

Supportive module 3 "Basics of diagnosis, treatment and prevention of major pulmonary diseases "

16.	Pneumonias	2	20/12
17.	Chronic obstructive pulmonary disease	2	27/12
18.	Bronchial asthma	2	03/01
19.	Respiratory failure. Chronic pulmonary heart	2	10/01
20.	Pulmonary embolism	2	17/01
	Total	40	

Approved at a meeting of the Department of Internal Medicine
protocol № 1/1 30.08.2016

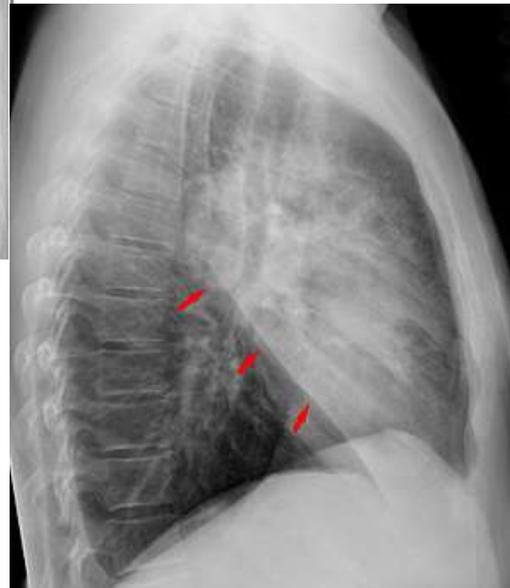
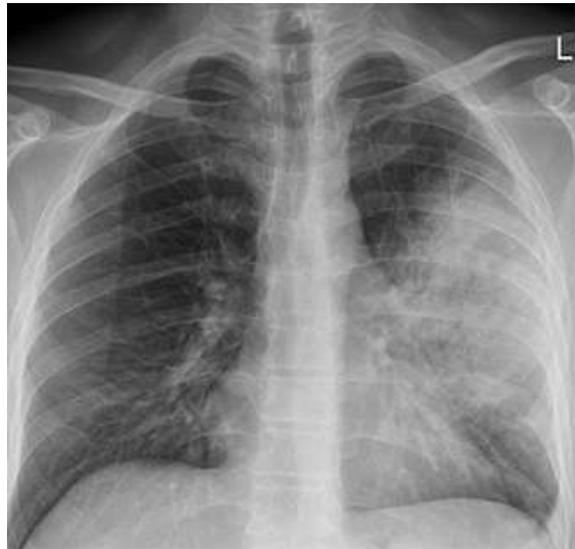
Supportive module 2: Basics of diagnosis, treatment and prevention of major gastroenterological diseases

Pneumonia

LECTURE IN INTERNAL MEDICINE FOR IV COURSE STUDENTS

M. Yabluchansky, L. Bogun, L. Martymianova, O. Bychkova, N. Lysenko, N. Makienko
V.N. Karazin National University Medical School' Internal Medicine Dept.

Plan of the Lecture



Typical X-ray image of a lobar pneumonia in the left upper lobe. The arrows point to the border of the lower lobe

- Definition
- Epidemiology
- Risk Factors and Etiology
- Mechanisms
- Classification
- Clinical presentation
- Diagnosis
- Treatment
- Prognosis
- Prophylaxis
- Abbreviations
- Diagnostic guidelines

