Community-Acquired Pneumonia

TEAM 439
MICROBIOLOGY

VERSION 1

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

Colour index:

Red: Important & Doctor's notes.

Grey: Extra info & explanation.

Purple: Only in girl's slides.

Orange: Only in boy's slides.

Green: Lecture notes

Any future corrections will be in the editing file, so please check it frequently.

Scan the code
Or click here

SCAN ME

Pneumonia is an infection that leads to inflammation of the parenchyma of the lung (the alveoli) (consolidation and exudation)

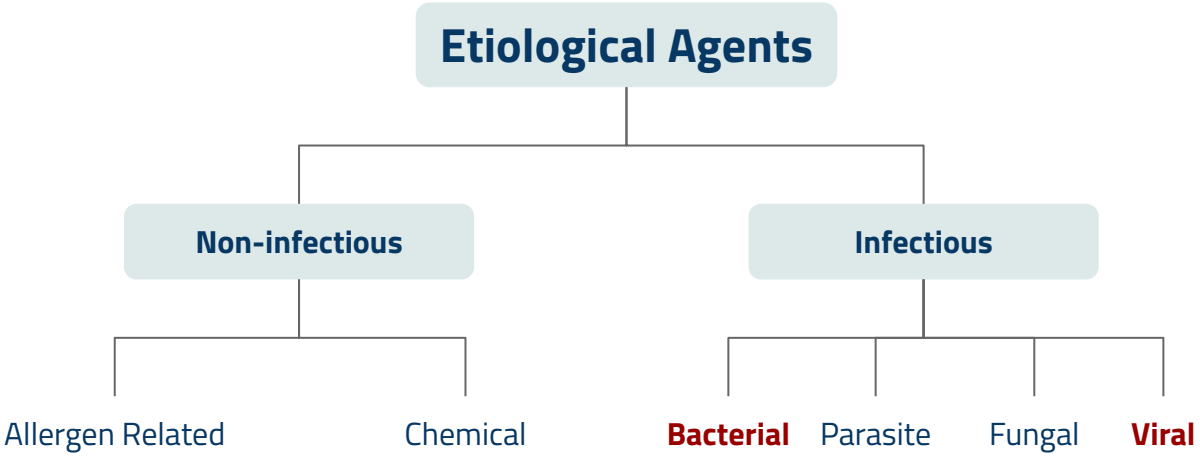
It may present as acute, fulminant clinical disease or as a chronic disease with a more prolonged course

Epidemiology

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

Risk factors

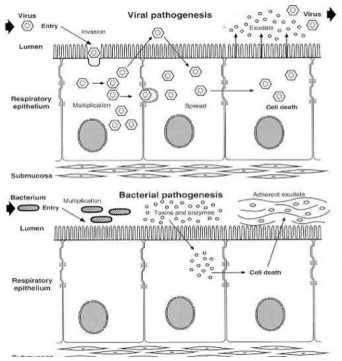
- Age extremities (younger than 2 years | **older than 65 years**)
- Immunosuppression
- Asthma and COPD (Uncontrolled or severe)
- Prior influenza
- Alcoholism
- HIV
- Smoking
- Institutionalization (nursing homes, prisons)
- Aspiration
- Recent hotel : Legionella
- Dementia
- Travel, pets, occupational exposures- birds (C. psittaci

