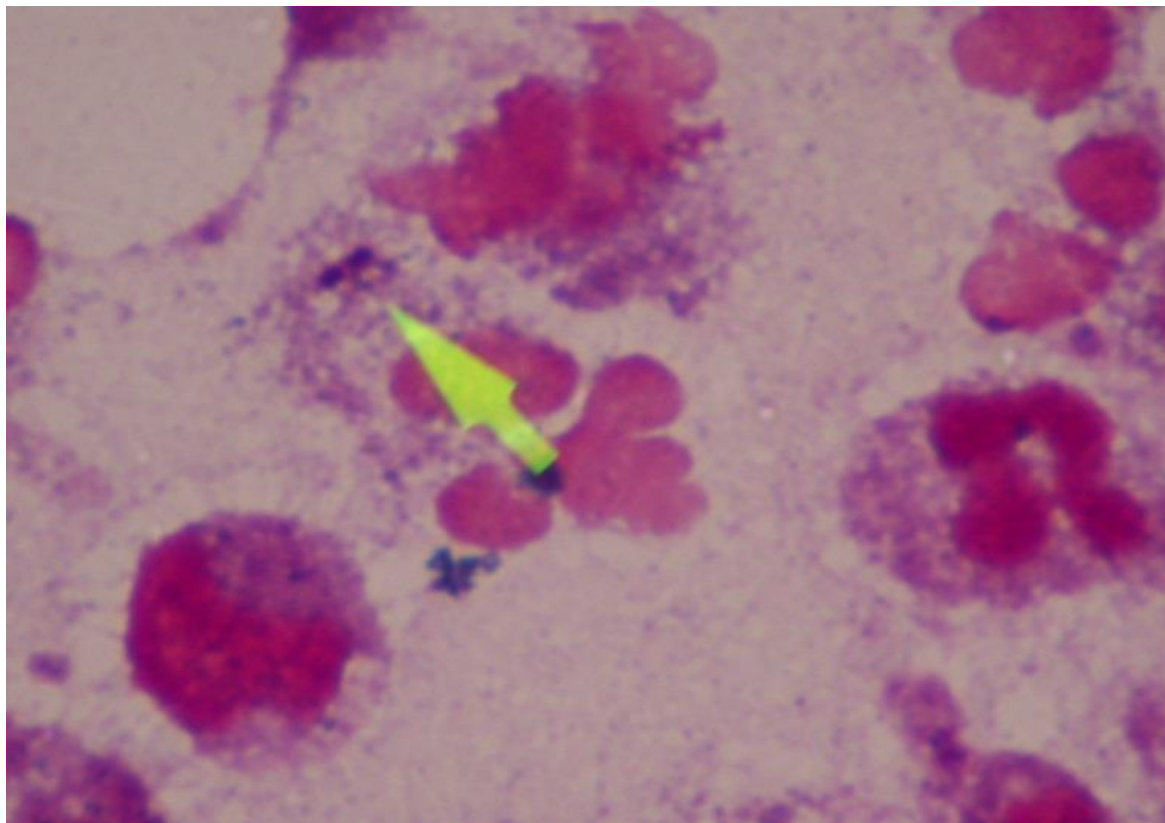
N/L: 93/6

RBC: 0

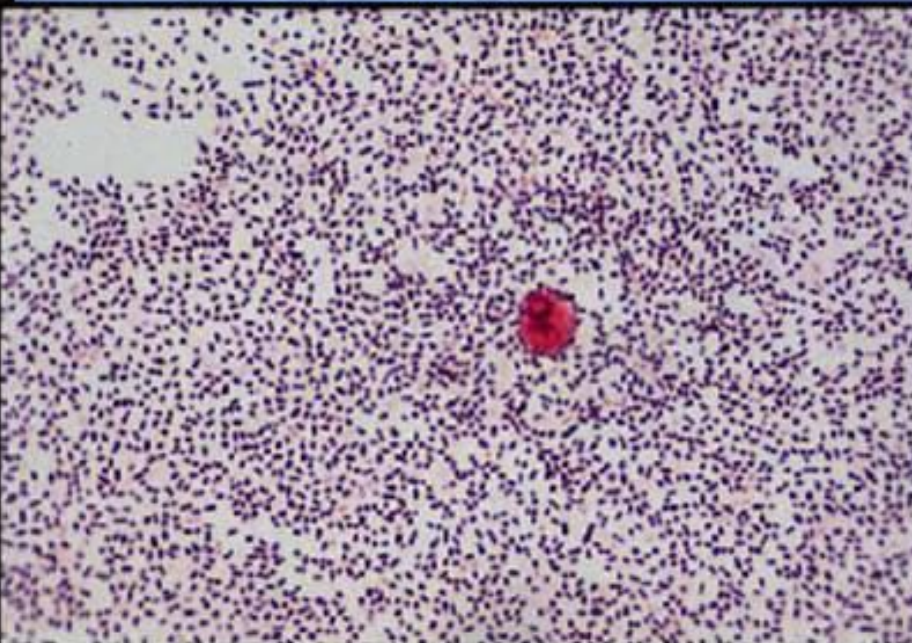
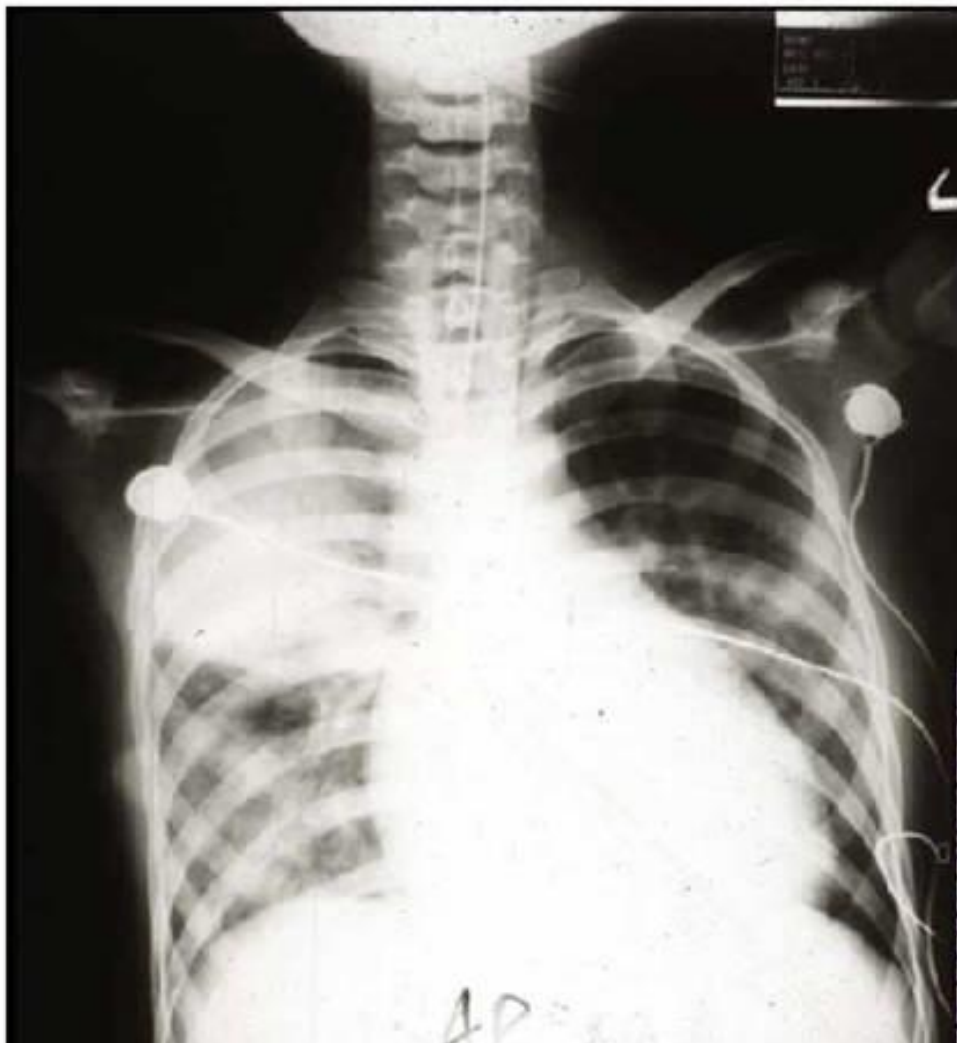
Protein 980

Sugar : 20/146

Lac: 161.3

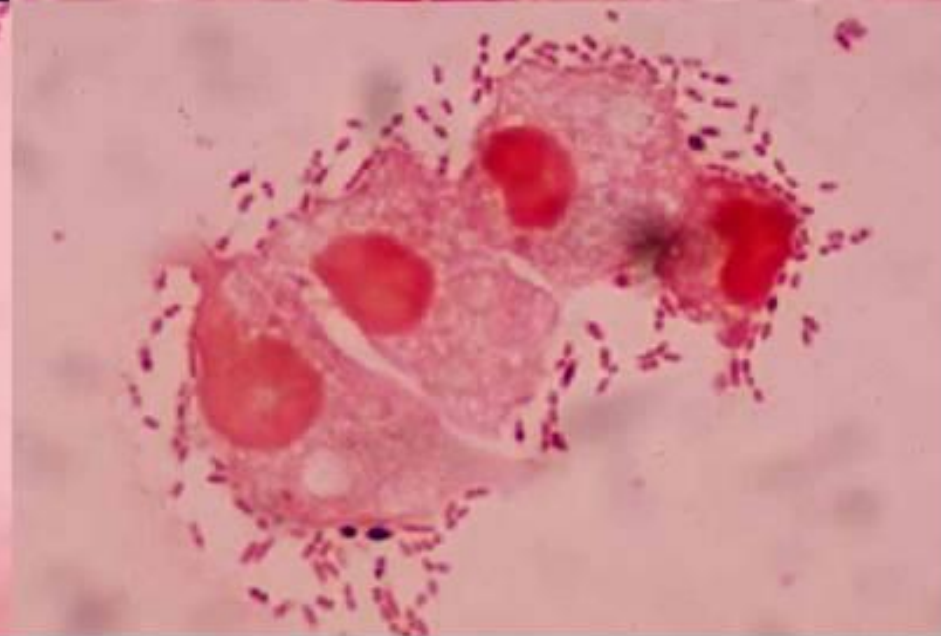
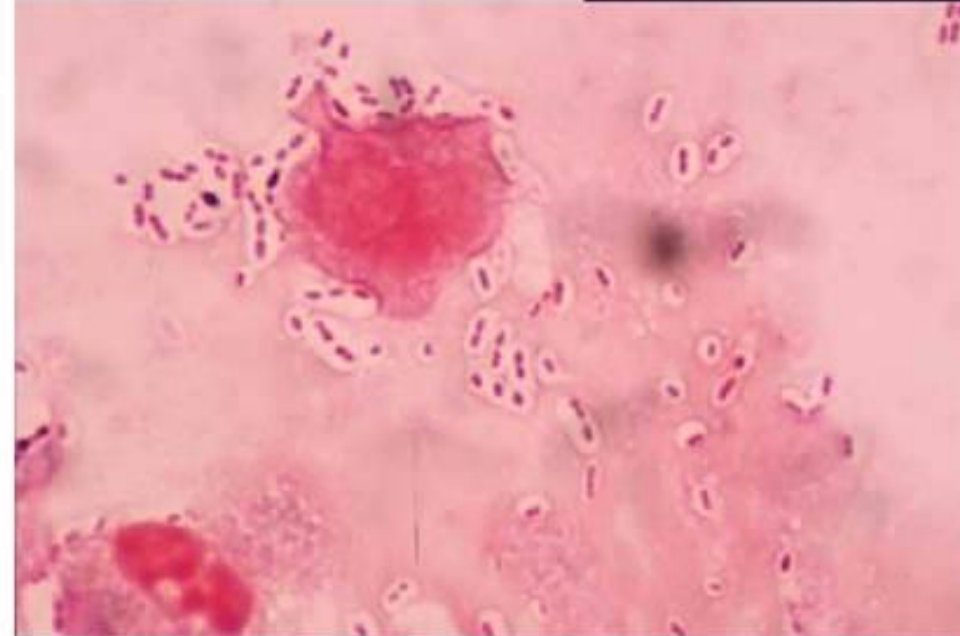
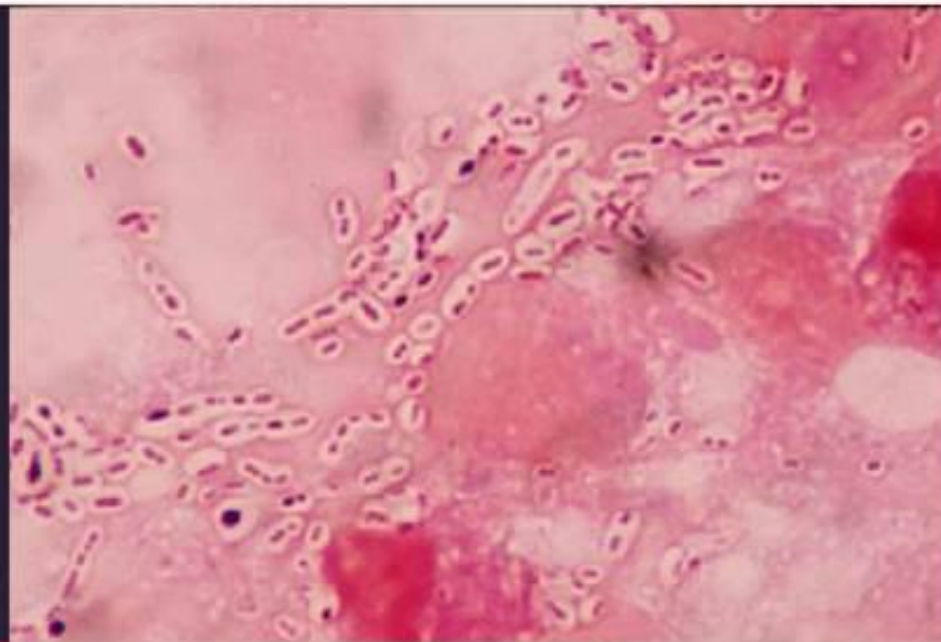