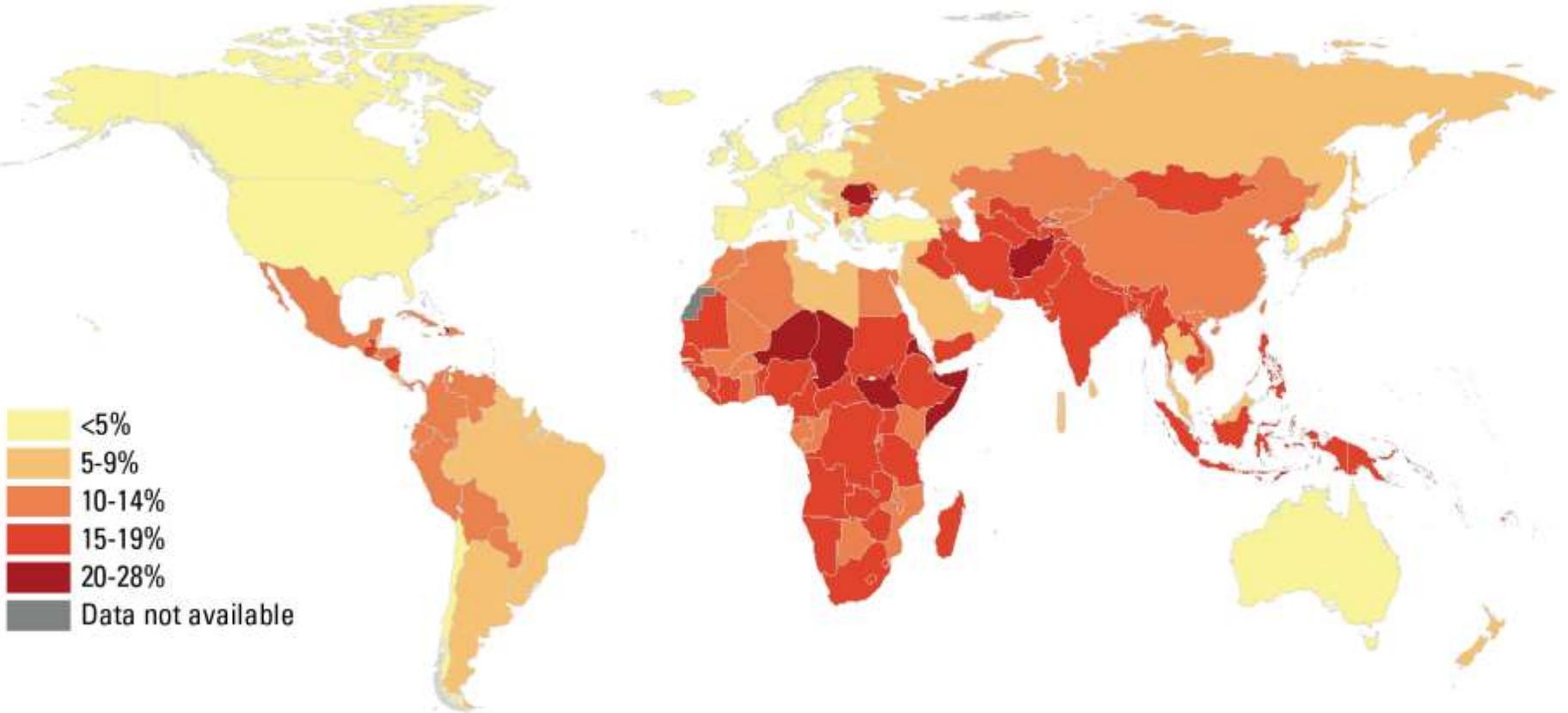
Definition

Pneumonia is acute inflammation of the lungs affecting primarily the microscopic air sacs and caused by infection with typical signs and symptoms include a varying severity and combination of productive or dry cough, chest pain, fever, and trouble breathing, depending on whether the infection is bacterial, viral, fungal, or parasitic; whether it is acquired in the community, hospital, or other health care–associated location; and whether it develops in a patient who is immunocompetent or immunocompromised.