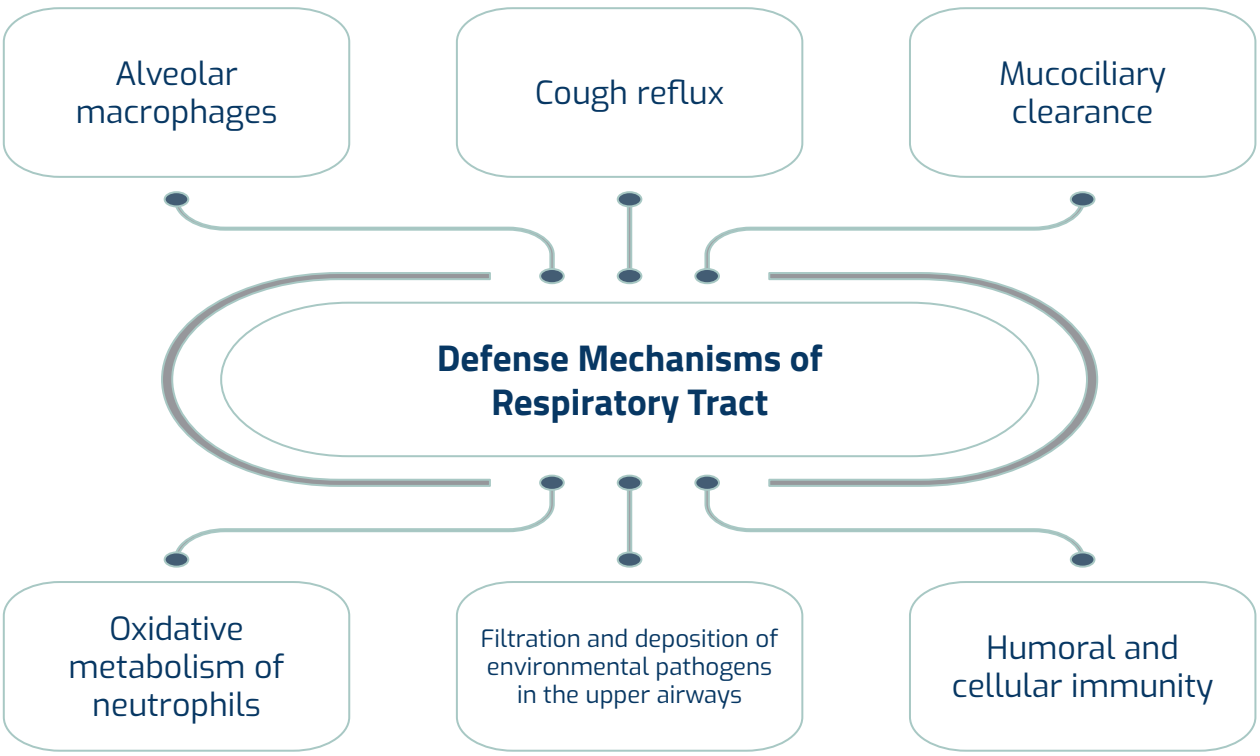


Pathogenesis

Two factors involved in the formation of pneumonia:

1- Pathogens
2- Host defenses





Pathophysiology

1 **Inhalation or aspiration** of pulmonary pathogenic organisms into a lung segment or lobe. (Mainly)

2 Results from secondary bacteraemia from a distant source, such as Escherichia coli urinary tract infection and/or bacteraemia (less commonly).
Infection in other organ / place such as urinary tract leads to bacteremia then infects the lung.

3 Aspiration of oropharyngeal contents (multiple pathogens).

Pneumonia is Classified According To

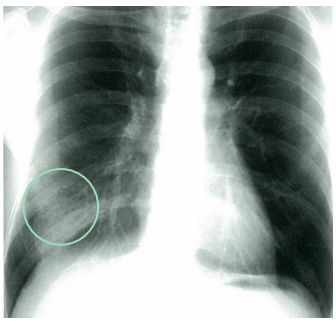
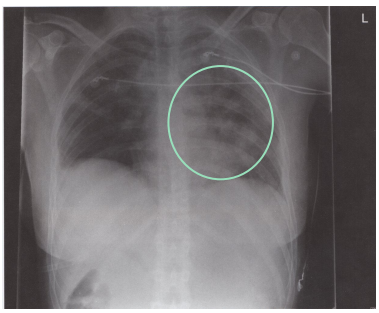
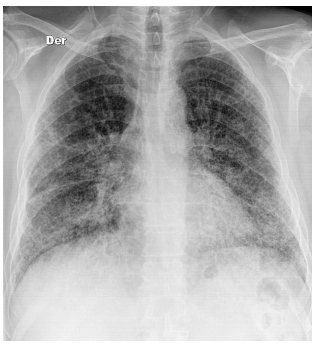
- 1- Pathogen
- 2- Anatomy
- 3- Acquired Environment

1- Classification By Acquired Pathogen

Bacterial		Viral	Fungal	Parasite
Typical Typical presentation of pneumonia, fever, productive cough, leukocytosis, chest pain, low oxygenation etc..	Atypical Less sick than typical, also called walking pneumonia, dry cough, less dangerous.	Viruses are common cause of URTI but it is not a common cause of lower respiratory tract infections like pneumonia	Unusual cause of pneumonia, so when it happens, you have to question the immune system.	Unusual cause

Typical & Atypical pneumonia is a clinical term. So when we say the patient has atypical pneumonia then that means he is less sick and we are less worried about him than patient with typical pneumonia.