***Strep. pneumoniae meningitis***



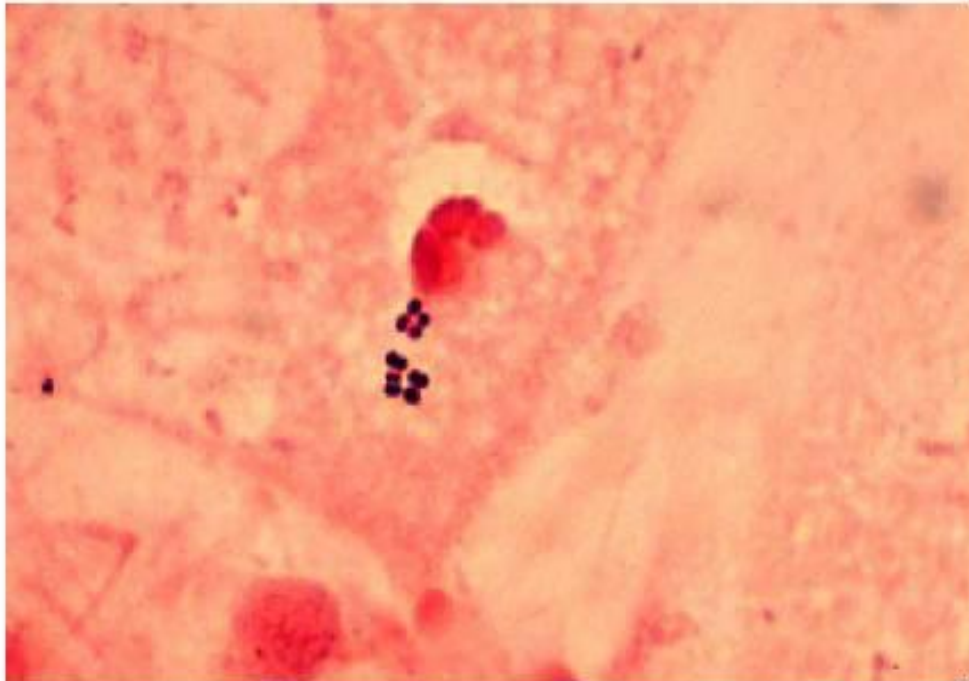
***Strep. pneumoniae* pneumonia  
and meningitis**

***S. pneumoniae***  
**meningitis**

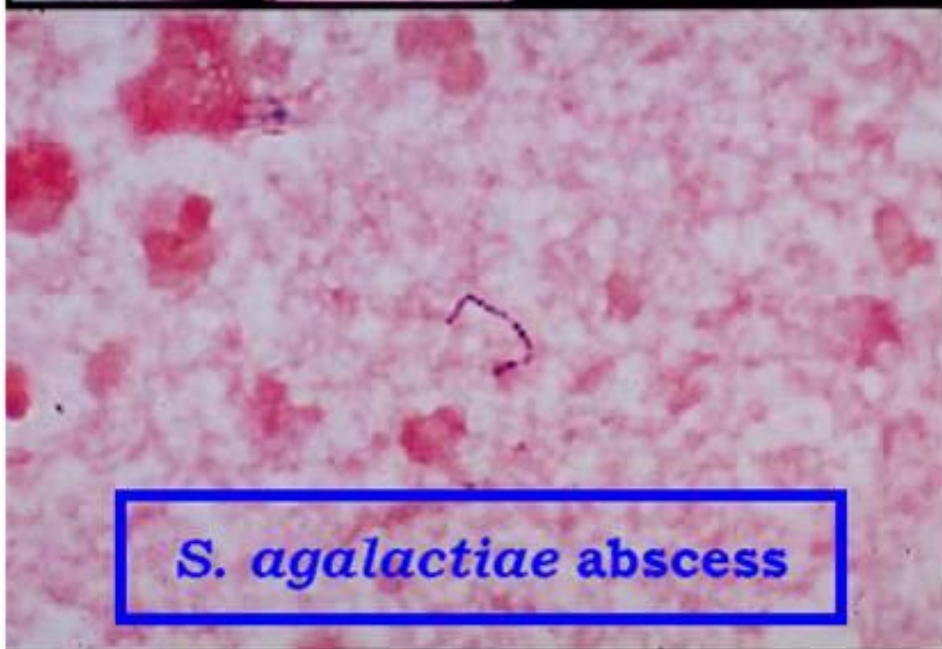


- 89 year-old male
- CHF, COPD, hypertension
- Pneumonia, septic shock (4/1/02)

Community-acquired MRSA %?



Sputum culture: MRSA



*S. agalactiae* abscess



tenacious, yellowish  
- green

no foul - smelling

Rivalta test (+)

Protein 6.5 g/dl

Glucose 9 mg/dl

Amylase 26 su

LDH 14476 lu/l

Triglyceride 1408 mg/dl

Cholesterol 1320 mg/dl

# Aerobic, Gram-Negative Bacilli

- Enterobacteriaceae

Citrobacter species

Enterobacter  
species

Escherichia species

Klebsiella species

- Enterobacteriaceae

Morganella species

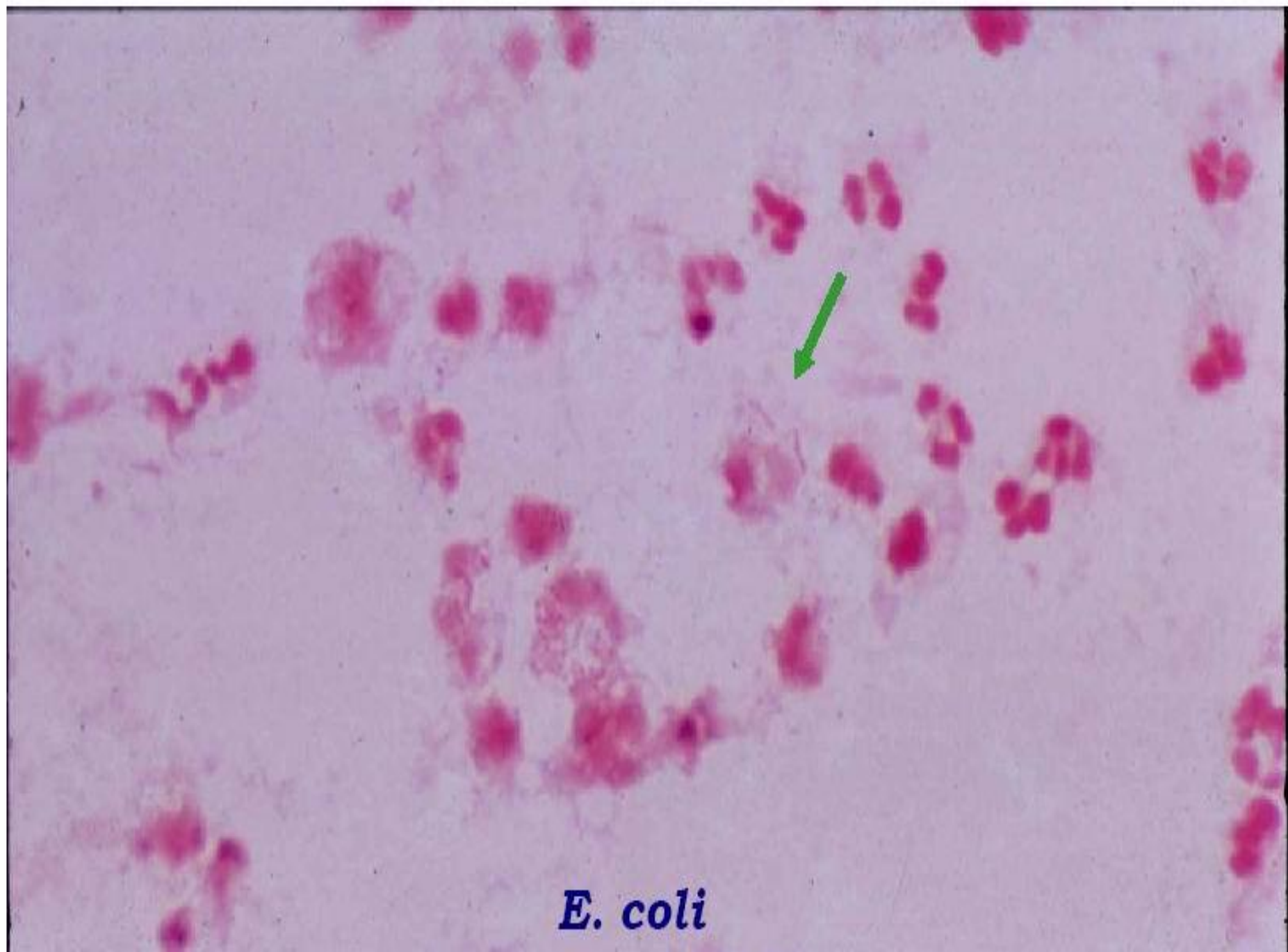
Proteus species

Salmonella species

Shigella species

Serratia species

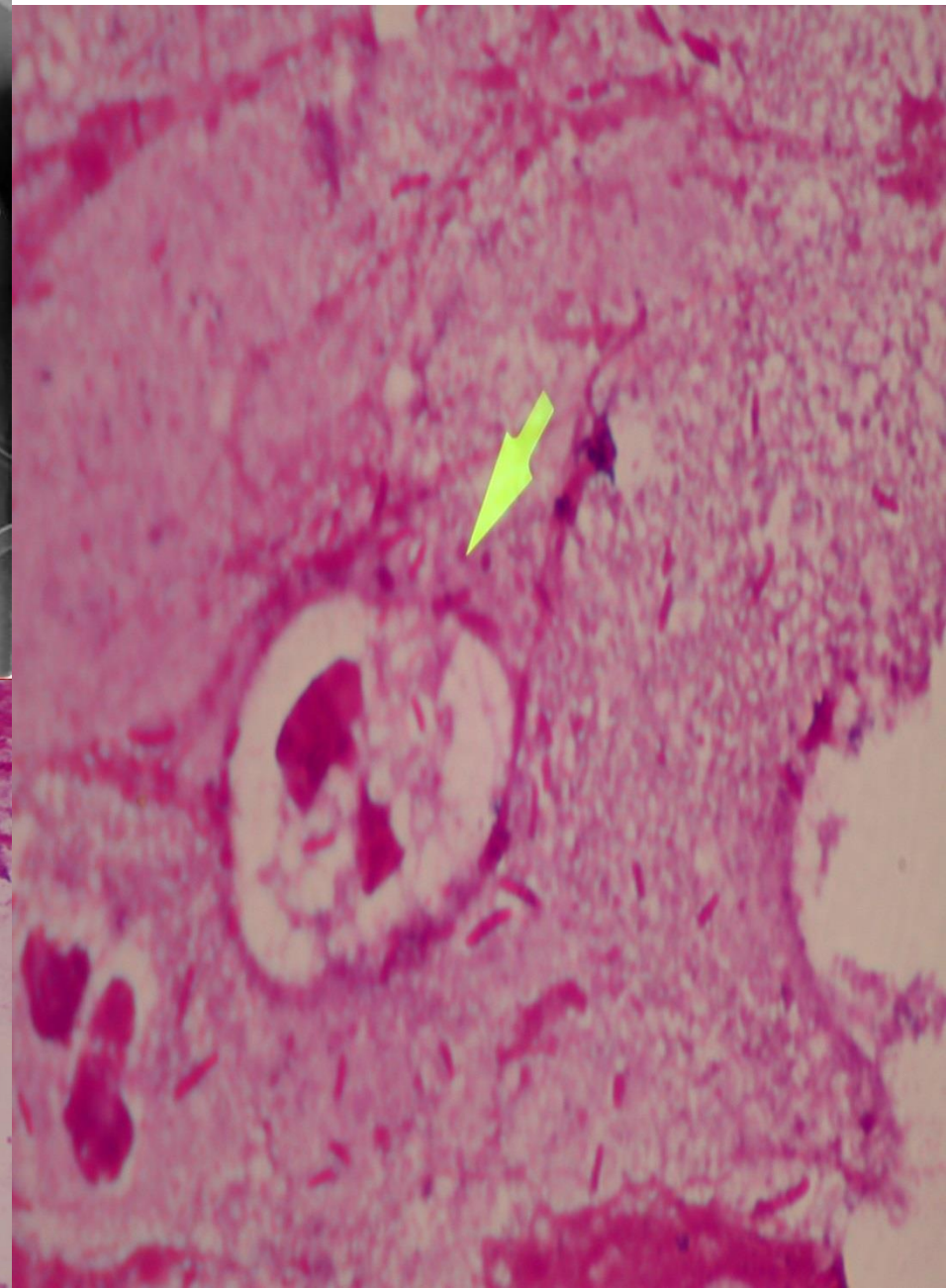
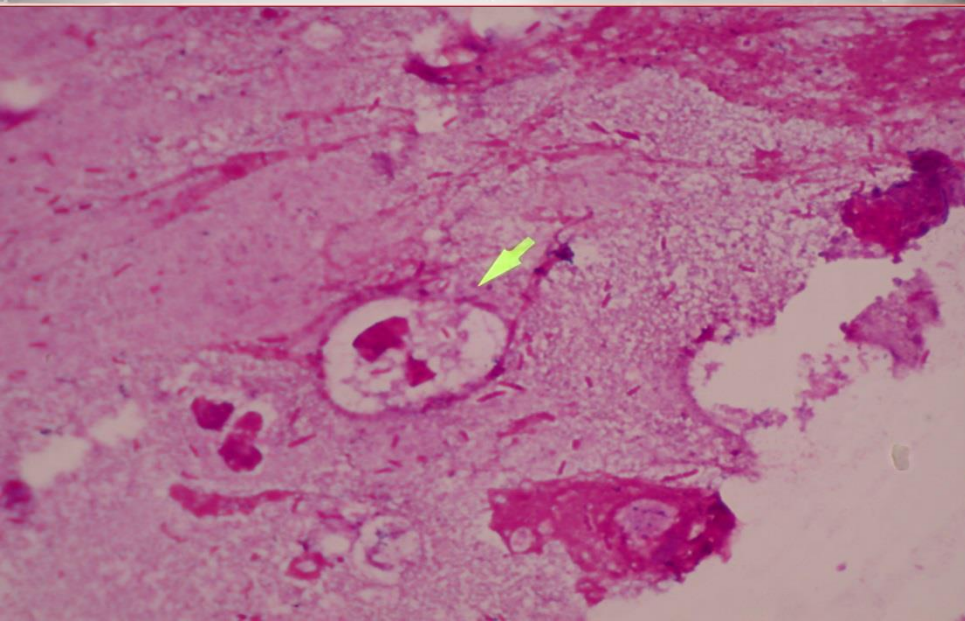
Yersinia species