Epidemiology

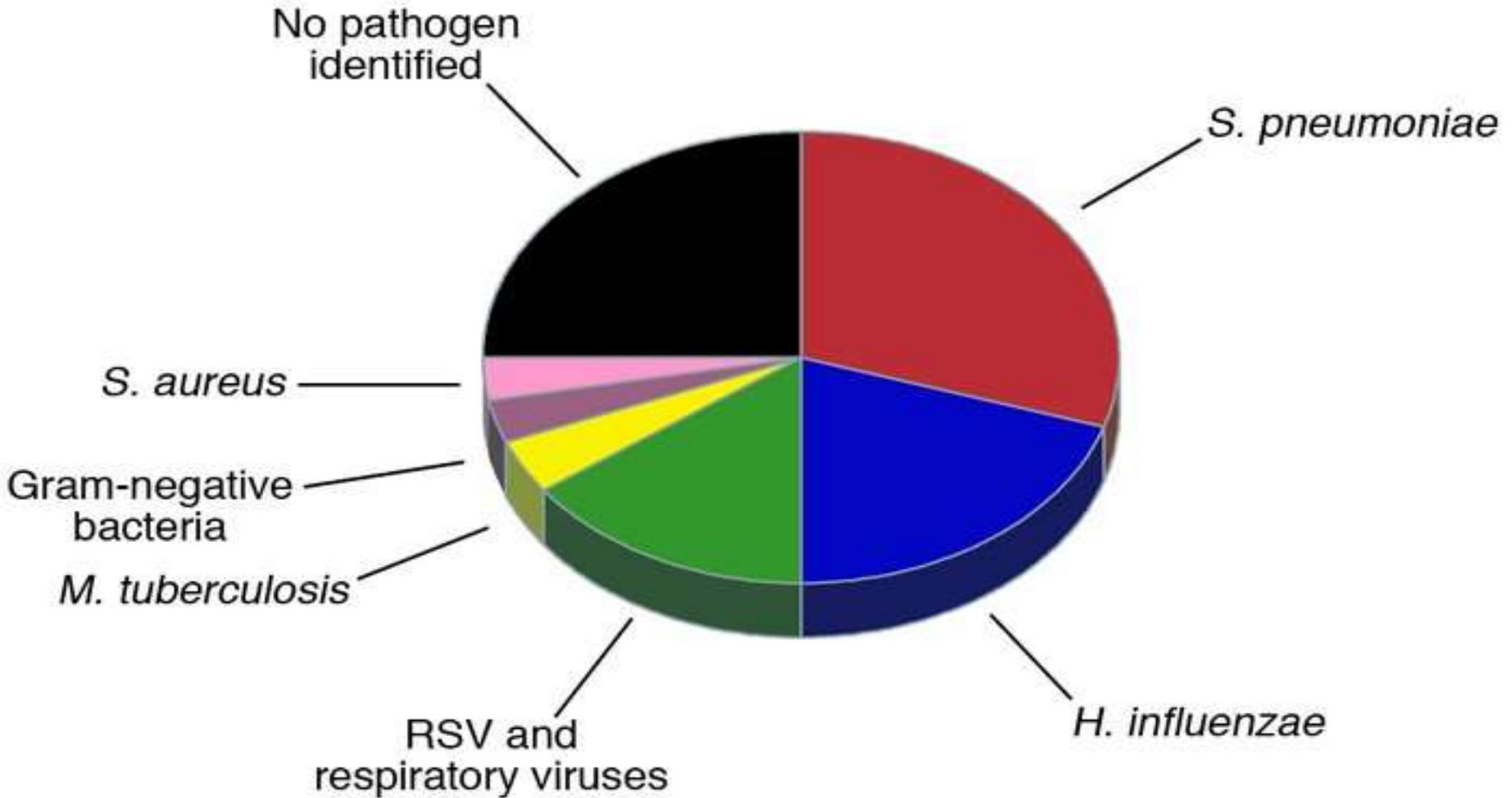
- Pneumonia is a common illness affecting approximately 450 million people a year and occurring in all parts of the world
- Pneumonia is a major cause of death among all age groups resulting in 4 million deaths (7% of the worlds yearly total)
- Rates are greatest in children less than five and adults older than 75 years of age
- Pneumonia occurs about five times more frequently in the developing world versus the developed world
- Viral pneumonia accounts for about 200 million cases.

Epidemiology



Pneumonia statistics around the World.

Epidemiology



Community-acquired pneumonia.

Risk Factors

- Indoor air pollution, smoking
- Immunodeficiency
- Alcoholism
- Chronic obstructive pulmonary disease, asthma
- Heart disease, diabetes mellitus, liver disease, chronic kidney disease
- Dementia, stroke, brain injury, cerebral palsy, or other brain disorders
- The use of acid-suppressing medications (proton-pump inhibitors or H2 blockers)
- Immune system problem (during cancer treatment, or due to HIV/AIDS, organ transplant, or other diseases)
- Recent surgery or trauma
- The risk is also increased in old age.