2- Classification by acquired anatomy

Lobar	Lobular	Interstitial
Entire lobe St. pneumoniae (usually)	bronchopneumonia (Around alveoli and bronchi) Most common in viral infection St. pneumoniae (usually)	Around the lung interstitium Usually caused by: Atypical or Viruses
		

*White color in the is the abnormal

3- Classification by acquired environment

Community acquired pneumonia (CAP)	Hospital acquired pneumonia (HAP)	Nursing home acquired pneumonia (NHAP)

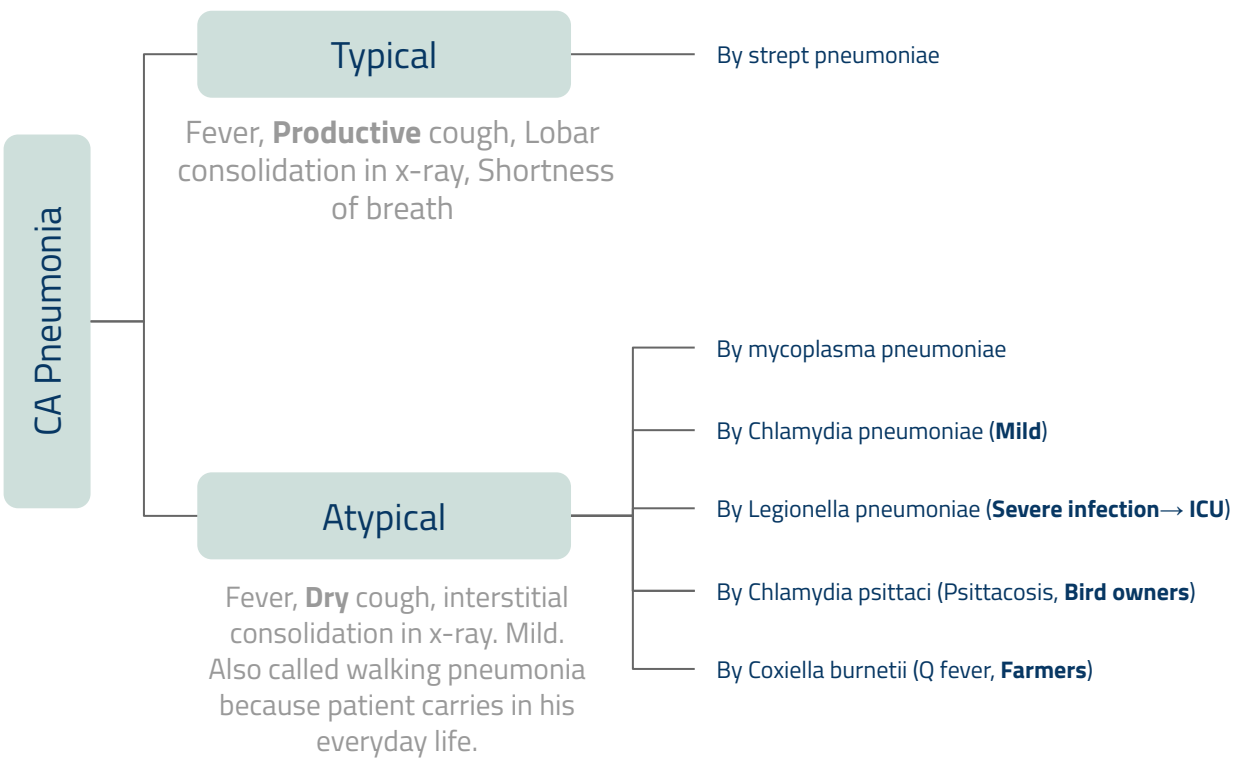
Community Acquired Pneumonia

- **CAP is a pneumonia acquired outside of hospitals or extended care facilities.**
- Fever, productive cough, infiltrate (we see it in x-ray).