*E. coli*



KP pneumonia



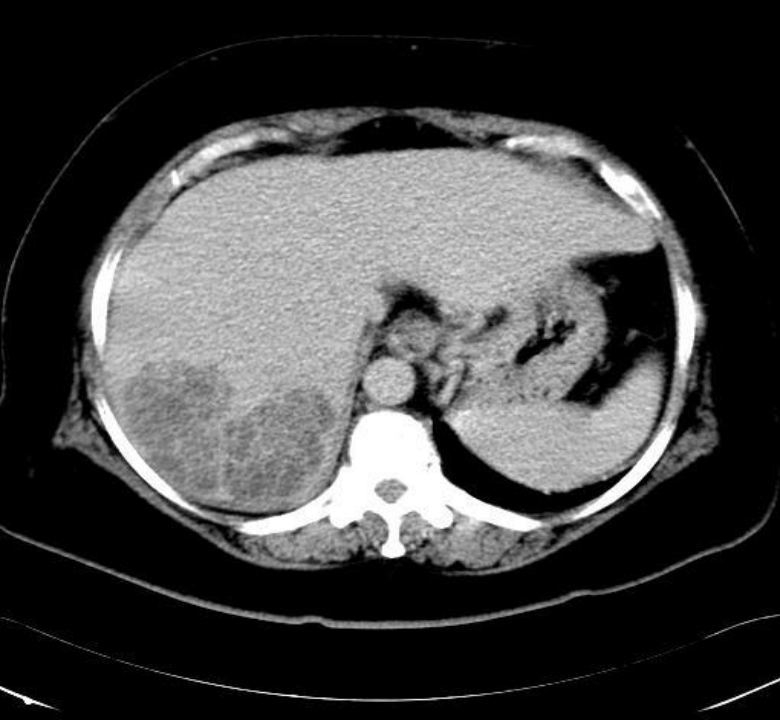
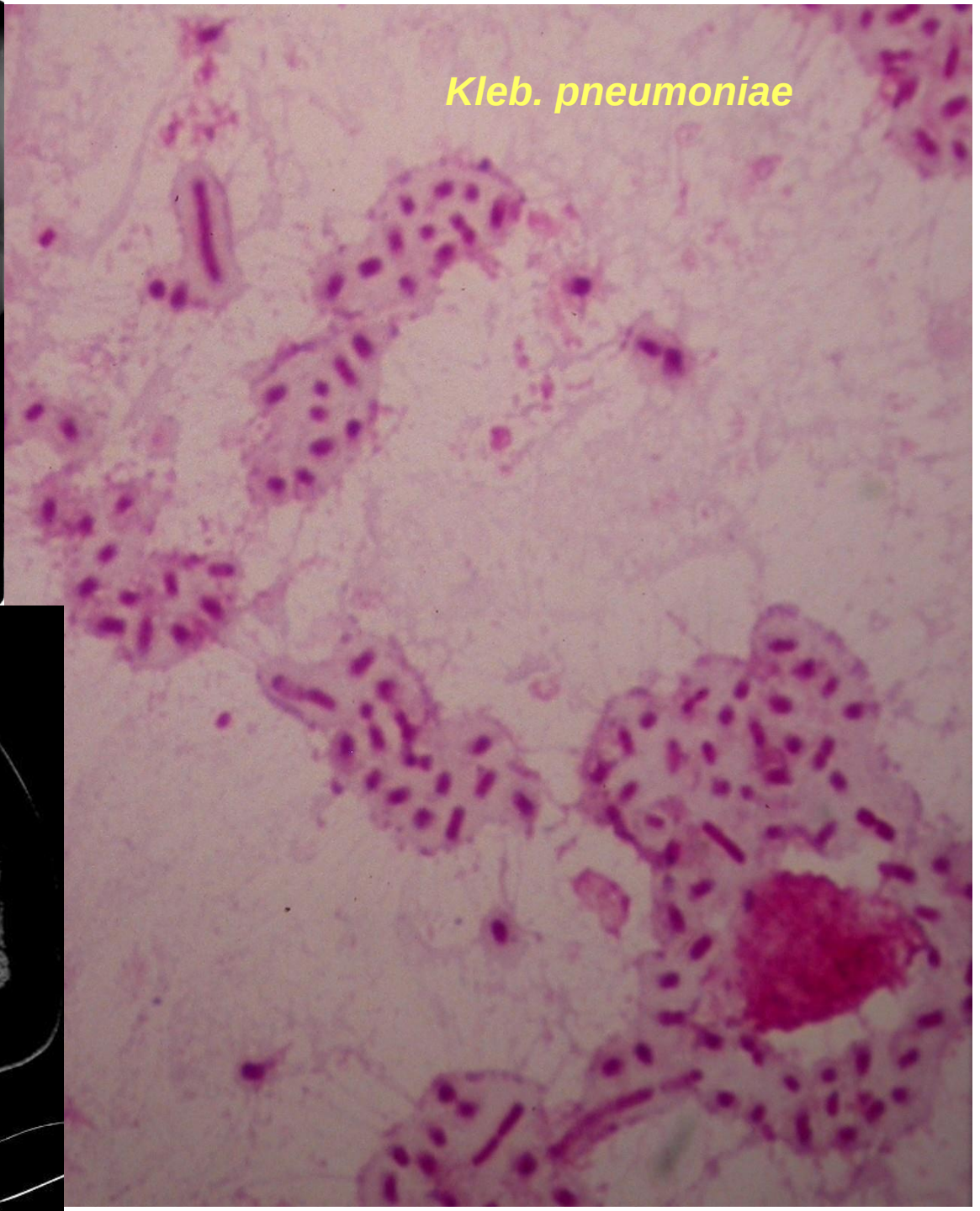
*E.coli*; DM, EMPHYMATOUS PYELONEPHRITIS.

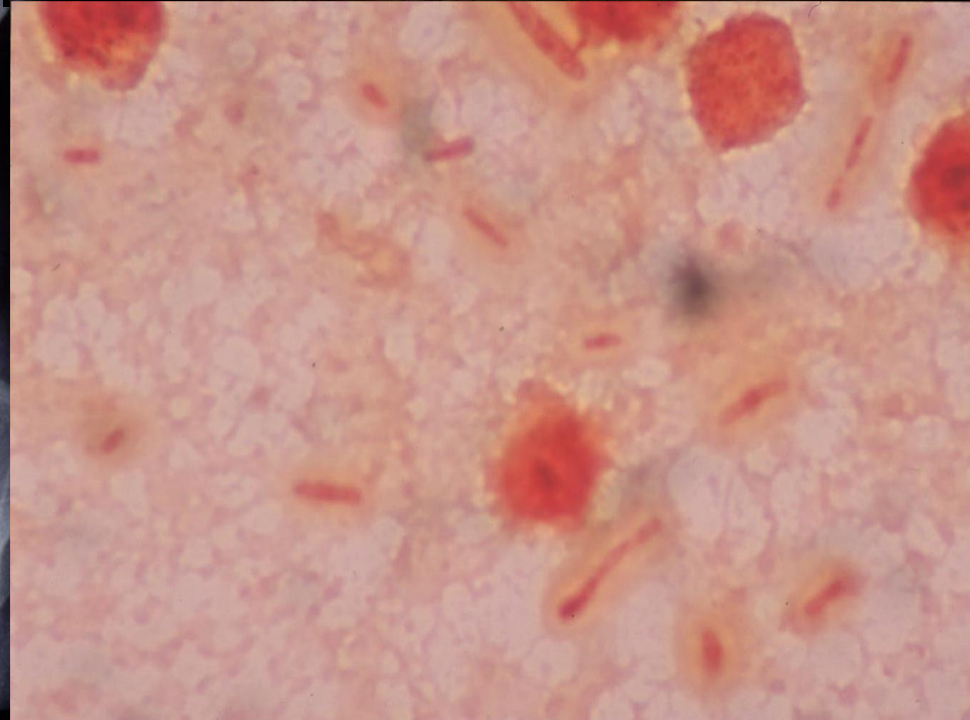




52 歲女性，糖尿病，肝硬化，膽道結石合併肝膿瘍

*E.coli*

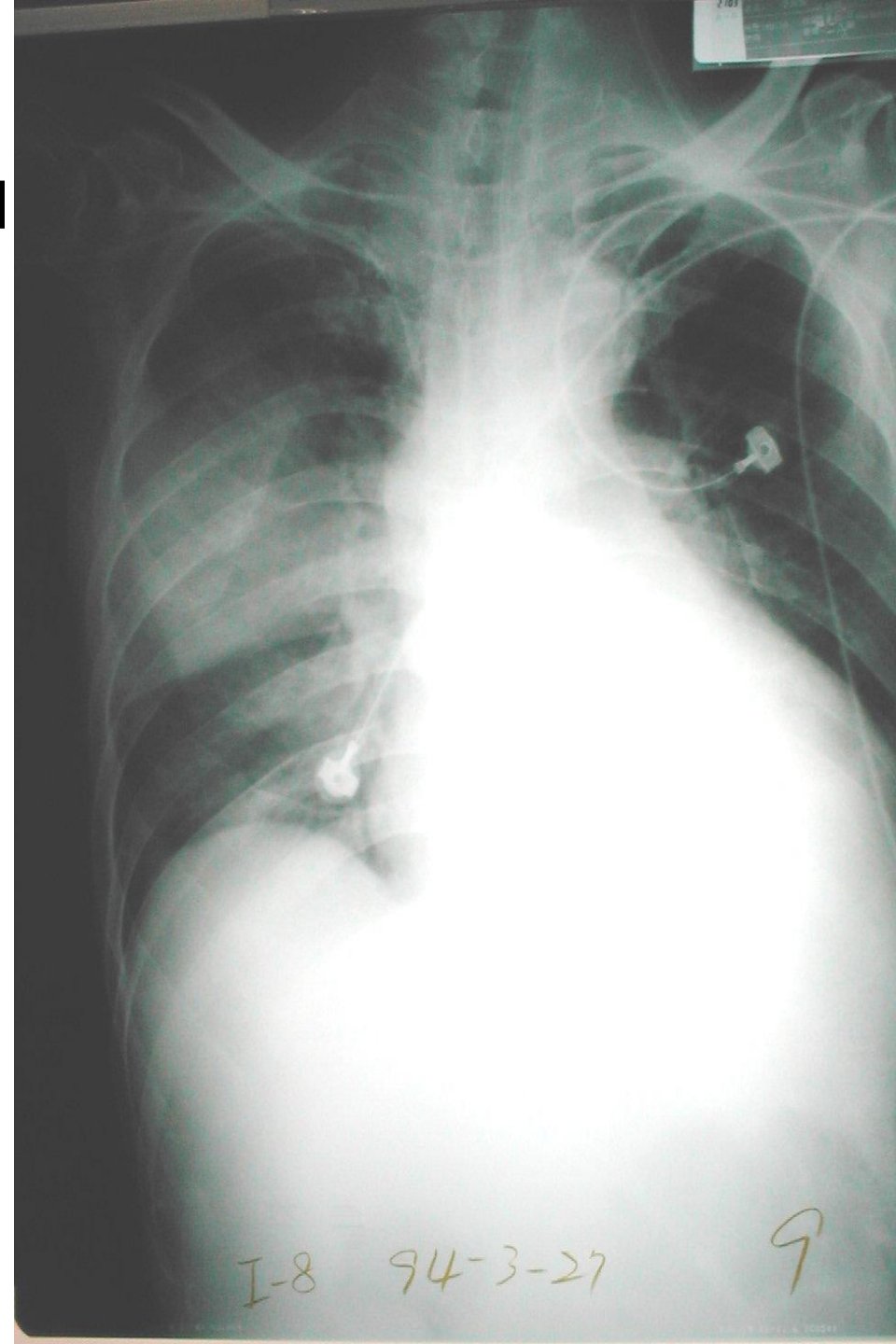
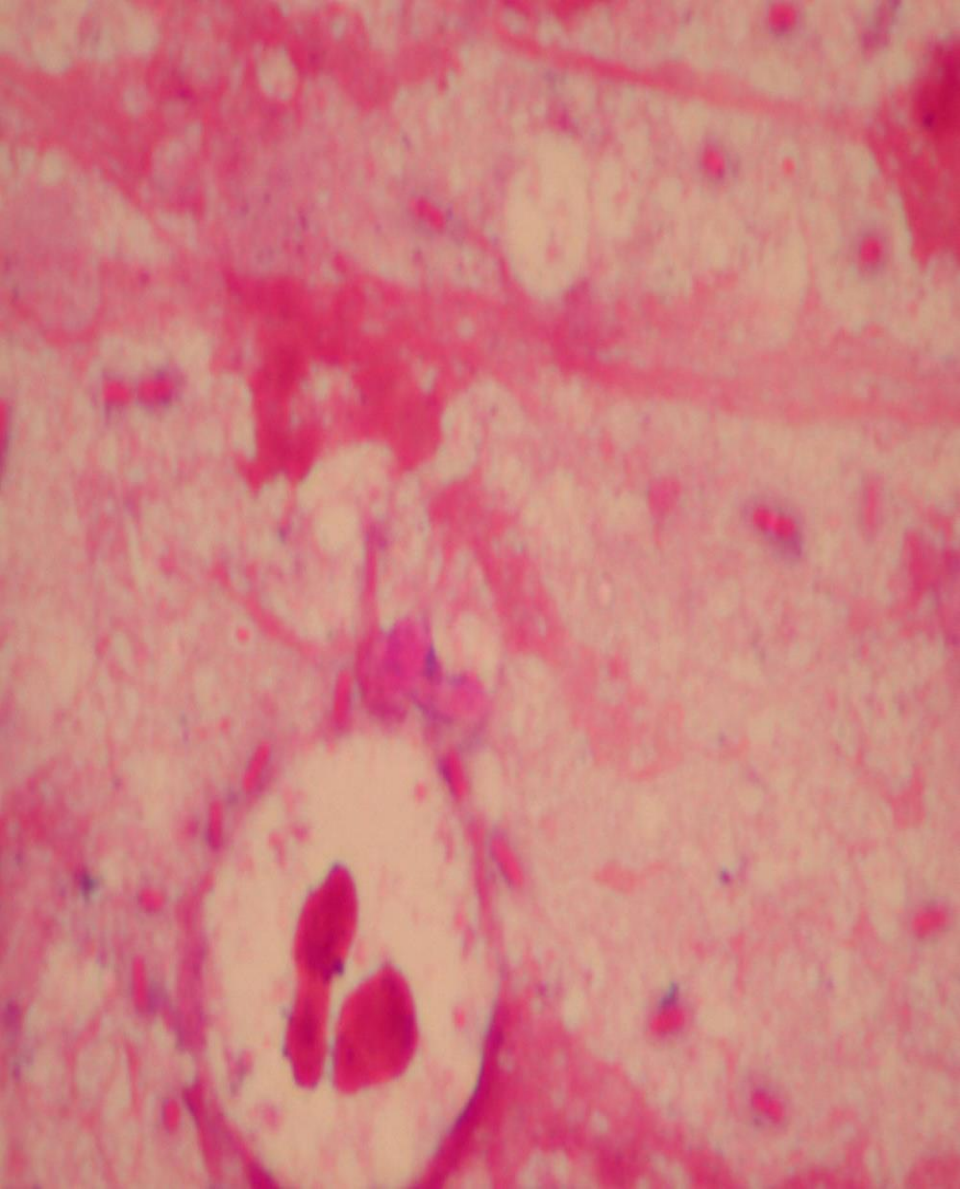




