

Please check the [editing file](#) to see if there are any changes



MED437  
KING SAUD UNIVERSITY



# Community acquired pneumonia



MICROBIOLOGY  
437

**Important!**

Doctor's Notes

Only found in females' slides

Only found in males' slides

Extra Notes



437  
PHYSIOLOGY TEAM

This lecture is made  
by Physiology team

*"I'm not telling you it's going to be easy. I'm telling you it's going to be worth it."*

# Objectives

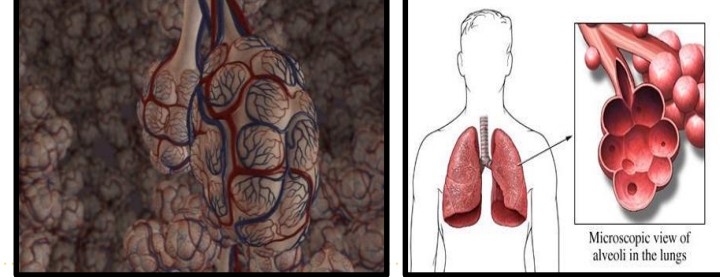
- Discuss the epidemiology and pathophysiology of pneumonia and CAP
- Explain the different classifications of pneumonia
- Recognize clinical presentations associated with CAP
- Discuss the diagnosis and treatment of CAP
- Identify common etiological agents causing CAP and discuss their laboratory work up
- Discuss virulence factors and prevention of *Streptococcus pneumoniae*.

# Definition

- Pneumonia: is an infection that leads to inflammation of the parenchyma of the lung (the alveoli) (consolidation and exudation) .
- It may present as acute, fulminant clinical disease or as a chronic disease with a more prolonged course .

# Epidemiology

- Overall the rate of CAP 5-6 cases per 1000 persons per year. **Usually its transmission by droplet.**
- Mortality 23%
  - High, especially in old people
- Almost 1 million annual episodes of CAP in adults > 65 yrs in the US.



# Risk factors

- Age < 2 yrs, > 65 yrs
- Alcoholism
- Smoking
- Asthma and COPD
- **Aspiration**
- **Dementia** (a chronic mental disorder marked by memory loss, personality changes and impaired reasoning)
- Prior influenza
- **HIV ; Immunosuppression**
- Institutionalization
- Recent hotel : **Legionella**
- Travel, pets, occupational exposures- birds (**C. psittaci**)

# Etiological agents

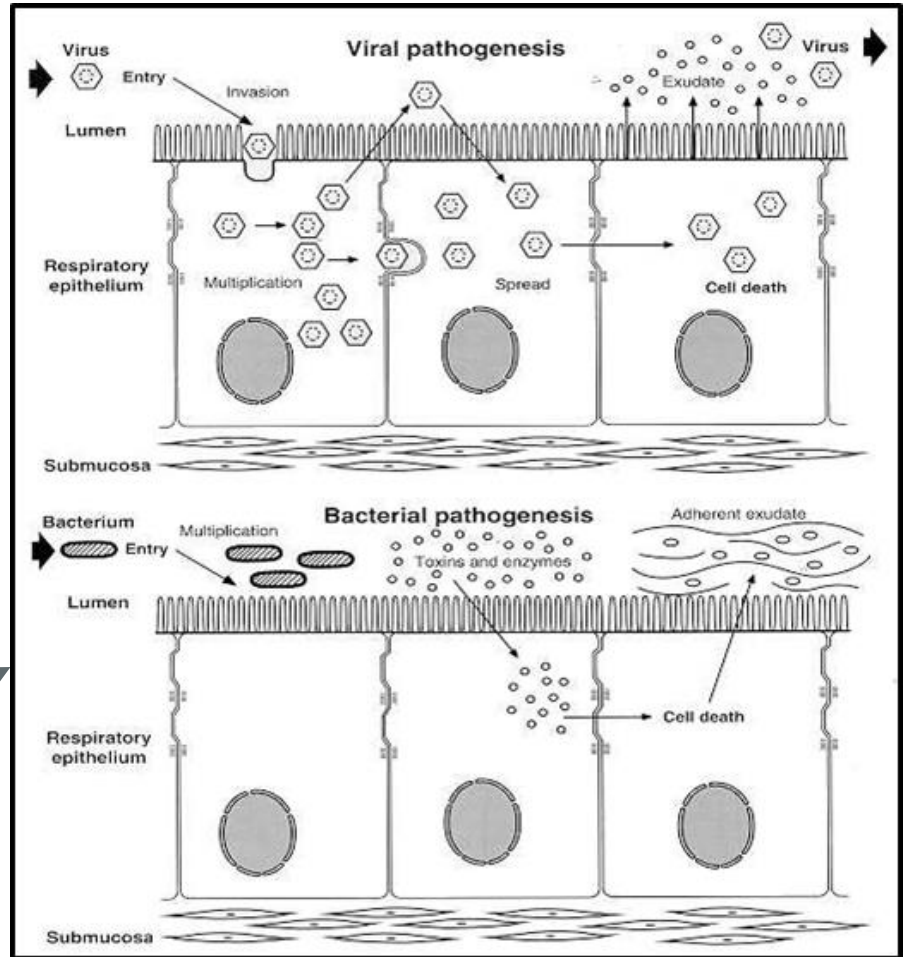
Infectious:

- Bacterial
- Fungal
- Viral
- Parasitic

They're rare and usually effect immunespurred

Non-infectious like:

- Chemical
- Allergen related



# Pathogenesis

Two factors involved in the formation of pneumonia

- Pathogens
- Host defenses.

## Defense mechanism of respiratory tract

- Filtration and deposition of environmental pathogens in the upper airways
- Cough reflex
- Mucociliary clearance
- Alveolar macrophages
- Humoral and cellular immunity
- Oxidative metabolism of neutrophils

## Pathophysiology

1. **Inhalation** or aspiration (لما يدخل شيء للرئة بالغلط) of pulmonary pathogenic organisms into a lung segment or lobe.
2. Results from secondary bacteraemia from a distant source, such as Escherichia coli urinary tract infection and/or bacteraemia (less commonly).
3. Aspiration of oropharyngeal contents (multiple pathogens).

# Pneumonia is classified according to:

## Acquired environment

- community acquired pneumonia.
- hospital acquired pneumonia.
- nursing home acquired pneumonia.

## Anatomy

- Lobar: entire lobe.
- Bronchopneumonia.
- Interstitial.

## Fungal

Candida  
Aspergillosis  
Pneumocystis carn

## Viral

the most common cause of pneumonia in children < than 5 years

- Adenoviruses
- Respiratory syncytial virus
- Influenza virus
- Cytomegalovirus
- Herpes simplex virus