Typical	Atypical
Detectable by gram stain, can be cultured easily.	- Approximately 15% of all CAP - Not detectable on Gram stain, and (won't grow on standard media. - Some don't have cell wall, so they will not respond to β lactams.
★ **Streptococcus pneumoniae (Lobar Pneumonia)** - Haemophilus influenzae - Moraxella catarrhalis - Staph. Aureus - Gram negative organisms	- **Mycoplasma pneumoniae** - **Chlamydia pneumoniae** - **Legionella pneumoniae** (less common but very severe, leading to ICU admission) - Coxiella burnetii (Related to sheep) - Chlamydia psittaci (Related to birds)

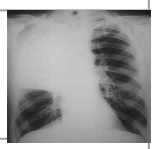
Prevalence of CAP

1. Strep pneumonia 48% (most common)
2. Viral 23% (most common on URTI)
3. Atypical orgs (MP,LG,CP) 22%
4. Haemophilus influenzae 7%
5. Moraxella catarrhalis 2%
6. Staph aureus 1.5%
7. Gram negative organisms 1.4%
8. Anaerobes

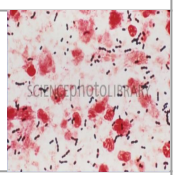


For the next pages, you will not be asked how exactly is each one diagnosed, so just get the general idea and know the different diagnostic methods; serology, urine antigen, gene, special cultures & media, molecular testing.. etc..

Typical Pneumonia

Overview	The onset is usually acute Prior viral upper respiratory infection (3-4 days after viral infection, patient develops pneumonia)	
Respiratory symptoms	❖ Fever ★ Shaking chills ★ Cough with sputum production (rusty-sputum) ❖ Chest pain or pleurisy ❖ Shortness of breath	
Diagnosis	Clinical	History (fever, cough, chest pain) Physical examination (Decreased air entry & dullness on percussion)
	Radiological	**X-ray examination** (used to confirm the diagnosis,pneumonia, and to determine the type,lobar/interstitial/lobular) - **X-ray of typical is usually lobar or lobular** 
	Laboratory	- CBC Shows leukocytosis - Sputum ▪ Gram stain- 15% ▪ Culture - Blood culture-5-14% - Pleural effusion gram+culture

Streptococcus Pneumoniae (Causes Typical)

Overview	Normal flora of upper respiratory tract in 20- 40% of people, might cause pneumonia with the risk factors	
Organism (Same morphology as S. viridans)	▪ Gram Positive diplococci ▪ Alpha hemolytic streptococci ▪ Catalase Negative 	
Other Features	• **Sensitive to Optochin** • **Lysed by bile** (bile soluble) These 2 methods are used to differentiate between S.viridans & S.pneumoniae (Remember S.viridans is normal flora in the GIT so it can survive in bile unlike S.pneumoniae which can't)	
Virulence factors	★ **Capsule** (Most important virulence factor) ▪ More than 90 capsular types ❖ Pneumolysin (Pore forming toxin that destroys host cells→Hemolysis) ❖ Autolysin (Hydrolyzes its own cell wall to release the pneumolysin) باختصار تقتل نفسها بالـAutolysin عشان تطلع الـPneumlysin وتضر الهوست ❖ Neuraminidase (Used for attachment to host cell)	
Prevention	Vaccination	
Infections	Respiratory infections	Pneumonia, Sinusitis, Otitis
	Non Respiratory infections	Bacteremia, Meningitis