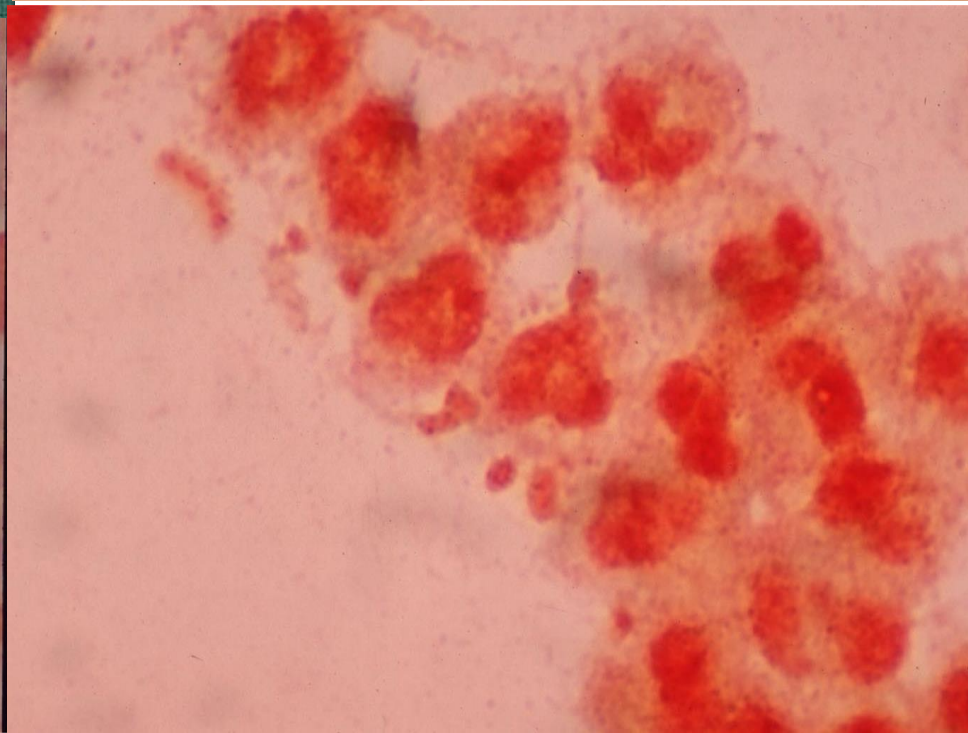
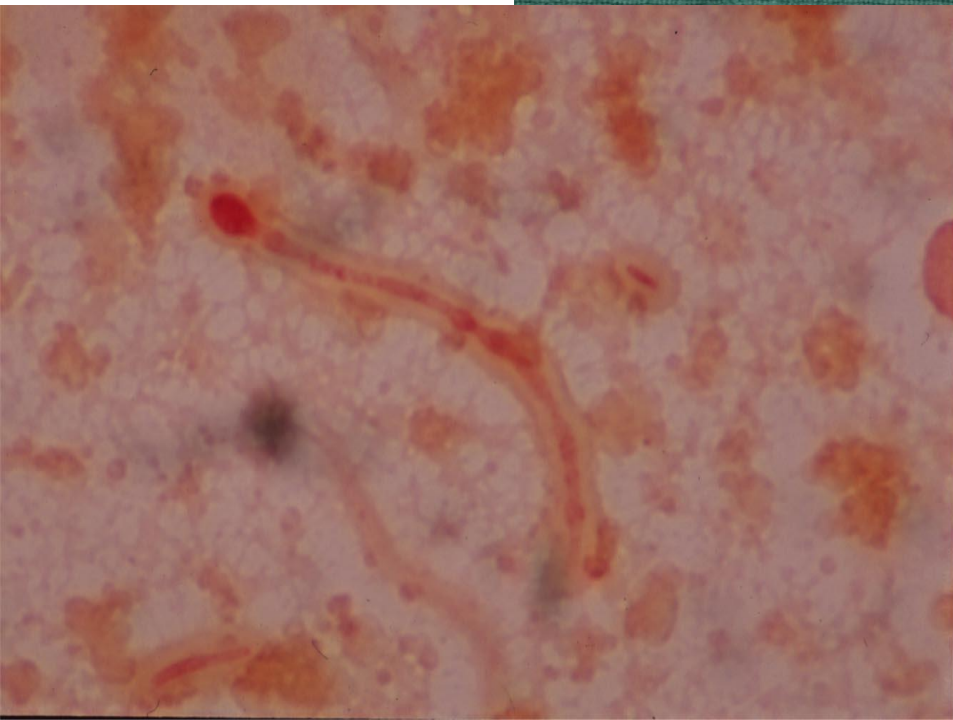
***Hypopeon:***  
***a unique manifestation of metastatic Kleb.***  
***pneumoniae infection in diabetes patients.***



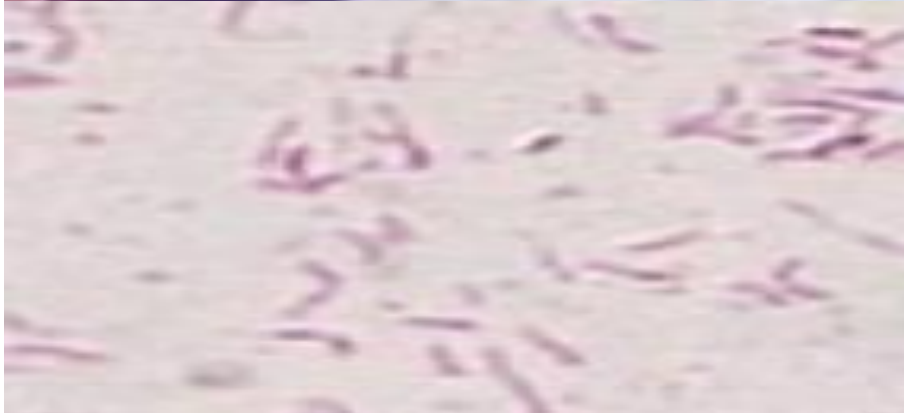
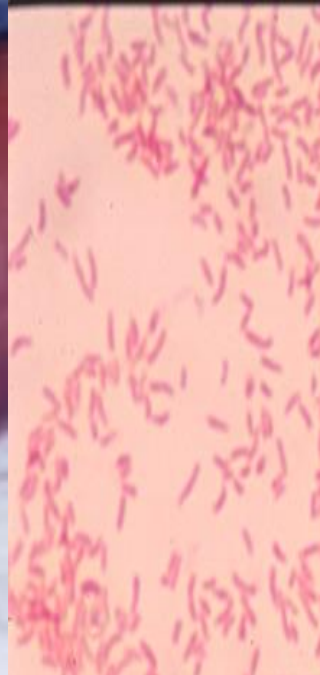
*Kleb. pneumoniae* is the pathogen of the severe community-acquired pneumonia, in patients of DM



***K. pneumoniae*  
meningitis**



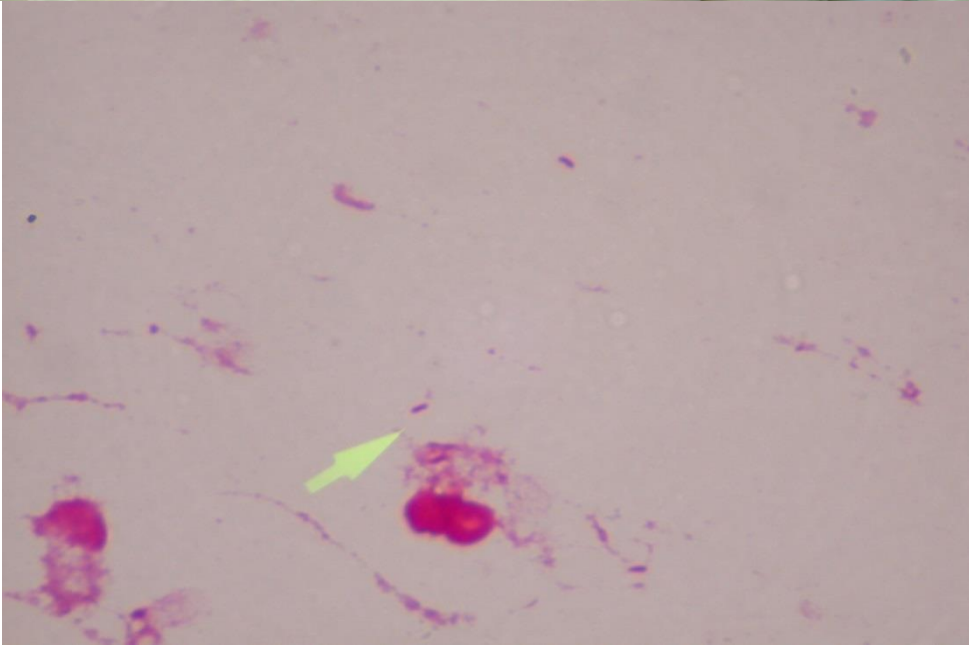
***Hemorrhagic bullae, cellulitis and fasciitis in  
cirrhotic patients who exposed to fish.***



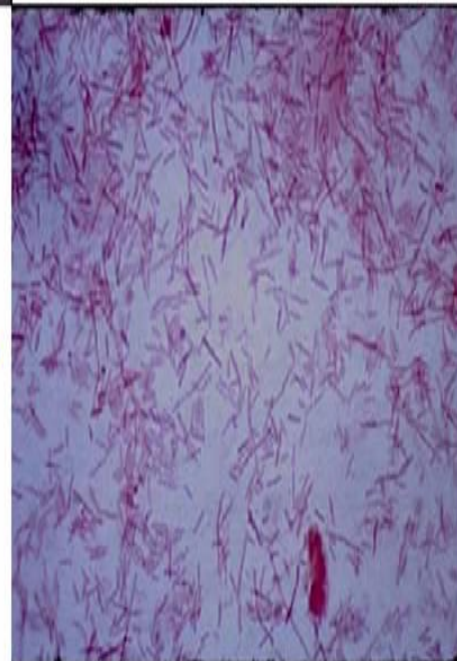
***V. vulnificus***  
**necrotizing fasciitis**