## Pathogen

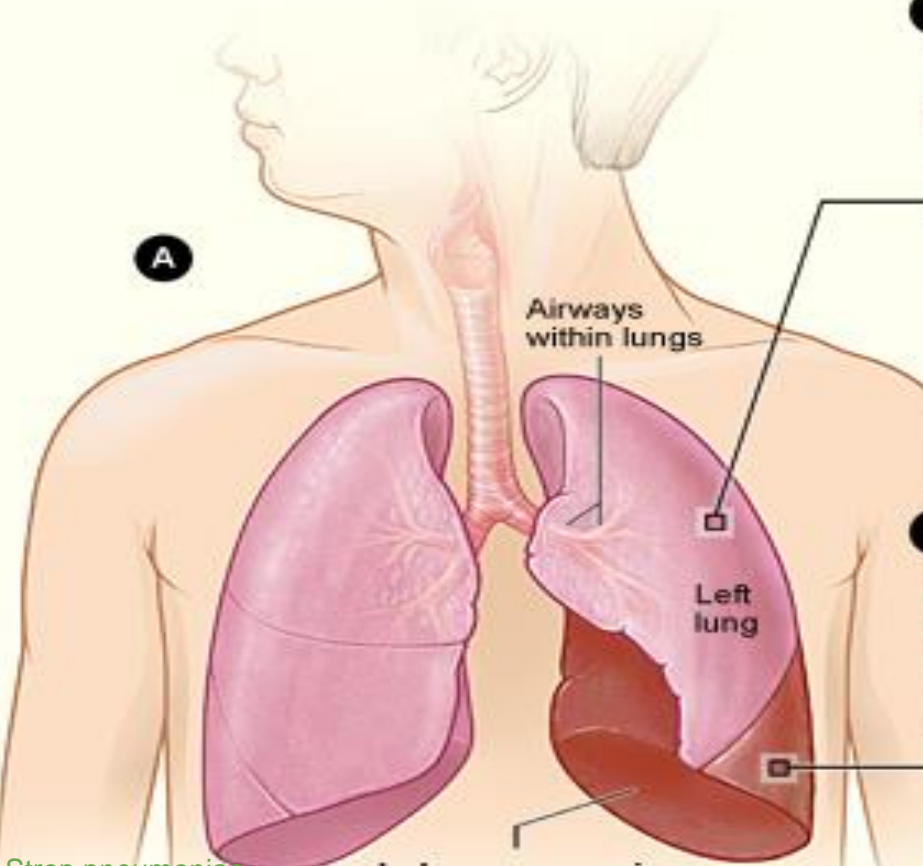
## Parasite

## Bacterial

- Typical:  
*Gram-positive* : ***Streptococcus pneumoniae***(most common) , *Staphylococcus aureus*, Group A hemolytic streptococci.  
*Gram-negative* : *Klebsiella pneumoniae*, *Hemophilus influenzae*, *Moraxella catarrhal* and *Escherichia coli*.
- Atypical:  
***Mycoplasma pneumoniae***(most common), *Chlamydia pneumoniae* and *Legionella*.  
Anaerobic bacteria



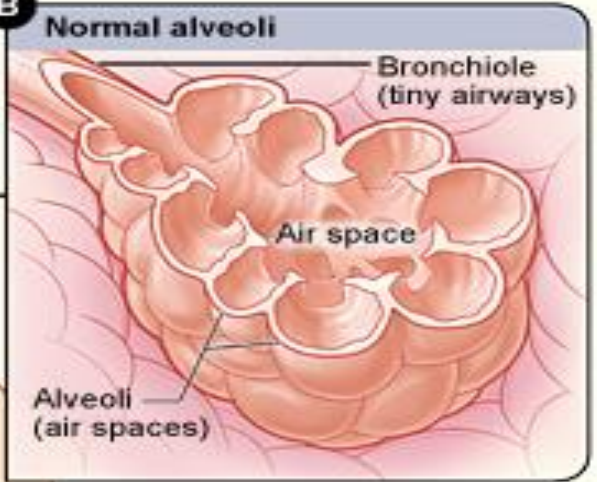
**A**



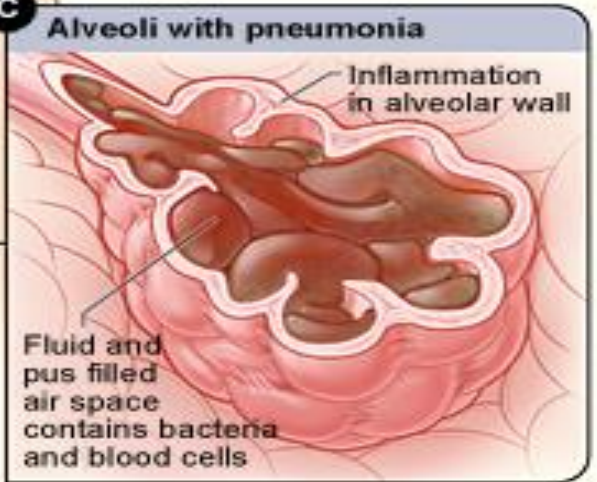
**Lobar pneumonia**  
 in lower lobe of left lung  
 (i.e., *Streptococcus pneumoniae*)