Etiology

Infectious Agents

- Pneumonia is due to infections caused primarily by bacteria or viruses and less commonly by fungi and parasites
- There are more than 100 strains of infectious agents identified
- Mixed infections with both viruses and bacteria may occur in up to 45% of infections in children and 15% of infections in adults
- A causative agent may not be isolated in approximately half of cases despite careful testing
- The term *pneumonia* is sometimes more broadly applied to any condition resulting in inflammation of the lungs (caused for example by autoimmune diseases, chemical burns or drug reactions); however, this inflammation is more accurately referred to as pneumonitis.

Etiology

Transmission

- Pneumonia can be spread in a number of ways
- The viruses and bacteria that are commonly found in nose or throat, can infect the lungs if they are inhaled
- The viruses and bacteria may also spread via air-borne droplets from a cough or sneeze
- In addition, pneumonia may spread through blood
- More research needs to be done on the different pathogens causing pneumonia and the ways they are transmitted, as this is of critical importance for treatment and prevention.

Etiology

Bacteria

- Bacteria are the most common cause of pneumonia, with *Streptococcus pneumoniae* isolated in nearly 50% of cases
- Other bacteria include *Haemophilus influenzae*, *Chlamydophila pneumoniae*, *Mycoplasma pneumoniae*, *Staphylococcus aureus*, *Moraxella catarrhalis*; *Legionella pneumophila* and Gram-negative bacilli
- A number of drug-resistant infections are becoming more common, including drug-resistant *Streptococcus pneumoniae* (DRSP) and methicillin-resistant *Staphylococcus aureus* (MRSA)
- The spreading of organisms is facilitated when risk factors are present (alcoholism is associated with *Streptococcus pneumoniae*, anaerobic organisms, and *Mycobacterium tuberculosis*; exposure to birds is associated with *Chlamydia psittaci*; farm animals associated with *Coxiella burnetti*; etc.).

Etiology

Viruses

- In adults, viruses account for approximately a third and in children for about 15% of pneumonia cases
- Commonly implicated agents include rhinoviruses, coronaviruses, influenza virus, respiratory syncytial virus (RSV), adenovirus, and parainfluenza
- Herpes simplex virus rarely causes pneumonia
- People following organ transplantation or those otherwise-immunocompromised present high rates of cytomegalovirus pneumonia
- Those with viral infections may be secondarily infected with the *Streptococcus pneumoniae*, *Staphylococcus aureus*, or *Haemophilus influenzae*
- During influenza season influenza may account for over half of all viral cases.

Etiology

Fungi

- Fungal pneumonia is uncommon, but occurs more commonly in individuals with weakened immune systems due to AIDS, immunosuppressive drugs, or other medical problems
- It is most often caused by *Histoplasma capsulatum*, blastomyces, *Cryptococcus neoformans*, *Pneumocystis jiroveci* (pneumocystis pneumonia), and *Coccidioides immitis*
- Histoplasmosis is most common in the Mississippi River basin, and coccidioidomycosis is most common in the Southwestern United States
- The number of cases has been increasing in the later half of the 20th century due to increasing travel and rates of immunosuppression in the population.

Etiology

Parasites

- A variety of parasites can affect the lungs, including *Toxoplasma gondii*, *Strongyloides stercoralis*, *Ascaris lumbricoides*, and *Plasmodium malariae*
- These organisms typically enter the body through direct contact with the skin, ingestion, or via an insect vector
- Except for *Paragonimus westermani*, most parasites do not affect specifically the lungs but involve the lungs secondarily to other sites
- Some parasites, in particular those belonging to the *Ascaris* and *Strongyloides* genera, stimulate a strong eosinophilic reaction, which may result in eosinophilic pneumonia
- In other infections, such as malaria, lung involvement is due primarily to cytokine-induced systemic inflammation
- Around the world, these infections are most common in the immunodeficient.