*A. hydrophila* bacteremia



Gram stain of pus



# Aerobic, Gram-Negative Bacilli

- Miscellaneous genera

*Acinetobacter* species

*Bordetella* species

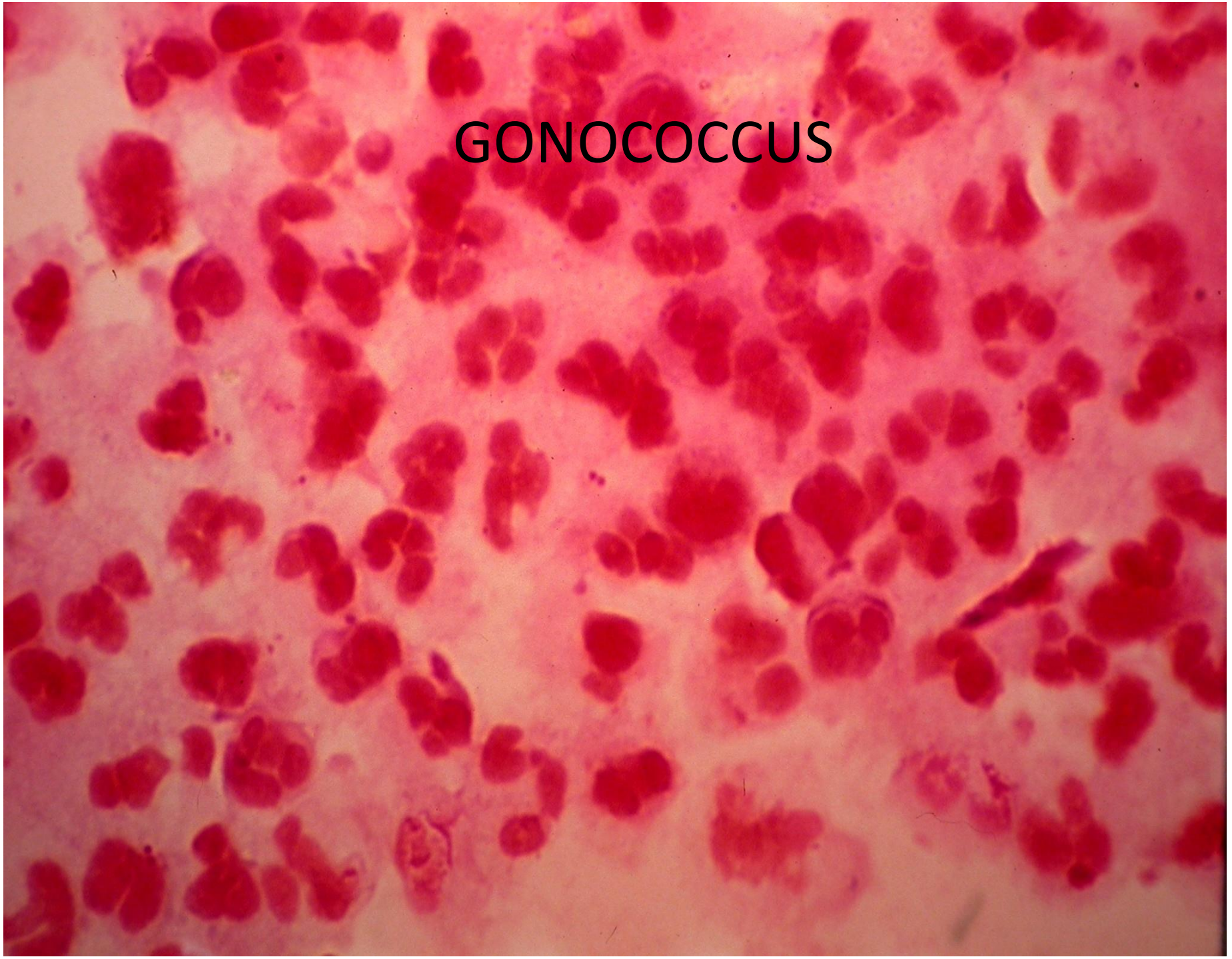
*Brucellae*

*Burkholderia* species

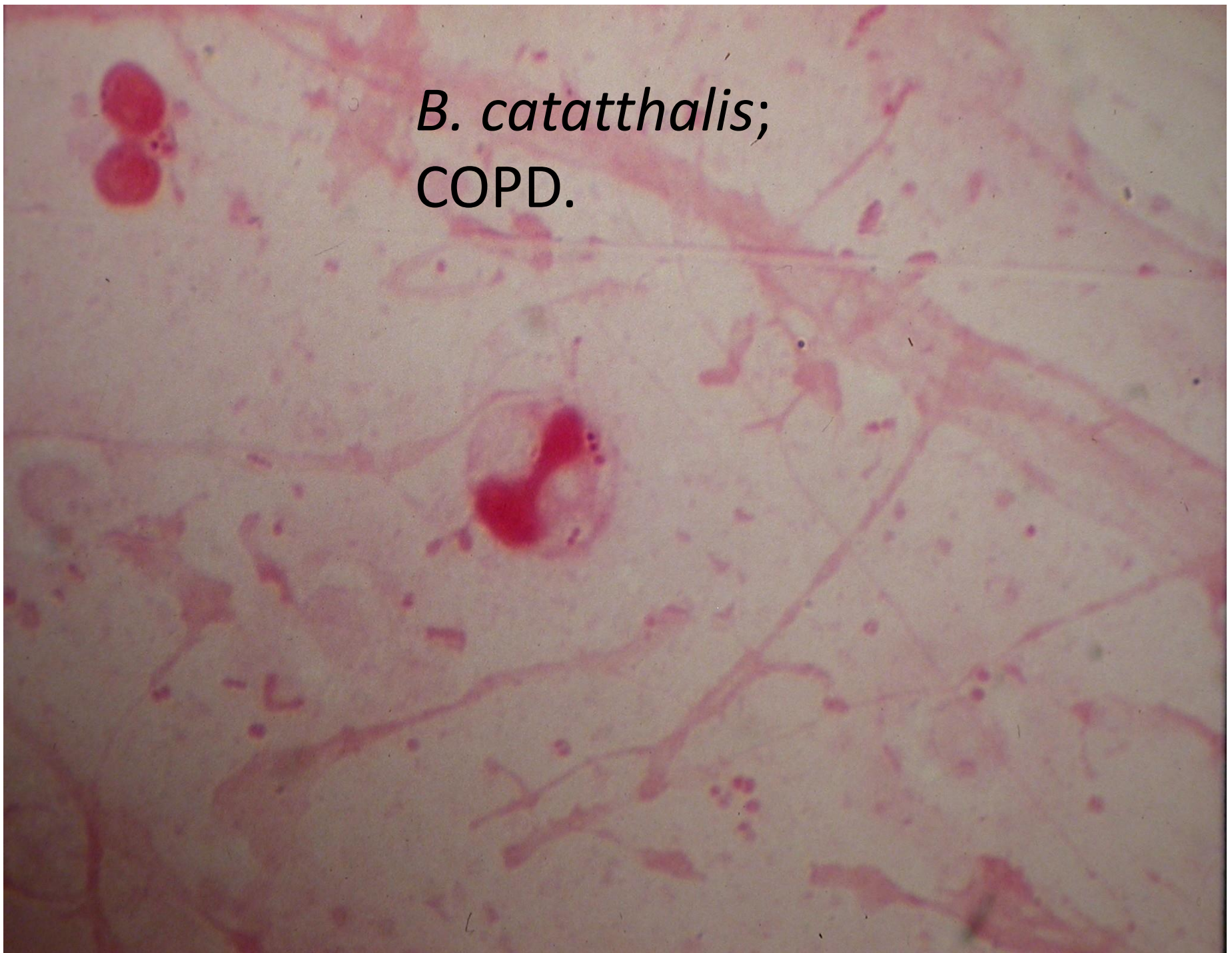
*Corynebacterium* species

*Cardiobacterium* species

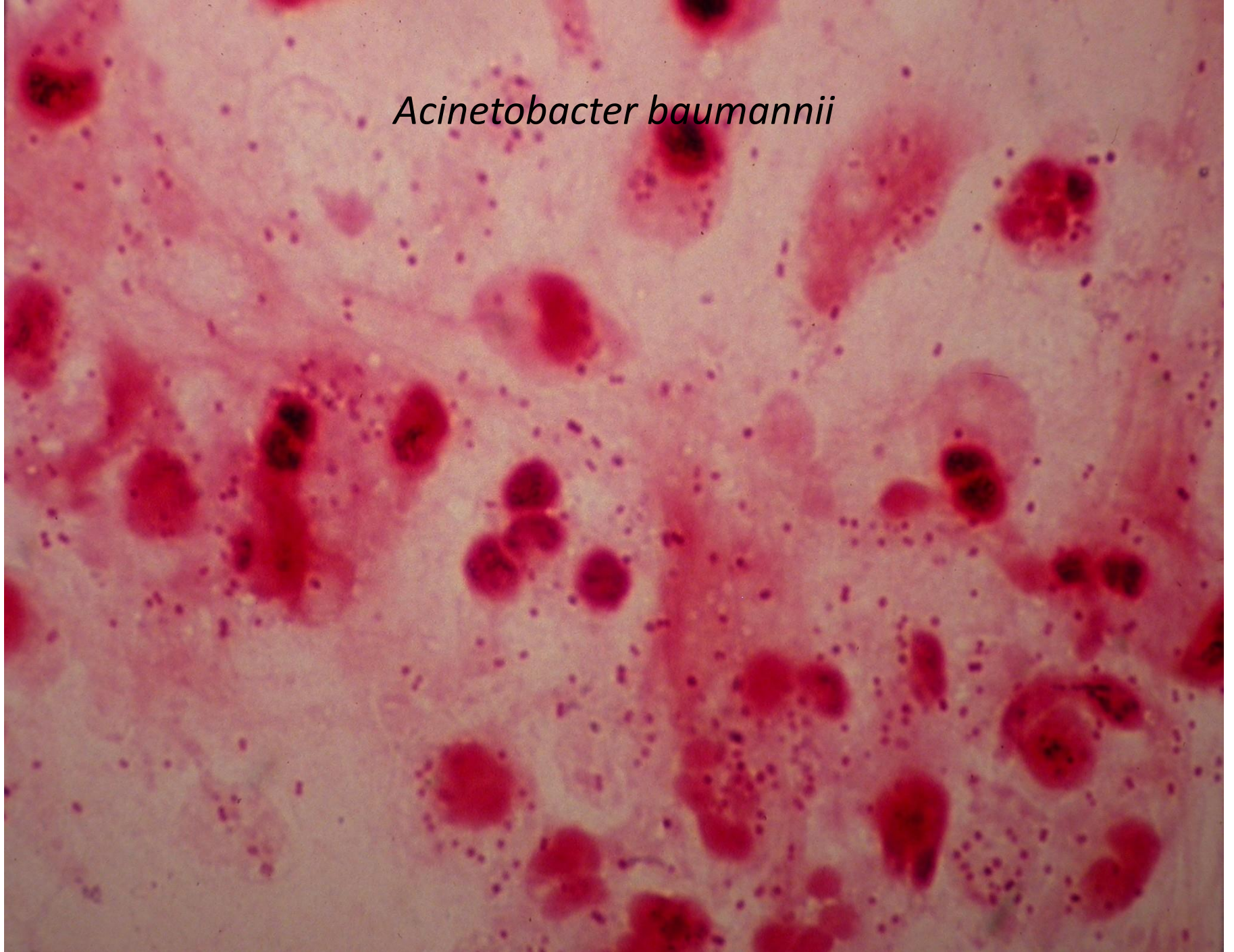
GONOCOCCUS



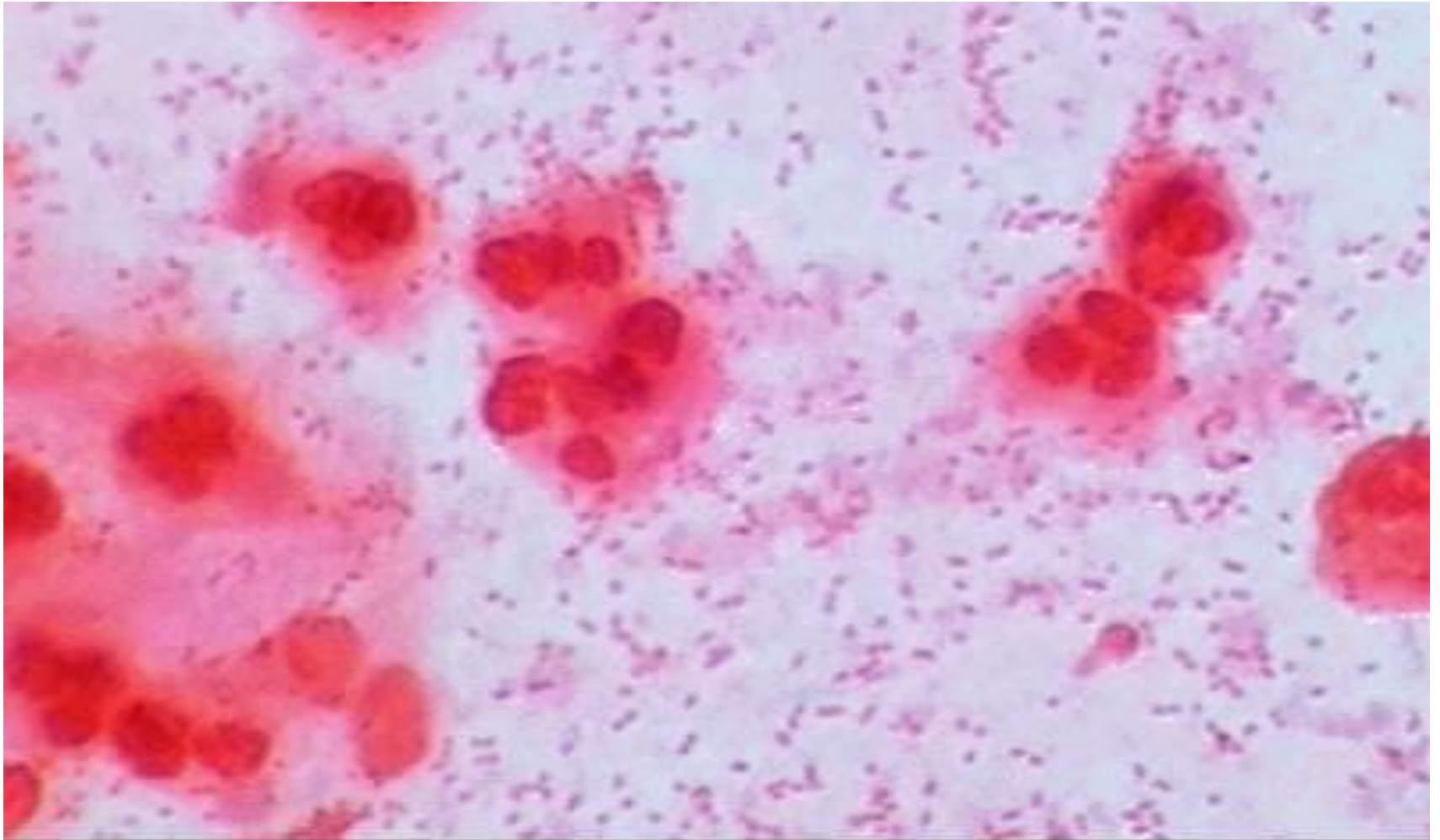
*B. catatthalis*;  
COPD.