Strep pneumoniae causes lobar and sometimes legionella does

**B**



**C**



# Community acquired pneumonia pathogens

• <i>Strep pneumonia</i> (the most)	48%
• Viral	23%
• Atypical orgs (MP, LG, CP)	22%
• <i>Haemophilus influenza</i>	7%
• <i>Moraxella catharralis</i>	2%
• <i>Staph aureus</i>	1.5%
• Gram –ive orgs	1.4%
• Anaerobes	



# According to pathogens :

Thanks  
to 436  
team

1- Bacteria (dominant)			Atypical pneumonia	2- Fungal pneumonia	3- Viral pneumonia common cause of pneumonia in children less than 5 years	4- Others
Typical pneumonia						
Gram +	Gram -	Anaerobic				
1) <b>Streptococcus pneumoniae</b> (most common Typical pneumonia) 2) Staphylococcus aureus 3) Group A hemolytic streptococci	1) <b>Klebsiella pneumoniae</b> 2) <b>Hemophils influenzae</b> 3) <b>Moraxella catarrhal</b> 4) Escherichia coli		1) <b>Legionnaires pneumonia (Legionella)</b> 2) <b>Mycoplasma pneumoniae (most common)</b> 3) <b>Chlamydia pneumoniae</b> 4) Chlamydia Psittaci 5) Rickettsias. 6) Francisella tularensis (tularemia)	1) Candida. 2) Aspergillosis. 3) Pneumocystis jiroveci (carinii), It causes PCP.	1) Respiratory syncytial V. 2) Influenza V. 3) Adenoviruses. 4) Human metapneumovirus. 5) SARS and MERS CoV. 6) Cytomegalovirus. 7) Herpes simplex virus.	1) Parasites 2) Protozoa 3) Chemical 4) Allergy

1) Streptococcus pneumoniae, H. influenzae and Moraxella: have cell wall therefore are gram stained and respond to Penicillin and B-lactam

2) Mycoplasma pneumoniae, Legionella and chlamydia: doesn't have cell wall (resistant to drugs that work on cell wall E.g (penicillin and B-lactam)

Actually legionella has cell wall but a little bit different

# Clinical Manifestation

## Typical Pneumonia

Signs and symptoms are quite similar but Atypical pneumonia is less severe.

## Atypical Pneumonia

- The onset is acute (2-3 days)
- Prior viral upper respiratory infection (follows viral infection) غالباً قبل ما المريض يصاب بالنومونيا يكون أصابه فيروس فيهيئ الايروايز للنومونيا
- Fever
- Shaking chills
- Cough with sputum production (rusty-sputum)
- Chest pain or pleurisy (inflammation of the pleura)
- Shortness of breath (dyspnea)

- Gradual onset
- Usually mild to moderate but in case of legionella it could be severe
- Headache, malaise and low grade fever
- Dry cough
- Arthralgia / Myalgia ألم في المفاصل والعضلات
- In case of doctor examination, signs such as minimal, few crackles and rhonchi could notify.

# Diagnosis

## Typical Pneumonia

CBC: Complete blood count  
LFTs : Liver function test

## Atypical Pneumonia

1. **Clinical examinations ( history & physical )**
2. **X-ray** ( to determine whether the pneumonia is lobar, lobular or interstitial)
3. **Laboratory**
  - CBC test shows leukocytosis
  - **Sputum either gram stain**( low sensitivity due to normal flora) **or culture**
4. Blood culture not always but usually in case of pneumococcal pneumonia
5. Culture of pleural fluid if there is effusion