Atypical pneumonia

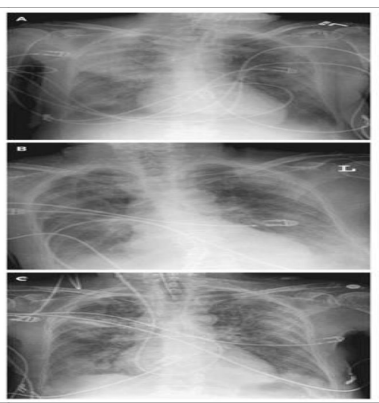
Overview	❖ Usually called walking pneumonia because the patient carries on with everyday activities. ❖ Approximately 15% of all cases of community acquired pneumonia ❖ **Not detectable on gram stain** & Won't grow on standard media ★ Some don't have a bacterial cell wall, **don't respond to B-lactams**
Symptoms	❖ Usually mild except in legionella (which is the most severe) ❖ Gradual onset, ❖ Headache, Malaise, Fever ★ Dry cough ❖ Arthralgia / myalgia
Signs	❖ Minimal ❖ Low grade fever ❖ Few crackles ❖ Rhonchi (continuous sound produced in the lungs due to an obstruction)
Diagnosis	★ **X-ray** (Usually interstitial) ❖ CBC (Mild elevation WBC) ★ U&Es (urea & electrolytes), Low serum Na (Legionella) ❖ LFTs (liver function tests) ALT (alanine aminotransferase) & Alk Phos ❖ **Sputum Culture on special media** (BCYE) **for Legionella** ❖ Urine antigen for Legionella ❖ Serology for detecting antibodies (Most common diagnostic tool) Get the general idea that it needs a special culture media, and that it can be diagnosed by urine antigen, serology, etc
Treatment	❖ **Macrolide (Protein synthesis)**, **Quinolones (DNA)**, and Tetracycline (We can use one, or a combination of these in case of resistance) ❖ B lactams have no activity ❖ Treat for 10-14 days

Mycoplasma Pneumoniae (Causes Atypical)

(previously called Eaton's agent)

❖ Common cause of atypical pneumonia
★ No cell wall (so antibiotics that affect the cell wall won't work, e.g β lactams)
❖ Common
❖ Rare in children and in patients older than 65
❖ Common with people younger than 40 (middle aged)
❖ Can cause URT symptoms (Sore throat, Sneezing, Nasal blockage.)
★ **Usually mild and responds well to antibiotics.** (usually self-limiting)
❖ Can be very serious.
❖ Transmits well in crowded places like schools, homeless shelters, prisons.

Diagnosis	**Serology** **NAAT** (Molecular testing) (nucleic acid amplification testing) **Culture** Requires special media and takes weeks, so it is not practical **X-ray** Usually interstitial
Extrapulmonary effects	**Myocarditis,** Skin rash, Encephalitis, Hemolysis, Pancreatitis



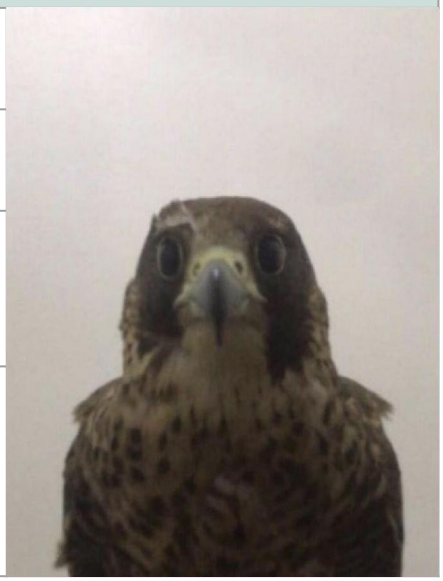
Chlamydia Pneumonia

Mild disease
5-10% of community acquired pneumonia
Obligate intracellular organism
50% of adults Sero-positive
Subclinical infections common

Diagnosis	Serology & NAAT

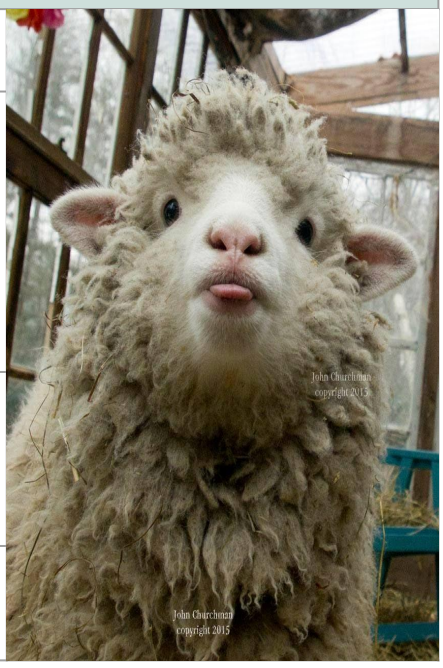
Psittacosis

Organism	**Chlamydia psittaci**
Cause of infection	Exposure to **birds**
Usual Patients	Bird owners, pet shop employees, vets.
Carriers	Parrots, Pigeons, and poultry. (Often Asymptomatic)