*Acinetobacter baumannii*



***“Haemophilus influenzae”* is a common cause of COPD with secondary infection.**



# Aerobic, Gram-Negative Bacilli

## – Miscellaneous genera

Eikenells species

Francisells species

Helicobacter species

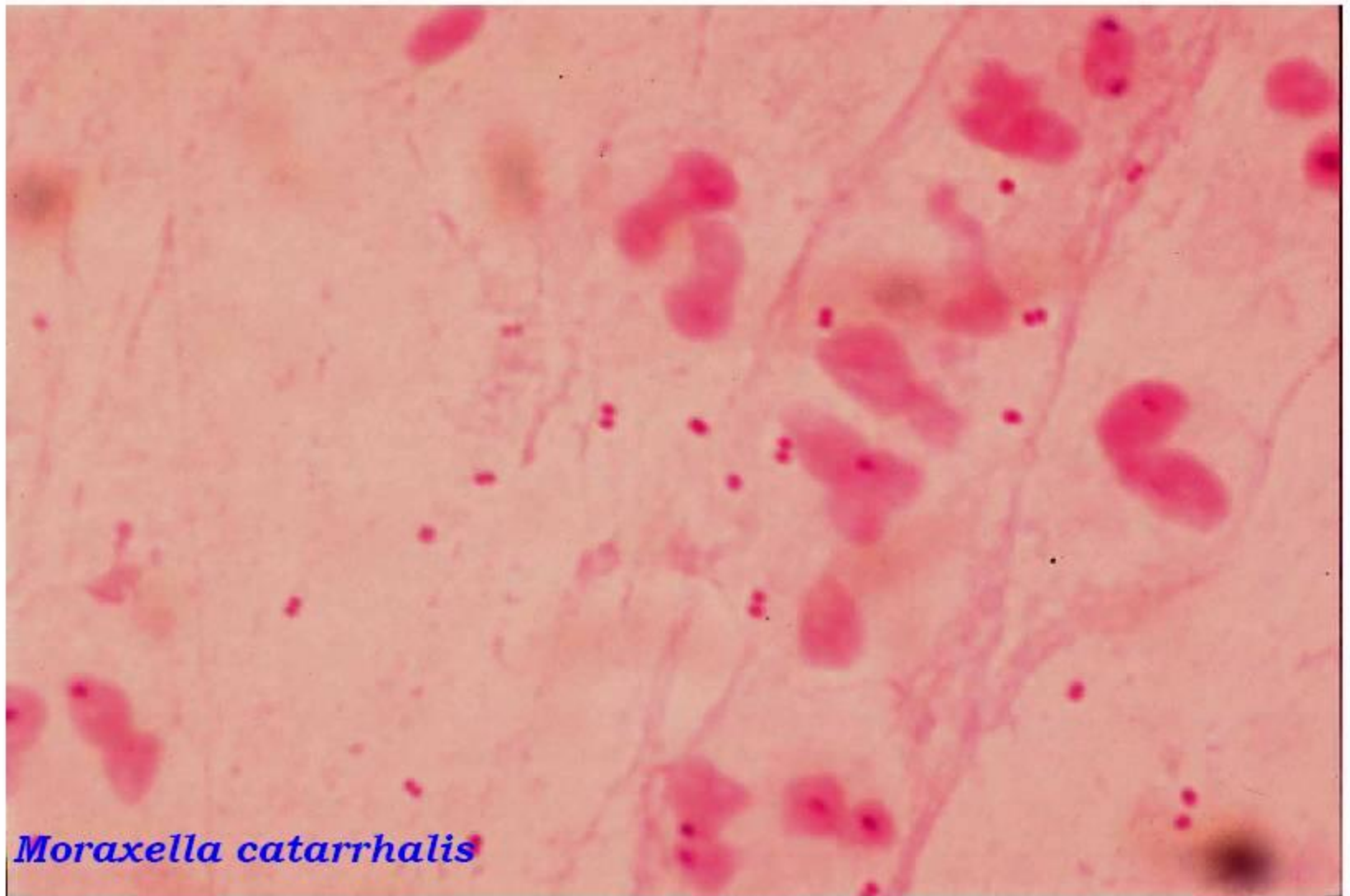
Kingells species

**Pseudomonas species**

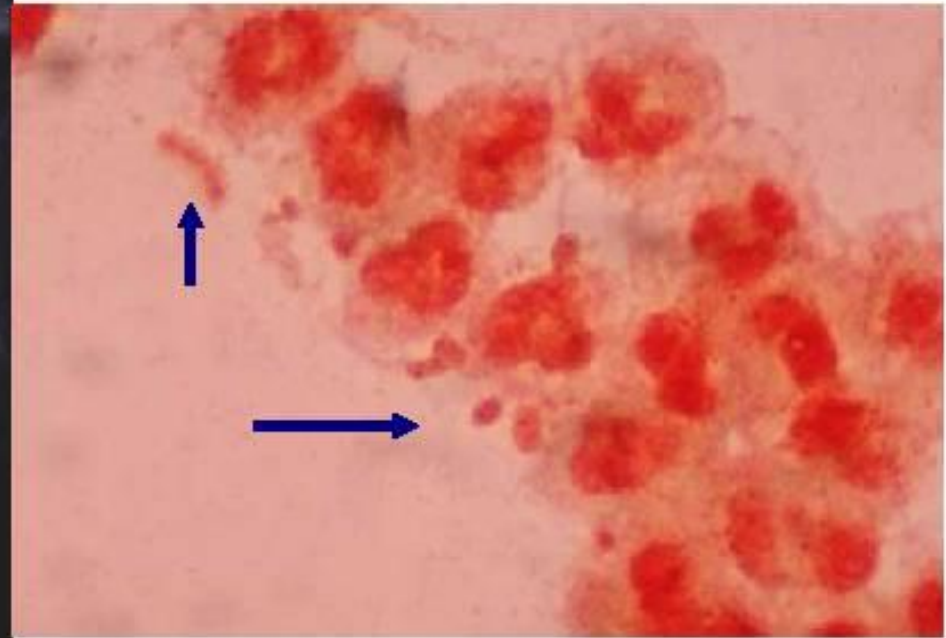
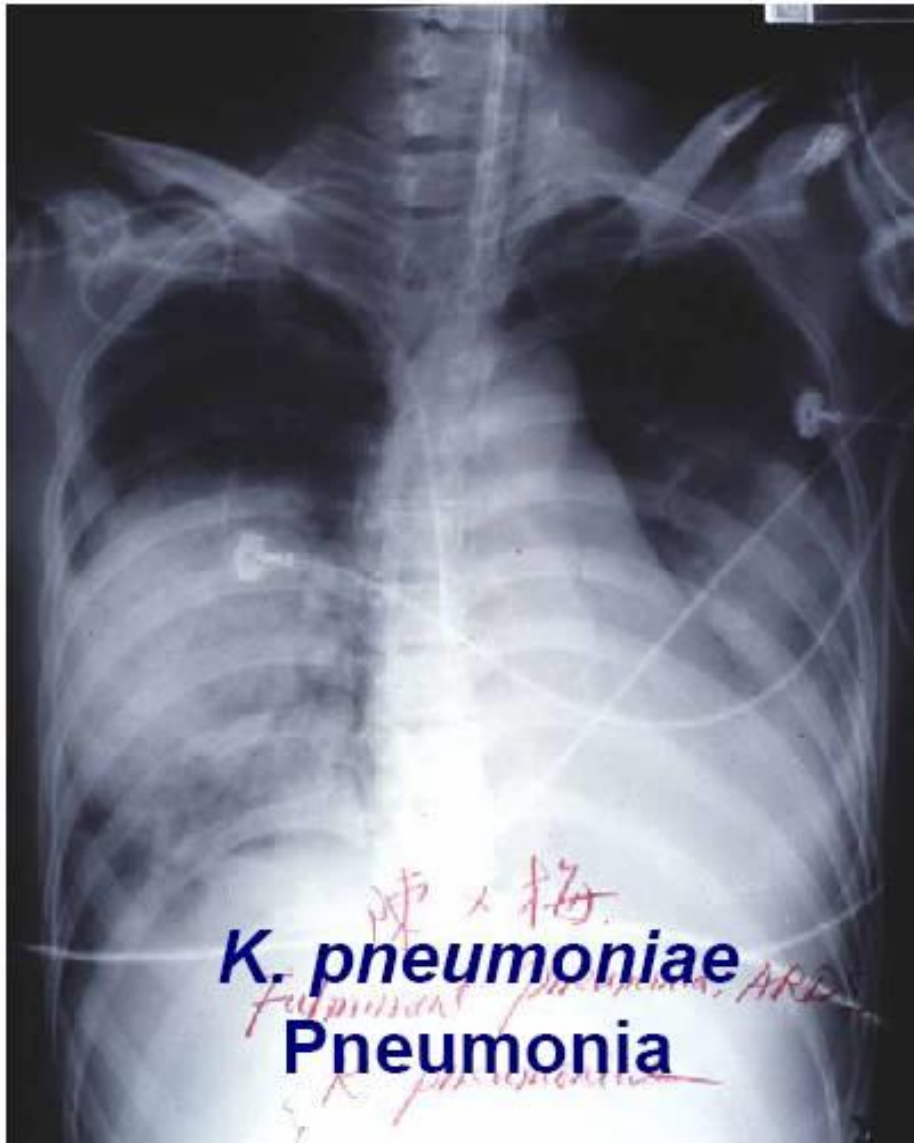
**Stenotrophomonas species**

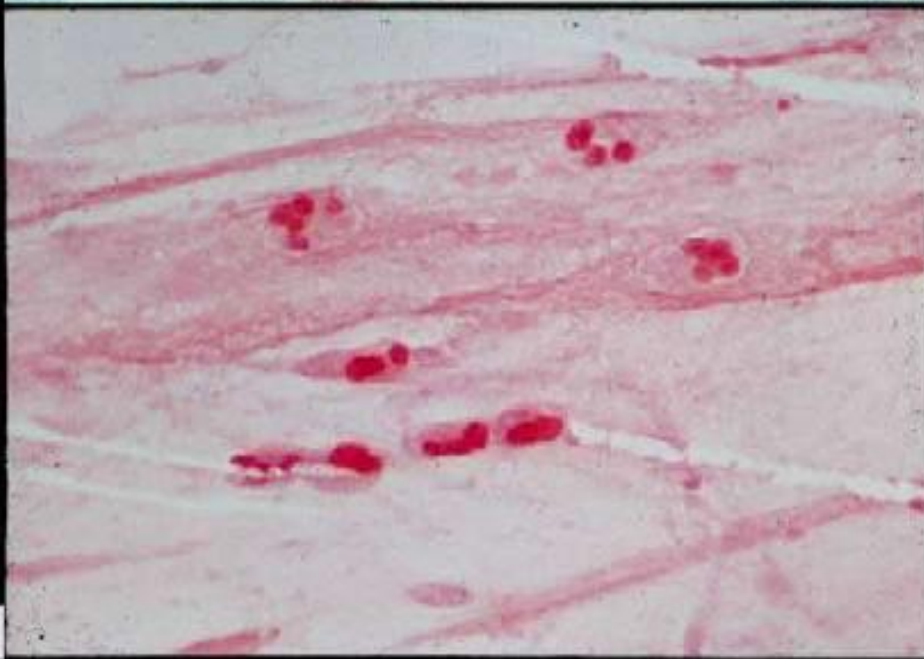
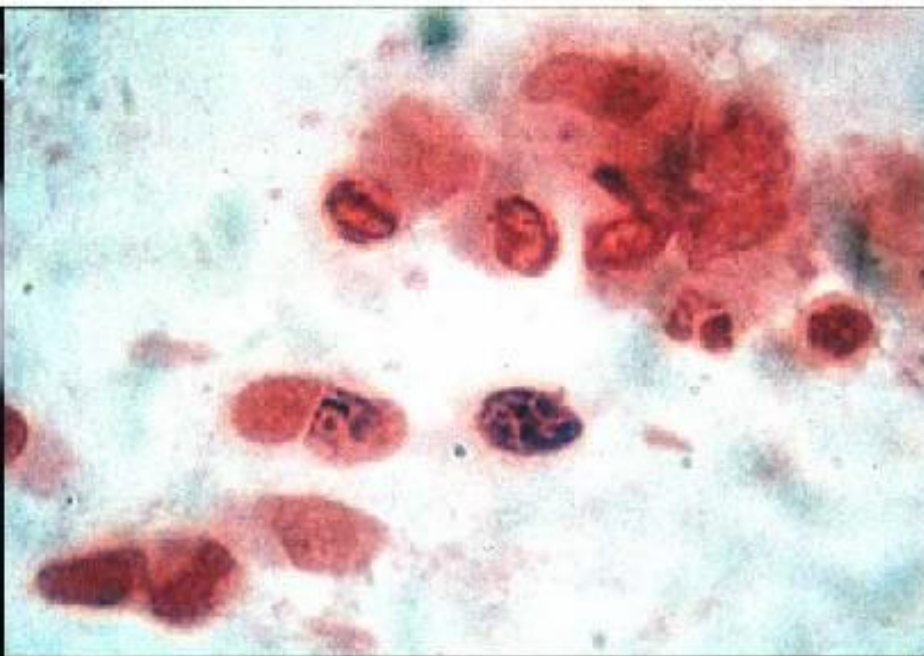
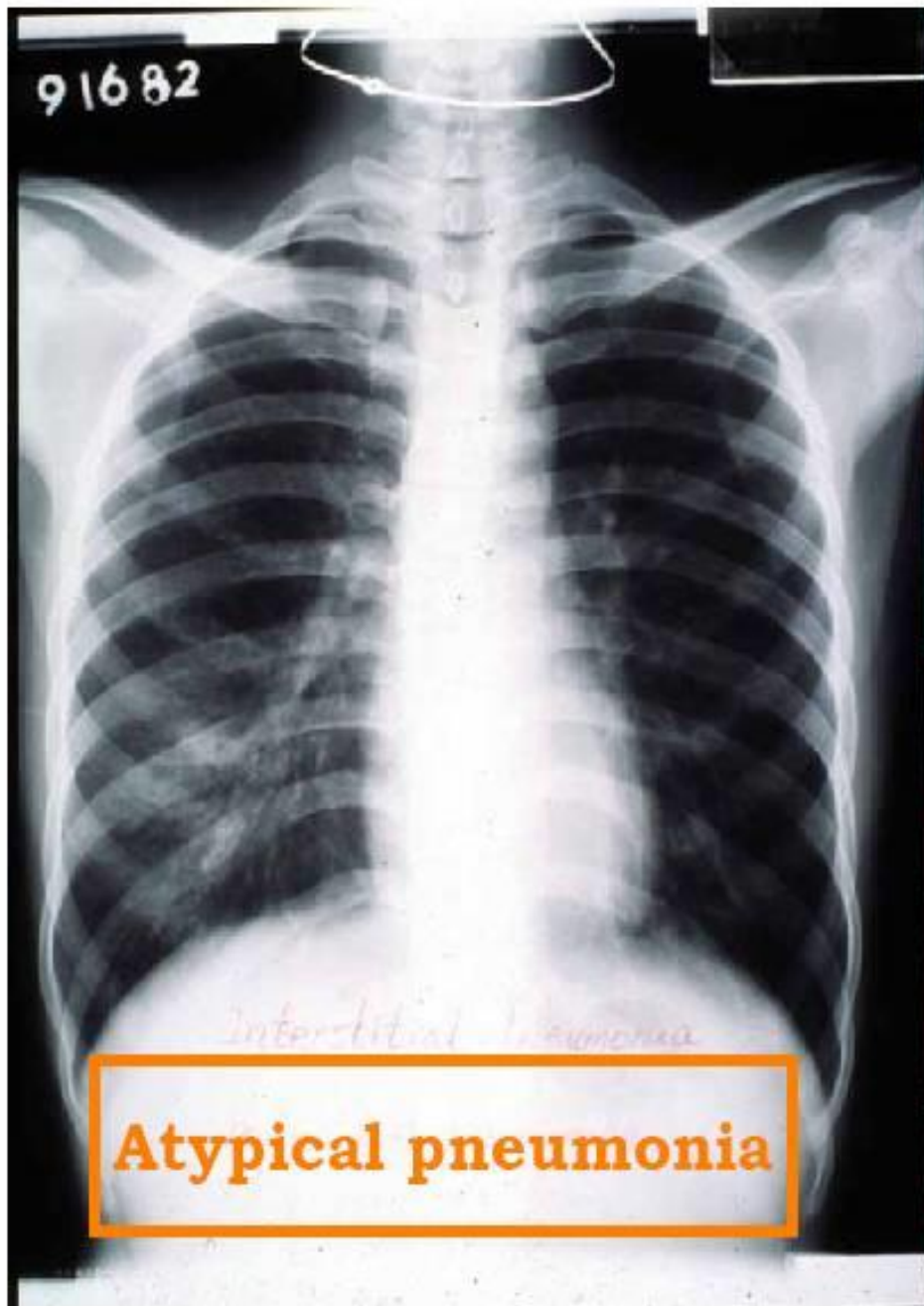
Spirillum species