1. **Clinical examinations ( history & physical)**
2. **X-ray** ( to determine whether the pneumonia is lobar, lobular or interstitial)
3. **Laboratory**
  - CBC test shows mild elevation of WBC
  - **LFTs show elevation of ALT & Alk Phos**
  - **Sputum culture in case of Legionella**
  - Detection of antibodies
  - DNA detection
4. **Urine antigen for Legionella**

# Streptococcus pneumonia

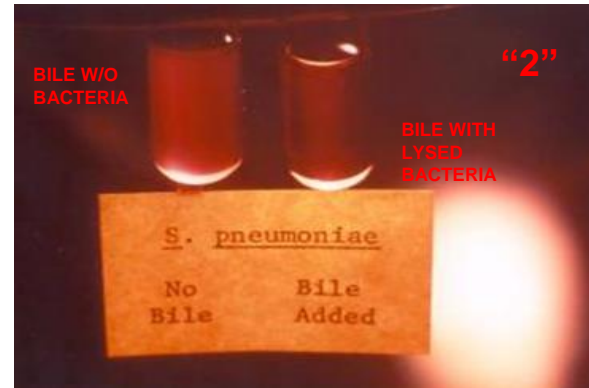
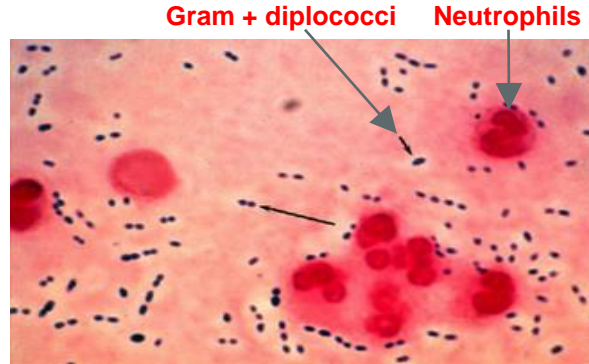
**Gram Positive diplococci - Alpha hemolytic - Catalase negative** - Normal flora of UPT in 20-40% of people. Can cause respiratory infections such as **pneumonia, sinusitis and otitis**. Also, can cause non respiratory infections such as meningitis and bacteremia.

## Virulence Factors:

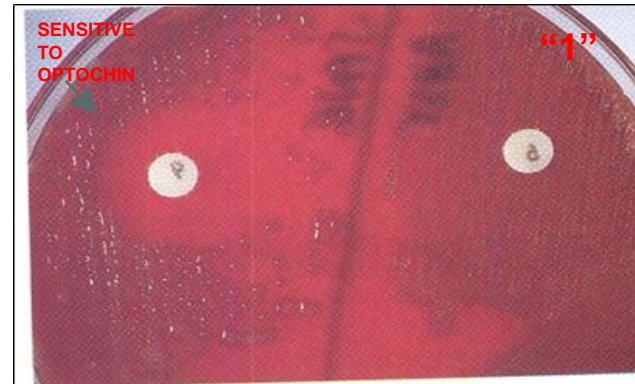
important

- **Capsule** “most important virulence factor”
- There are more than 90 types of capsule.
- **Pneumolysin** (pore forming toxin, also stimulates cytokines and disrupts the cilia of respiratory epithelial cells released on lysis of organism by autolysin) عشان هالخاصيتين لما تسوي له كلتشر باللاب اول يومين ينمو بشكل طبيعي بعدها يكون شكل العينة مسطح وكأنها ماتت
- **Autolysin**
- **Neuraminidase** (cleaves sialic acid)

**Prevention:** There is **vaccination** for S.pneumonia but it does not cover all the types of capsule.



-Alpha hemolytic consist of two broad groups S.Pneumonia and S.Viridans.  
- **S.Pneumonia** sensitive to **Optochin** unlike **S.Viridans** which is resistance. "1"  
- **S.Pneumonia** lysed "soluble" by bile unlike **S.Viridans** which insoluble in bile. "2"  
**This two** tests differentiate between S.pneumonia & S. Viridans



# Atypical Pneumonia

## General Principles

- Approximately 15% of all CAP.
- Not detectable on gram stain.
- Won't grow on standard media.
- Most don't have a bacterial cell wall  
"Don't respond to  $\beta$ -lactams".
- Usually less severe than Typical Pneumonia with some exceptions.