Etiology

Noninfectious

Idiopathic interstitial pneumonia or noninfectious pneumonia is a class of diffuse lung diseases that include:

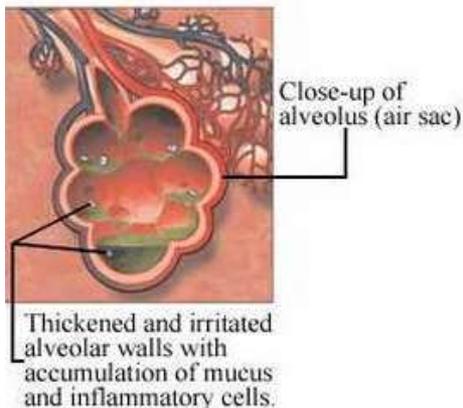
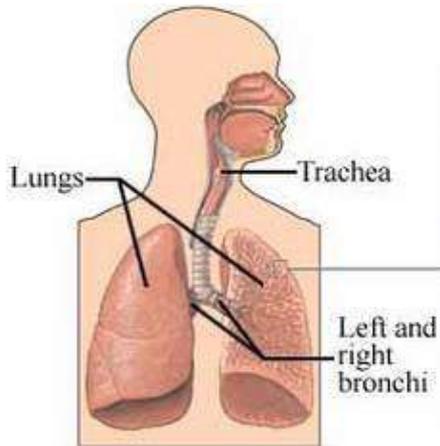
- Diffuse alveolar damage
- Organizing pneumonia
- Nonspecific interstitial pneumonia
- Lymphocytic interstitial pneumonia
- Desquamative interstitial pneumonia
- Respiratory bronchiolitis interstitial lung disease
- Usual interstitial pneumonia.

Mechanism

- The normal lung as seen by surface stereomicroscopy is made up of a series of saccules separated from one another by a thin, transparent, interalveolar wall; the bulk of this wall is composed of large and small capillaries so arranged as to allow for the largest possible exposure of blood to the alveolar gases; under normal conditions air enters the alveoli through the terminal bronchiole, and with each expiration a part or the whole of this air is expelled back into the bronchial tree and thence outward
- When inflammation occurs in the alveoli, it has its origin in the vascular tree, in the inner wall of the alveolus or, by extension, in the pleural surface; regardless of origin the steps of inflammation in the alveolus are practically the same as those in inflammation in any other part of the body; in other words, one would expect hyperemia followed by swelling and exudation and finally resolution or suppuration.

Mechanism

- Pneumonia occurs when the defense mechanisms are overcome and germs from an inhaled contaminant reach the peripheral air passages
- Pneumonia causes edema in the alveolar tree along with leukocyte infiltration
- The congestion creates a perfect place for bacteria to grow and replicate
- This process may stay circumscribed to an area or extend along the lungs
- As consolidation takes place, the respiratory function alters the vital capacity and the dispensability of the airways decreases
- The blood flow and ventilation of the involved areas is affected with decreased oxygenation and increased respiratory and cardiac workloads.



Mechanism

Viral

- Respiratory syncytial virus is typically contracted when people touch contaminated objects and then they touch their eyes or nose
- Other viral infections occur when contaminated airborne droplets are inhaled through the mouth or nose
- The invasion of the lungs may lead to varying degrees of cell death
- When the immune system responds to the infection, even more lung damage may occur
- Primarily white blood cells, mainly mononuclear cells, generate the inflammation
- As well as damaging the lungs, many viruses simultaneously affect other organs and thus disrupt other body functions
- Viruses also make the body more susceptible to bacterial infections; in this way, bacterial pneumonia can arise as a co-morbid condition.

Mechanism

Bacterial

- Most bacteria enter the lungs via small aspirations of organisms residing in the throat or nose
- A minority of types of bacteria such as *Mycobacterium tuberculosis* and *Legionella pneumophila* reach the lungs via contaminated airborne droplets
- Bacteria can spread also via the blood
- Once in the lungs, bacteria may invade the spaces between cells and between alveoli, where the macrophages and neutrophils attempt to inactivate the bacteria
- The neutrophils also release cytokines, causing a general activation of the immune system
- The neutrophils, bacteria, and fluid from surrounding blood vessels fill the alveoli, resulting in the consolidation seen on chest X-ray.