Q Fever

Organism	**Coxiella burnetii**
Cause of infection	**Exposure to farm animals** **Sheep** (Spread by inhalation of infected animal birth products) تفرز وقت الولادة في الحيوانات بعدين يجي احد يستنشقها
Complications	Acute Q fever could cause Atypical Pneumonia
Diagnosis	Serology (via IFA, immunofluorescence assay)



Remember:
Sheep = Q fever
Birds = psittacosis

Legionella Pneumophila

- Causes **Legionnaires disease**
- Serious **outbreaks** linked to exposure to **cooling (water) towers**
- Can be **very severe and lead to ICU admission**
- Can be any form of consolidation (interstitial, lobar, lobular).
  (but most likely for the exam they will bring interstitial)

Can Cause (these might come as hints in case questions)	**Hyponatraemia** (common) Decrease in serum sodium concentration <130 mMol	
	Bradycardia	
	WBC < 15,000	
	Abnormal LFTs (liver function test) > affect muscles	
	Raised CPK (creatinine phosphokinase)	
	Acute Renal failure	
Diagnosis	Sputum	Culture on specialized media (BCYE–Buffered charcoal yeast extract)
		DFA (low sensitivity) Direct fluorescent antibody test (Direct immunofluorescence)
		NAAT (most commonly PCR)
	Urine antigen testing	
Pontiac fever **Not very important**	• Non pneumonic • Influenza like illness • Self limiting • Related to exposure to environmental aerosols containing *Legionella* (potentially a reaction to bacterial endotoxins)	

Antibiotic Treatment of CAP

Factors to consider in selection of antibiotics:

1. Comorbidities
   (other diseases they have)
2. Precious antibiotic exposure in the last 3 months
   (maybe resistant)
3. Severity
4. Outpatient management vs requiring inpatient admission vs requiring ICU

Type of Patient	Microorganism	Macrolides	Doxycycline	Levofloxacin	□-lactam & macrolide	□-lactam & Levo
Outpatient, Healthy ,no exposure to antibiotics in last 3 months	- S.pneumoniae - Atypical pathogens - Viral					
Outpatient, with comorbidity,or exposed to antibiotics in last 3 months	- All of the above - Anaerobes - S. aureus					
Inpatient: Not ICU	- All of the above - Coliforms					
Inpatient ICU	- All of the above - Pseudomonas					

Summary

Check our summary by clicking here

SAQ

SAQ1: A 65 year old man with a history of COPD came to the hospital complaining from a fever & productive cough. An x-ray showed lobar consolidation. A gram stain showed gram +ve diplococci. A) What is the diagnosis? B) Name 2 potential risk factors that makes him at more risk of this condition? C) What is the most likely causative agent? D) What is the most important virulence factor?

SAQ2: A 35-year-old woman presents to a clinic in Australia for evaluation of fever, fatigue, and non-productive cough for 1 week. She had been doing a work-stay program on a sheep farm that is specialized in exporting high-quality organic wool. On physical exam, she has rhonchi in the left lower lobe of the lung and chest radiography. A) Your diagnosis? B) Causative organism? C) Cause of infection D) Suggested diagnostic method?

SAQ3: A 60-year-old man is brought to the emergency department for confusion, cough, and diarrhea. He had recently attended a conference and stayed at an old hotel where other people reported similar symptoms. His past medical history includes chronic obstructive pulmonary disease and hypertension. He smokes 1 pack per day. On physical exam, his oxygen saturation is 92% on room air. There are fine crackles bilaterally on chest auscultation. A chest radiograph reveals diffuse patchy infiltrates. He is also found to have hyponatremia. A) What is your diagnosis? B) What is the source if infection? C) Mention one diagnostic method you can use to confirm your diagnosis.

SAQ1: (A)Typical(lobar) Pneumonia (B) Age, COPD, immunity (C) S.pneumoniae (D) Capsule

SAQ2: (A) Q fever (B) Coxiella burnetii (C) Exposure & inhalation of sheep's birth products (D) Serology

SAQ3: (A) Legionella pneumophila (B) Outbreaks & exposure to cooling towers (C) Special culture, molecular testing (NAAT), urine antigen testing.