## Causative Agents

- *Chlamydia pneumoniae*
- *Mycoplasma pneumoniae*
- *Legionella spp*
- Psittacosis (*Chlamydia psittaci*)
- Q fever (*Coxiella burnettii*)
- Viral (Influenza, Adenovirus, Rhinovirus)
- Pneumocystis Jiroveci

# Atypical(interstitial) pneumonia

هذي والي  
بعدها  
مكررة  
لكن لو

## Symptoms

- Insidious onset
- Mild to severe
- Headache
- Malaise
- Fever
- **Dry cough**
- Arthralgia myalgia

## Signs

- Minimal
- Low grade fever
- Crackles
- Rhonchi (similar to wheezing)

تلي  
تتركها  
عشان  
يوضح أننا  
بدينا  
بالاتييكال

# Diagnosis and treatment

## Diagnosis:

- X-ray
- CBC
- U&E test (urea and electrolytes)

### Low serum Na (legionella)

- LFT (Liver function test)  
▲ ALT                      ▲ ALK phos
- Sputum culture on special media(BCYE)
- Urine antigen for legionella
- Serology for detecting antibodies
- DNA detection

## Treatment:

- Macrolides
- Quinolones
- Tetracycline
- B lactams have no effect

Because there is no cell wall to be destroyed

- Treat for 10-14 days

-CBC is general infection detector  
-X-ray because it's pulmonary and we need to see the pattern (lobar,interstitial...)  
-We culture to see the microorganisms  
- organisms specific signs like ▲ ALT  
We use every group that we have study except B-lactam

# *Mycoplasma pneumoniae*

**Mycoplasma  
pneumoniae  
Cx-ray**

- Eaton's agent (1944)
- No cell wall
- Common
- Rare in children and in > 65
- People younger than 40.
- Crowded places like schools, homeless shelters, prisons.
- Can cause URT symptoms
- Usually mild and responds well to antibiotics.
- Can be very serious

May be associated with  
**extra-pulmonary findings:**  
skin rash, hemolysis, myocarditis,  
pancreatitis, encephalitis

## Diagnosis:

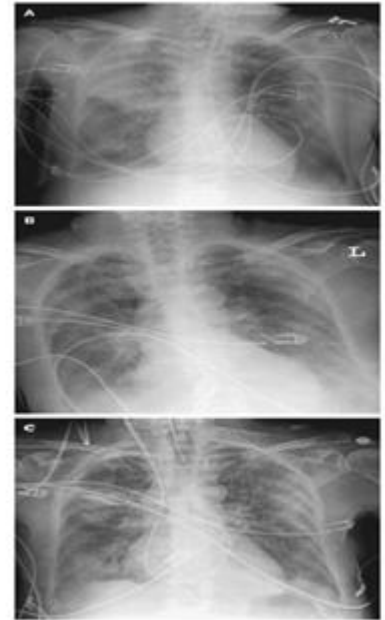
### Serology

**NAAT** Nucleic acid amplification tests. Done on throat or Np (nasopharynx) swab

Culture can be done but requires special media and slow grower (weeks)

Cold agglutinins test not specific but can be helpful

Al Rekabi notes:  
Hard to culture  
Can be detected by  
Complement fixation test  
But the better way is  
The cold agglutination test





# *Chlamydia pneumoniae*

- **Obligate intracellular organism**
- 50% of adults sero-positive
- Mild disease
- Sub clinical infections common
- 5-10% of community acquired pneumonia
  
- **Diagnosis:**
  - **Serology**
  - **NAAT**

Al Rekabi notes:

Causes three diseases:

1. Pneumonia
2. Urethritis
3. trachomatis

# Psittacosis



- *Chlamydia psittaci*
- Exposure to birds
- Bird owners, pet shop employees, vets
- Parrots, pigeons and poultry
- Birds often asymptomatic.