Classification

International Classification of Diseases

- X Diseases of the respiratory system
- J09-J18 Influenza and pneumonia
- J10 influenza due to identified seasonal influenza virus
- J11 Influenza, virus not identified
- J12 Viral pneumonia, not elsewhere classified
- J13 Pneumonia due to *Streptococcus pneumoniae*
- J14 Pneumonia due to *Haemophilus influenzae*
- J15 Bacterial pneumonia, not elsewhere classified
- J16 Pneumonia due to other infectious organisms, not elsewhere classified
- J17 Pneumonia in diseases classified elsewhere
- J18 Pneumonia in diseases classified elsewhere



Classification

By location acquired

Because pathogens and outcomes tend to be similar in patients in similar settings and with similar risk factors, pneumonias can be categorized as

- Community-acquired pneumonia
- Hospital-acquired (including ventilator-acquired and postoperative) pneumonia
- Health care–associated (including nursing home-acquired) pneumonia
- Occurring in immunocompromised patients, including patients with HIV infection, pneumonia
- Aspiration pneumonitis and pneumonia.

Classification

Community-acquired Pneumonia

- Community-acquired pneumonia develops in people with limited or no contact with medical institutions or settings
- The most commonly identified pathogens are *Streptococcus pneumoniae*, *Haemophilus influenzae*, atypical bacteria (ie, *Chlamydia pneumoniae*, *Mycoplasma pneumoniae*, *Legionella* sp.), and viruses.
- Symptoms and signs are fever, cough, sputum production, pleuritic chest pain, dyspnea, tachypnea, and tachycardia.
- Diagnosis is based on clinical presentation and chest x-ray
- Treatment is with empirically chosen antibiotics
- Prognosis is excellent for relatively young or healthy patients, but many pneumonias, especially when caused by *S. pneumoniae*, *Legionella*, *Staphylococcus aureus*, or influenza virus, are serious or even fatal in older, sicker patients.

Classification

Hospital-acquired Pneumonia

- Hospital-acquired pneumonia develops at least 48 h after hospital admission
- The most common pathogens are gram-negative bacilli and *Staphylococcus aureus*; antibiotic-resistant organisms are an important concern
- Symptoms and signs include malaise, fever, chills, rigor, cough, dyspnea, and chest pain, but in ventilated patients, pneumonia usually manifests as worsening oxygenation and increased tracheal secretions
- Diagnosis is suspected on the basis of clinical presentation and chest x-ray and is confirmed by blood culture or bronchoscopic sampling of the lower respiratory tract
- Treatment is with antibiotics
- Overall prognosis is poor, due in part to comorbidities.

Classification

Health Care–associated Pneumonia

- Health care–associated pneumonia occurs in non-hospitalized patients that reside in a nursing home or other long-term care facility; have undergone IV therapy or wound care within the previous 30 days; have been hospitalized in an acute care hospital for ≥ 2 days within the previous 90 days; or have attended a hospital or hemodialysis center within the previous 30 days
- In addition to the usual community-acquired pathogens include gram-negative bacilli and *Staphylococcus aureus* and various antibiotic-resistant pathogens
- Symptoms and signs are similar to those of pneumonia that occurs in other settings
- Diagnosis is based on clinical presentation and chest x-ray
- Treatment is with broad-spectrum antibiotics.
- Mortality is moderately high.

Classification

Pneumonia in Immunocompromised Patients

- Pneumonia in immunocompromised patients is often caused by unusual pathogens but may also be caused by the same pathogens as those that cause community-acquired pneumonia
- Symptoms and signs depend on the pathogen and on the conditions compromising the immune system.
- Diagnosis is based on blood cultures and bronchoscopic sampling of respiratory secretions, sometimes with quantitative cultures
- Treatment depends on the immune system defect and the pathogen.

Classification

Aspiration pneumonitis and pneumonia

- Aspiration pneumonitis and pneumonia are caused by inhaling toxic substances, usually gastric contents, into the lungs
- Chemical pneumonitis, bacterial pneumonia, or airway obstruction can occur
- Symptoms include cough and dyspnea
- Diagnosis is based on clinical presentation and chest x-ray findings
Treatment and prognosis differ by aspirated substance.