MCQs

Q1: A 55-year-old Caucasian woman comes to the office because of a 1-week history of a productive cough and shortness of breath. Her medical history is relevant for type II diabetes mellitus, high blood pressure, and major depressive disorder. She currently takes metformin, telmisartan, and escitalopram. Upon further interrogation, the patient reports having yellowish sputum whenever she coughs. On physical examination, the patient looks pale and has shaking chills. Auscultatory findings reveal inspiratory crackles on inspiration and increased tactile and vocal fremitus. Her temperature is 39.7°C (102.2°F), pulse is 122/min, respirations are 27/min, blood pressure is 130/61 mmHg, oximetry on room air shows an oxygen saturation of 96%. A conventional chest radiograph showed a right-upper-lobe consolidation.			
A- Encapsulated, gram positive, diplococci, optochin sensitive	B- Nonencapsulated, gram positive, diplococci, optochin sensitive	C- Encapsulated, gram negative, rod, oxidase negative	D- Unencapsulated, gram positive, positive acid-fast stain
Q2: A 38-year-old man comes to the office because of a persistent headache that has worsened in the last three days. His temperature is 38.1°C. He has also been sweating profusely at night and says his muscles ache. Rales (crackles) are heard on auscultation. He is the owner of a pet store, where he began remodeling the bird cage last week. He does not know of any sick contacts. Which of the following is the most likely diagnosis?			
A- Q fever	B- Psittacosis	C- Measles Virus	D- Chlamydia pneumoniae infection
Q3: A 50 year old man recently arrived from a vacation. After returning home he began suffering from a fever and dry cough. He went to the clinic. His serum sodium levels were <130 mEq/L. An x-ray showed interstitial infiltrate. What is the causative agent?			
A- Chlamydia pneumoniae	B- Chlamydia psittaci	C- Mycoplasma Pneumoniae	D- Legionella Pneumophila
Q4: A 26-year-old woman presents to her primary care physician for a nonproductive cough of 1-week duration. She reports that the cough started quite suddenly, along with subjective fevers. She denies having any headaches, any upper respiratory symptoms, chest pain, or shortness of breath. She has a past medical history of polycystic ovarian syndrome and anxiety. She lives at home with her parents and a 10-year-old parrot. A chest radiograph shows left lower lobe consolidation and bilateral small pleural effusions. What is the diagnosis & Causative organism?			
A- Chlamydia pneumoniae	B- Chlamydia psittaci	C- Mycoplasma Pneumoniae	D- Coxiella burnetii
Q5: All are true about mycoplasma pneumoniae except:			
A- It has no cell wall	B- Severe and poor response to antibiotics	C- Can lead to myocarditis	D- Can be diagnosed with NAAT
Q6: An 88-year-old man complaining of difficulty in breathing, Chest pain, irregular heartbeat, fever, headache, fatigue, poor appetite, and malaise. His symptoms began approximately 4 weeks ago, when he noticed he had a cough with no sputum. His temperature is 101°F (38.3°C), blood pressure is 136/93 mmHg, pulse is 101/min, and respirations are 22/min. Chest radiography demonstrates an interstitial consolidation. A sample was taken and a diagnostic identification of antibodies in the serum was done. Results came positive for mycoplasma pneumoniae. What is your choice of treatment?			
A- Macrolides & Quinolones for 10-14 days	B-Tetracycline for 10-14 days	C- Cephalothin	D- A & B

Q1	Q2	Q3	Q4	Q5	Q6
A	B	D	B	B	D

Team Leaders

- Duaa Alhumoudi
- Manee Alkhalifah

Team Members

- Sadem Alzayed
- Renad Alhomaidi
- Shahad Almezel
- Raghad Albarrak
- Noura Alsalem
- Ghadah Alsuwailem
- Noura Alshathri
- Mayasem Alhazmi
- Rand AlRefaei
- Muneerah Alsadhan
- Sarah AlAidaroos
- Sara AlQuwayz
- Sadeem Alhazmi
- Abdulaziz Alderaywsh
- Faisal Alomri
- Abdulaziz Alomar
- Meshal Alhamed
- Homoud Algadheb
- Abdulaziz Alsuhaim
- Bassam Alasmari