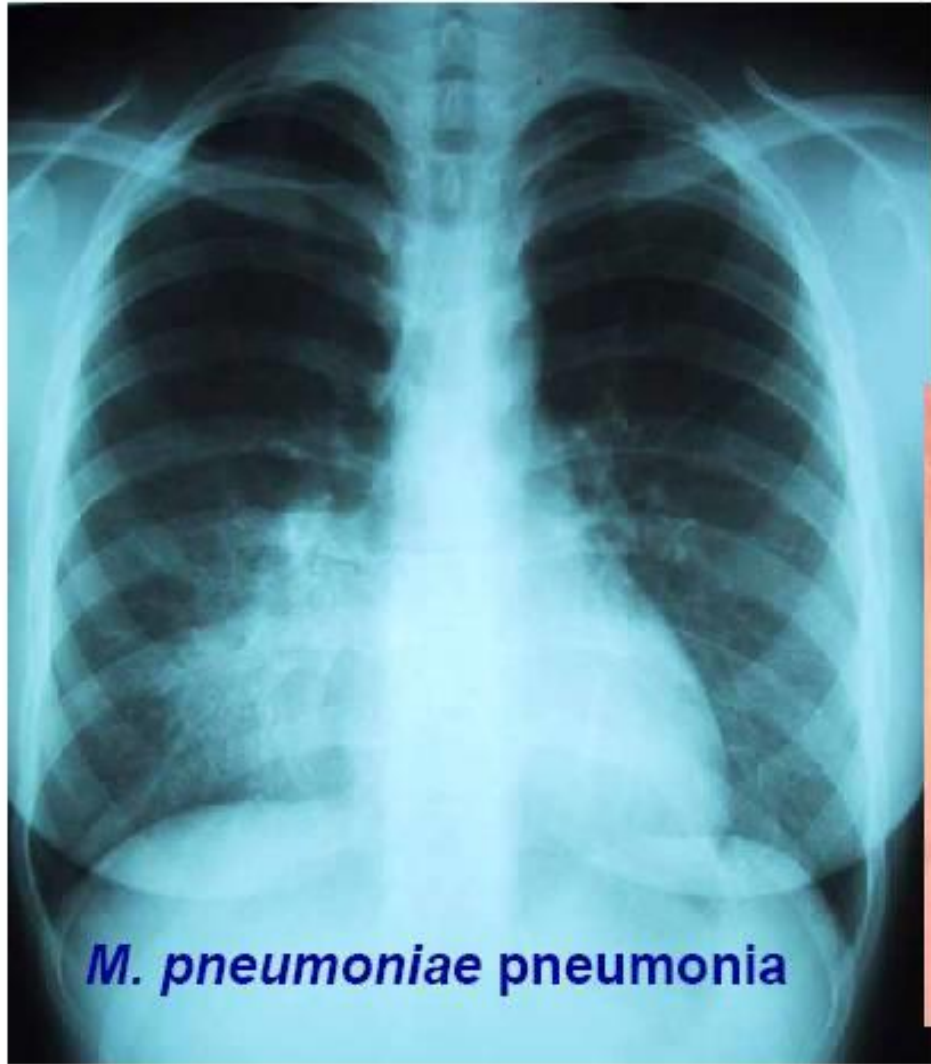
Streptobacillus species



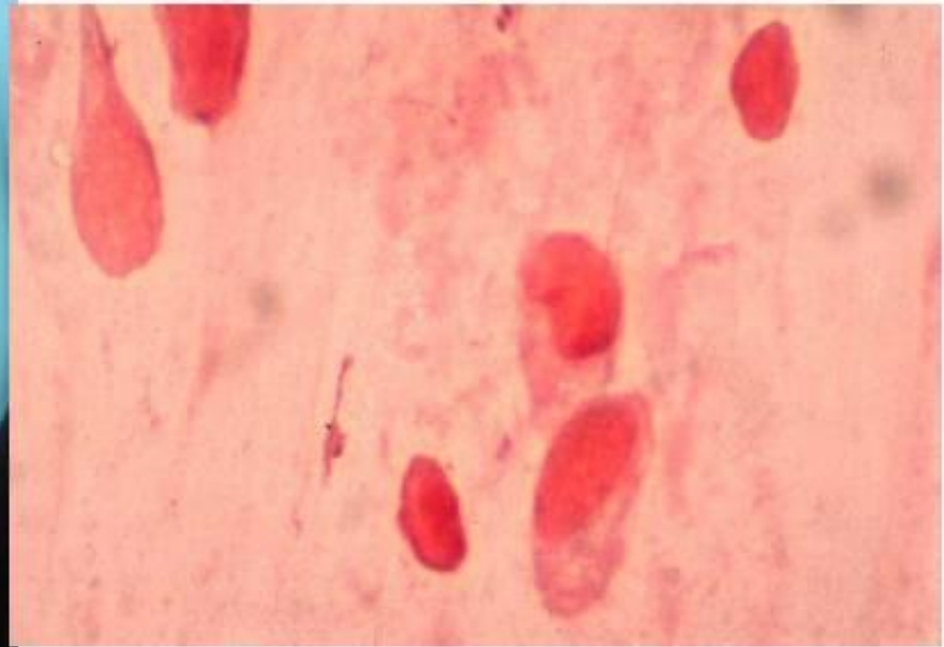
*Moraxella catarrhalis*







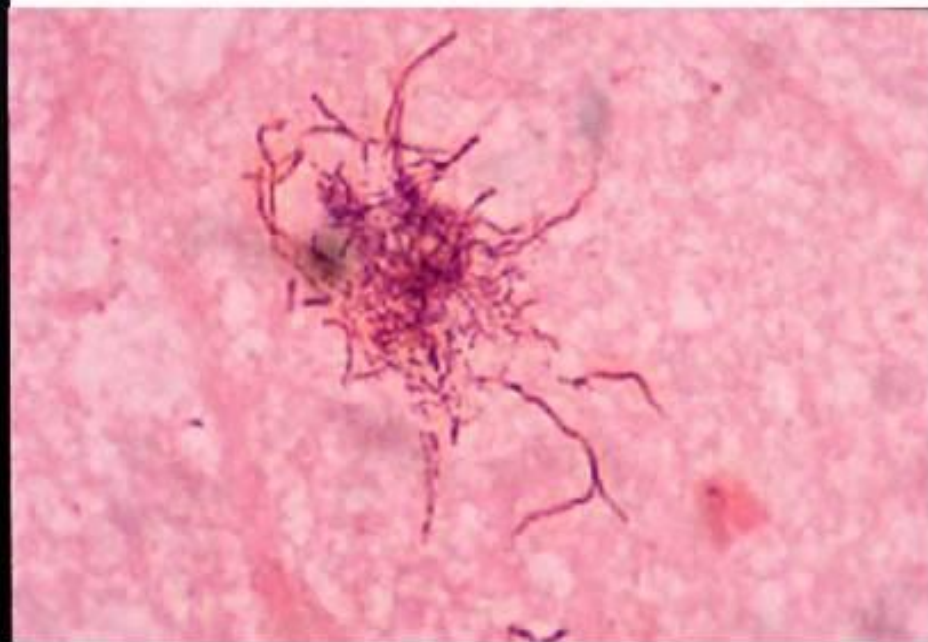
**20y/F**  
**Fever and cough for 5 days**