Classification

by Cause

- Bronchiolitis obliterans organizing (cryptogenic organizing) pneumonia
- Eosinophilic pneumonia (often occurs in response to infection with a parasite or after exposure to certain types of environmental factors)
- Chemical pneumonia (chemical pneumonitis)
- Aspiration pneumonia (aspiration pneumonitis)
- Dust pneumonia
- Necrotizing pneumonia (substantial necrosis of lung cells, lung abscess)
- Opportunistic pneumonia (in immunocompromised people)
- Double pneumonia (bilateral pneumonia)
- Severe acute respiratory syndrome (SARS is caused by the SARS coronavirus).

Classification

by Area of Lung Affected

- *A lobar pneumonia* is an infection that only involves a single lobe, or section, of a lung (lobar pneumonia is often due to *Streptococcus pneumoniae* (though *Klebsiella pneumoniae* is also possible)
- *Multilobar pneumonia* involves more than one lobe, and it often causes a more severe illness
- *Bronchial pneumonia* affects the lungs in patches around the tubes (bronchi or bronchioles).
- *Interstitial pneumonia* involves the areas in between the alveoli, and it may be called "interstitial pneumonitis" (it is more likely to be caused by viruses or by atypical bacteria).

Symptoms

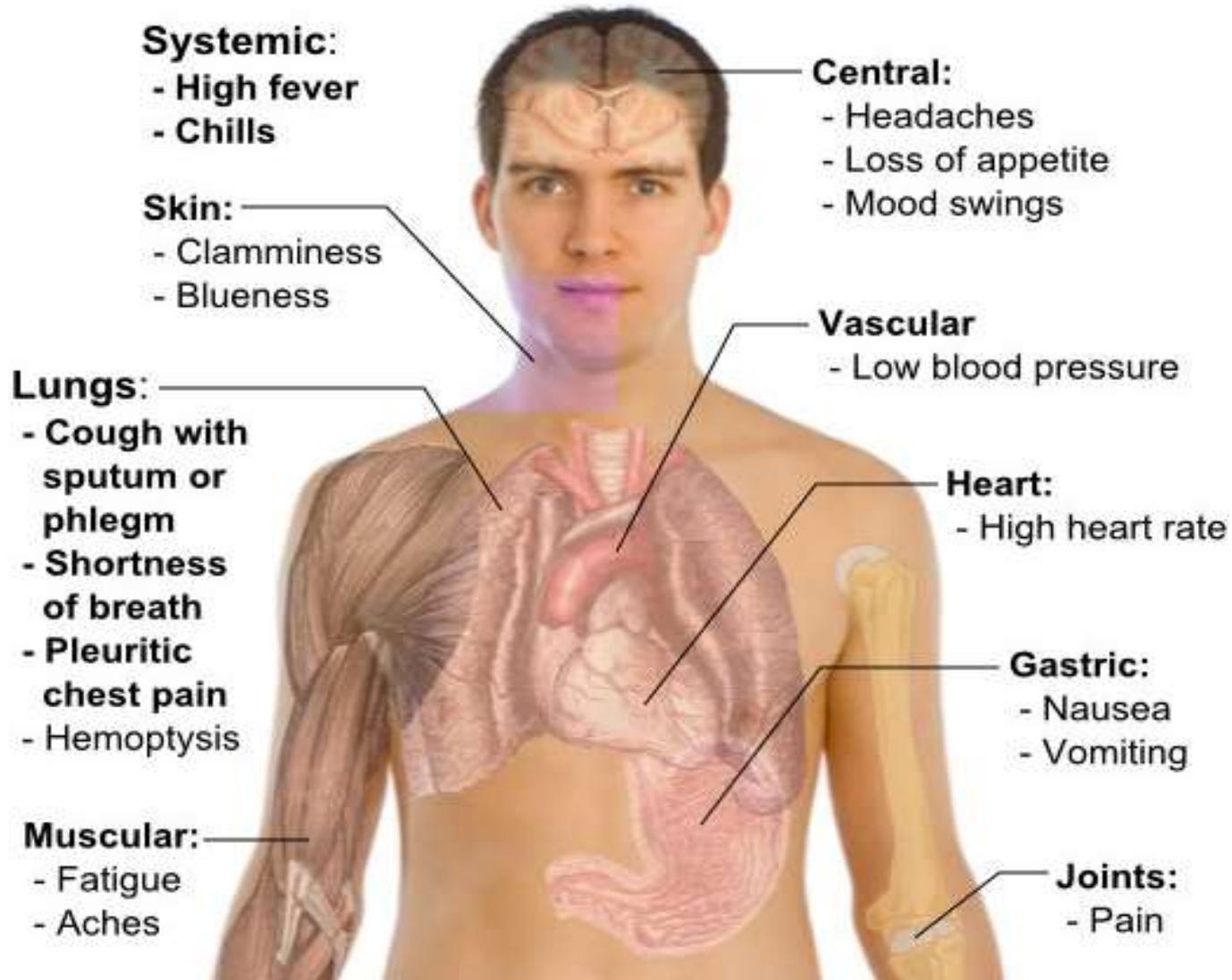
Presenting Features

- The presenting features of viral and bacterial pneumonia are similar
- The symptoms of viral pneumonia may be more numerous than the symptoms of bacterial pneumonia
- In children under 5 years of age, who have cough and/or difficult breathing, with or without fever, pneumonia is diagnosed by the presence of either fast breathing or lower chest wall indrawing where their chest moves in or retracts during inhalation (in a healthy person, the chest expands during inhalation)
- Wheezing is more common in viral infections.
- Very severely ill infants may be unable to feed or drink and may also experience unconsciousness, hypothermia and convulsions.

Symptoms and Signs

- Symptoms include malaise, chills, rigor, fever, cough, dyspnea, and chest pain
- Cough typically is productive in older children and adults and dry in infants, young children, and the elderly
- Dyspnea usually is mild and exertional and is rarely present at rest.
- Chest pain is pleuritic and is adjacent to the infected area