The disease/infection that come from animals are called zoonotic.

Less common more severe

# Q fever (*Coxiella burnetii*)



Drs note: know that  
its from animal  
like sheep

- Exposure to farm animals mainly sheep
- Spread by inhalation of infected animal birth products
- Pneumonia is acute form of infection
- Diagnosis: serology

# Legionella pneumophila

Very important

Legionnaires in ICU

- Legionnaire's disease
- Serious outbreaks linked to exposure to cooling towers
- Can be very severe and lead to ICU admission.
- Diagnosis:
  - Specimen: sputum (not accurate)
  - Culture on specialized media (BCYE)
  - DFA (low sensitivity)
  - NAAT
  - Urine antigen testing

Can cause  
Hyponatraemia common (<130mMol)

Bradycardia  
WBC < 15,000  
Abnormal LFTs  
Raised CPK  
Acute Renal failure

تعيش في المكيفات المركزية  
والمياة عشان كذا في البداية قلنا  
الفنادق من

Pontiac fever:  
Non pneumonic  
Influenza like illness  
Self limiting  
Related to exposure to environmental aerosols containing Legionella (potentially reaction to bacterial endotoxins)



Legionella presents on X-Ray as: interstitial pneumonia but can present as lobar or any other type

# Antibiotic Treatment of CAP

- Factors to consider in selection of antibiotic:
  - Co morbidities
  - Previous antibiotic exposure in last 3 months
  - Severity
    - Out patient management vs requiring inpatient admission vs requiring ICU

# Treatment

		Macrolides E.g. Erythromycin ..	Doxycycline Like Tetracycline  but wider range	Levoflo xacin  From quinolo nes	B-lactam And Macrolide B-lactam includes Penicillin And cephalosporins	B-lactam And Levo  To cover everythin g
<b>Outpatient, healthy patient with no exposure to antibiotics in the last 3 months</b>	- <i>S. pneumoniae</i> -Atypical pathogens -Viral					
<b>Outpatient, patient with comorbidity or exposure to antibiotics in the last 3 months</b>	<i>As above + Anaerobes S. aureus</i>					
<b>Inpatient : Not ICU</b>	Same as above + coliforms					
<b>Inpatient : ICU</b>	Same as above + <i>Pseudomonas</i>					

# Quiz

Which of the following most common causes of the community acquired pneumonia?

- A-S.pneumonia
- B-viral
- C-H.influenza
- D-M.catharralis

Which of the following is true about S.pneumonia ?

- A-gram+ and beta hemolytic
- B-gram- and beta hemolytic
- C-gram+ and alpha hemolytic
- D-gram- and alpha hemolytic

Which of the following organism don't have cell wall ?

- A-s.pneumonia
- B-s.aureus
- C-gram - organisms
- D-Mycoplasma pneumonia

Which of the following organism is transmitted by exposure to birds ?

- A-Legionella
- B-Mycoplasma
- C-S.pneumonia
- D-Chlamydia psittaci

Which of the following culture is used for diagnosis legionella ?

- A-SDA
- B-BCYE
- C-Lowenstein-Jensen
- D-Blood agar

Which of the following antibiotics is best choice for legionella ?

- A-Azithromycin
- B-clarithromycin
- C-cephalosporins
- D-penicillin

1-A 2-C 3-D 4-D 5-B 6-A (because legionella is gram - and azithromycin effect against gram - bacteria)

# Team Leaders

Alanoud Almansour & Omar  
Alsuhaibani

# Team Members

Khaled Alogaili  
Abdullah Alzaid  
Rayan Almousa  
Abdurhman Aldeheem  
Saif Almeshary  
Abduhakim Alonaiq

Please contact us if you have any suggestion,  
correction, or question:

**Microbiology.med437@gmail.com**