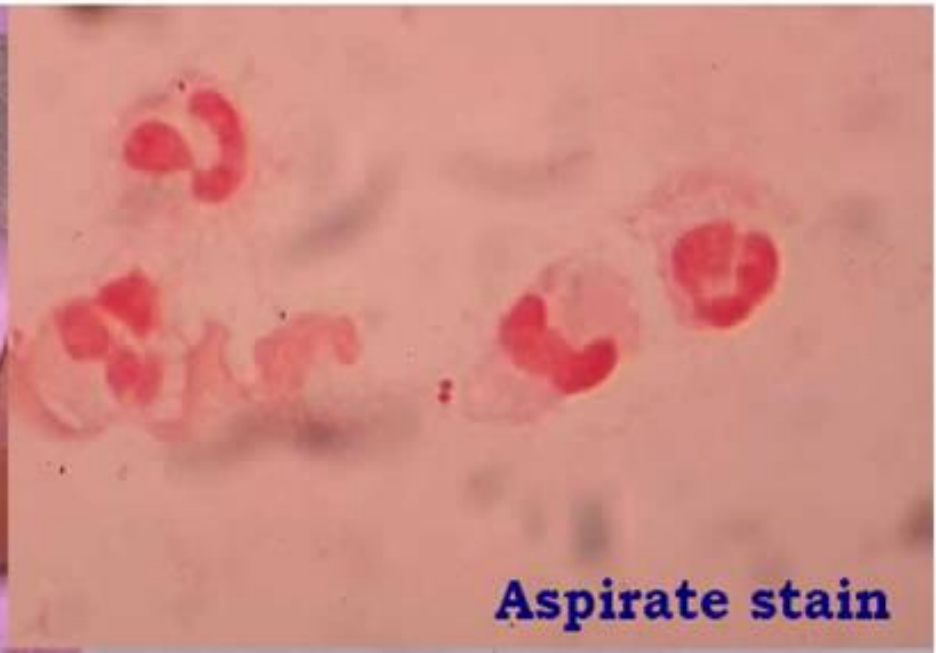


***M. pneumoniae* pneumonia**

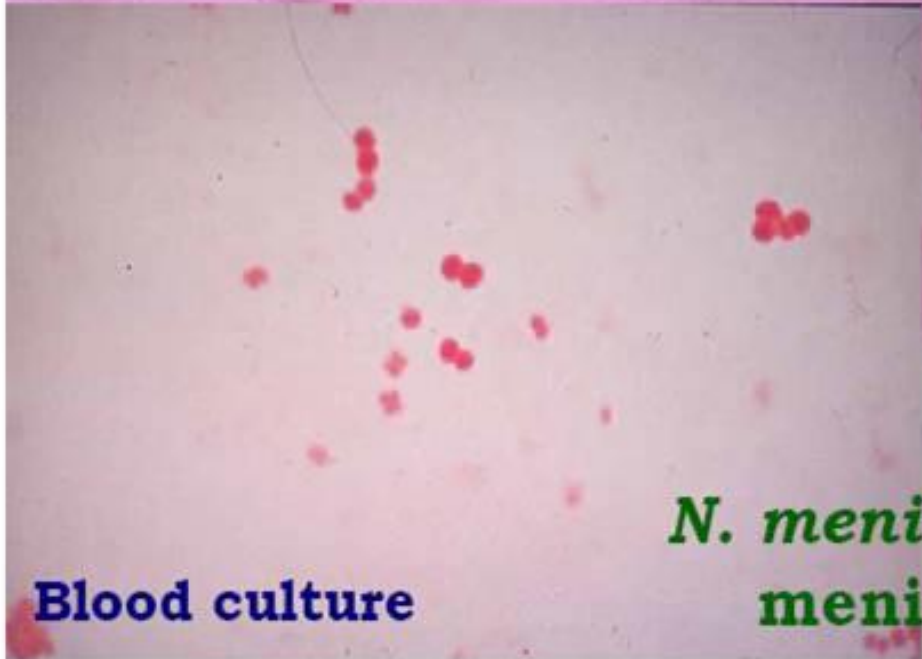


***Actinomyces israelii*  
empyema**



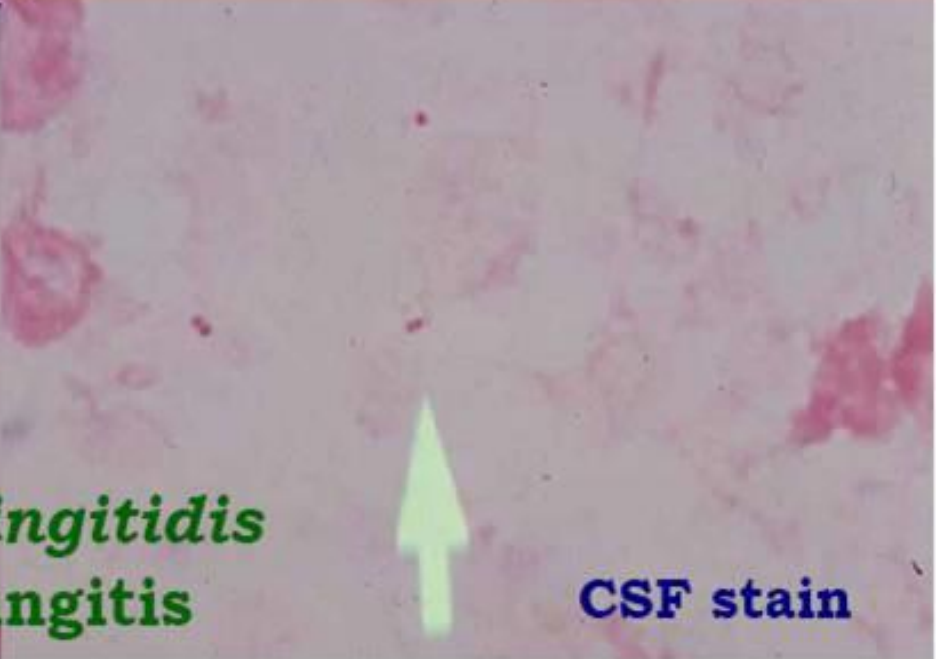


**Aspirate stain**



**Blood culture**

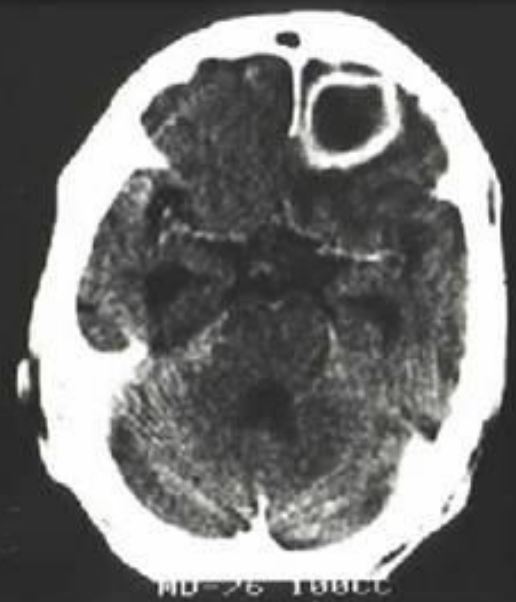
***N. meningitidis*  
meningitis**



**CSF stain**



18:29:34  
DU1:217  
SCAN 29



H/SP

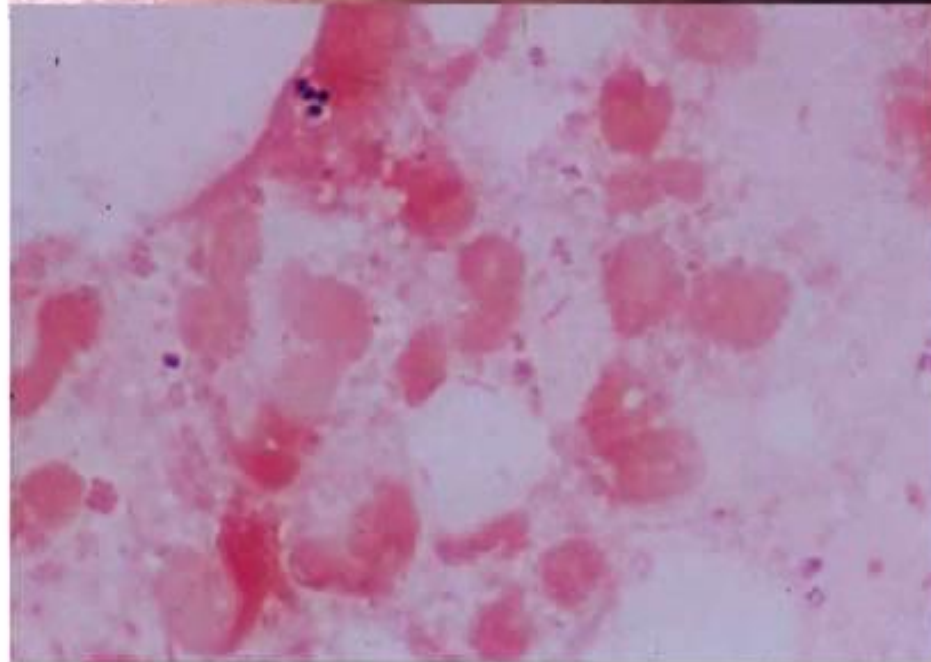
L  
E  
F  
T

5 CM

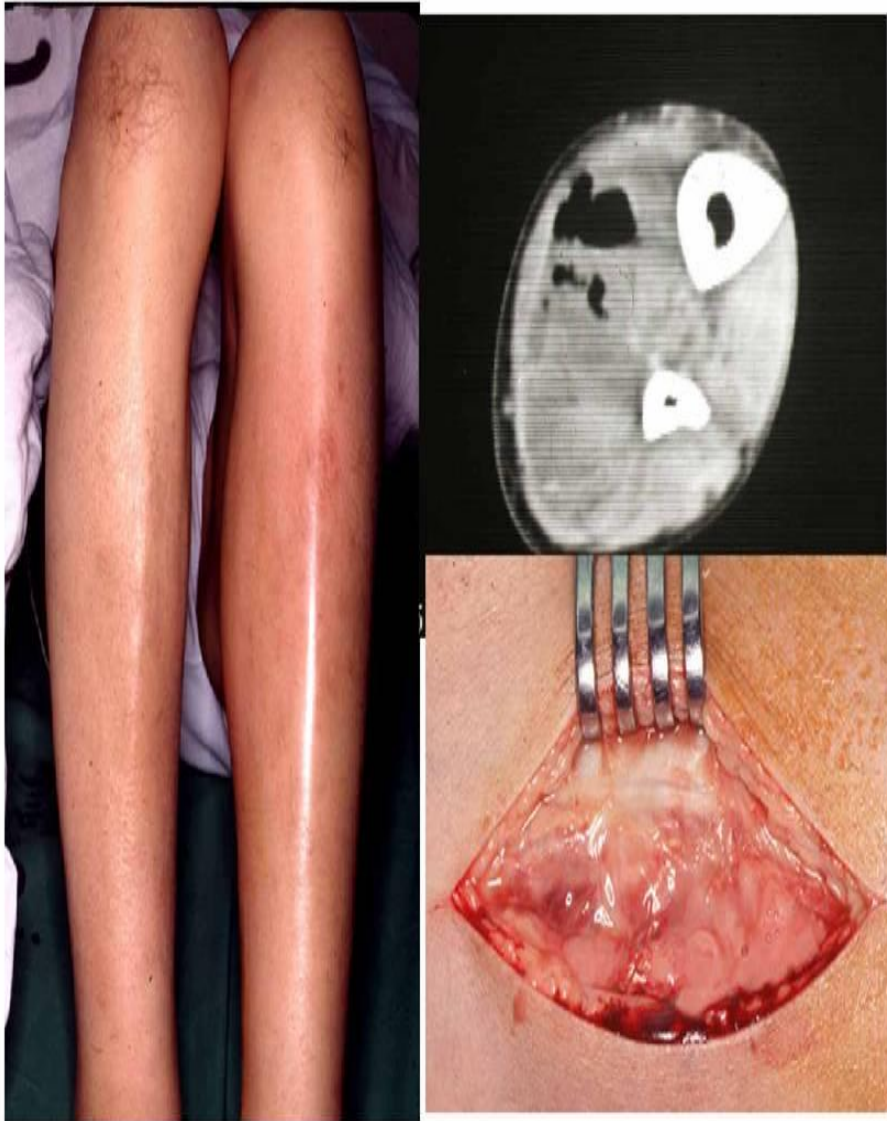
M 180  
C 48

TI 5  
KV 125  
AS 35  
SL 8  
GT -17  
TP -20

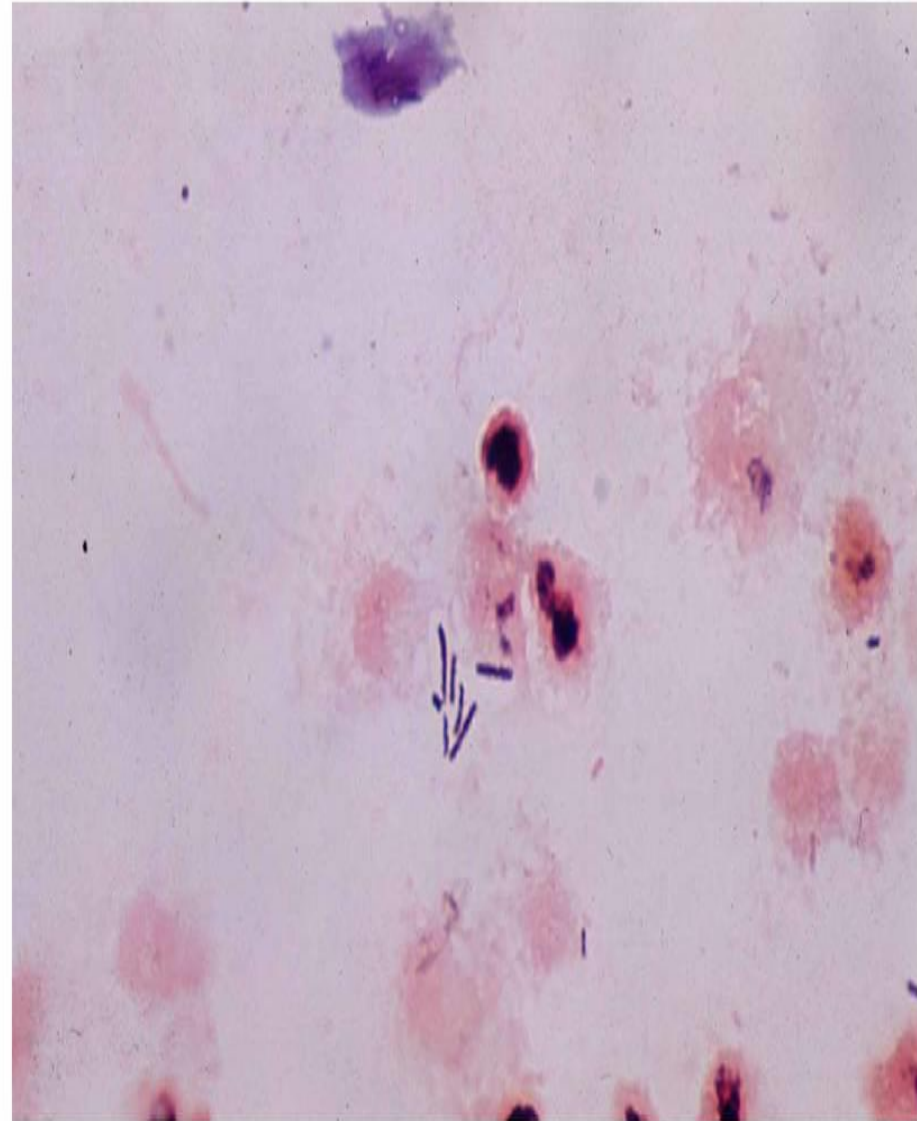
MD-76 188CC



***Post-traumatic brain abscess***  
***Caused by S. aureus***  
***E. coli***  
***B. fragilis***



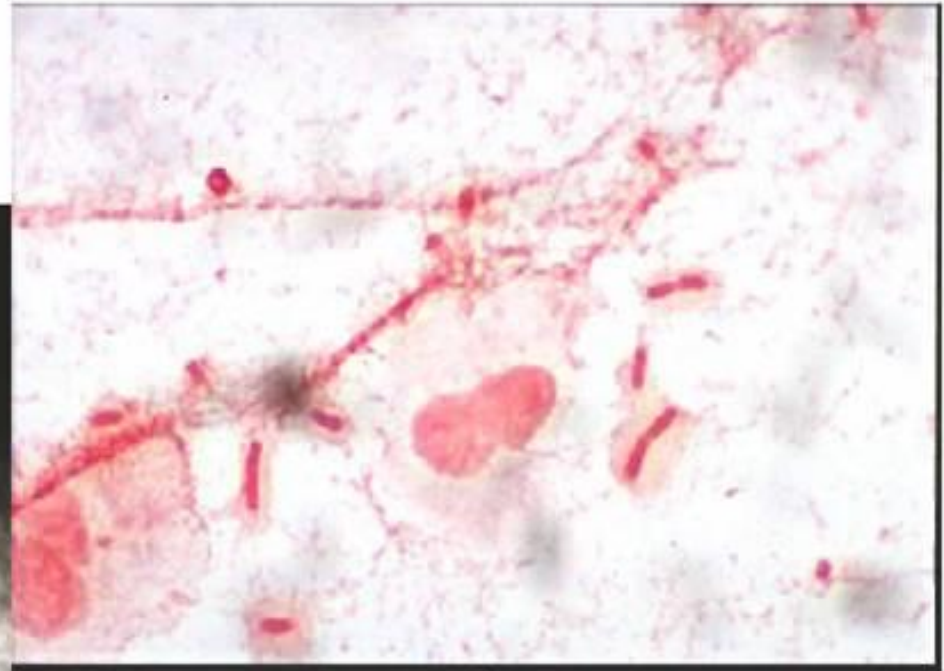
myonecrosis



*Clostridium perfringens*



*K. pneumoniae*  
**Pyomyositis**



**Air within fascia**