- Pneumonia may manifest as upper abdominal pain when lower lobe infection irritates the diaphragm; gastrointestinal symptoms are also common
- Signs include fever, tachypnea, tachycardia, crackles, bronchial breath sounds, egophony, and dullness to percussion
- Signs of pleural effusion may also be present.

Symptoms and Signs



Clinical Presentation

Bacterial Pneumonia

- During the intake history, the patient's potential exposures, aspiration risks, host factors, and symptoms should be reviewed
- A history of various exposures, such as travel, animal, occupational, and environmental exposures, can be helpful in determining possible etiologies and the likelihood of bacterial pneumonia (exposure to contaminated air-conditioning or water systems – *Legionella* species; exposure to overcrowded institutions - *S pneumoniae*, *Mycobacteria*, *Mycoplasma*, *Chlamydophila*; exposure to various types of animals - *C burnetii*, *B anthracis*; birds - *C psittaci*); rabbits, rodents - *F tularensis*, *Y pestis*)
- Aspiration risks (alcoholism, altered mental status, anatomic abnormalities, congenital or acquired, drug use, dysphagia, gastroesophageal reflux disease. Seizure disorder.

Clinical Presentation

Viral Pneumonia

- The clinical manifestations vary because of the number of diverse etiologic agents
- Various viral pneumonias typically occur during specific times of the year, among close populations or in populations with underlying cardiopulmonary or immunocompromising disease
- Influenza is usually seen in epidemics and pandemics in late winter and early spring
- Symptoms are similar to that of bacterial pneumonia
- Ascertaining immunization status, travel history, and possible exposure is important
- The typical infection consists of a sudden onset of fever, chills, myalgia, arthralgia, cough, sore throat, and rhinorrhea with the incubation period is 1-2 days, and symptoms normally last 3-5 days.

Complications

- Pleural effusion
- Empyema
- Lung abscess
- Pneumatocele
- Pneumothorax
- Pyopneumothorax
- Deep vein thrombosis
- Septicaemia, pericarditis, endocarditis, osteomyelitis, septic arthritis, cerebral abscess, meningitis
- Postinfective bronchiectasis
- Acute kidney injury.

Diagnosis

- Pneumonia is typically diagnosed based on a combination of physical signs and a chest X-ray
- The cause can be difficult to confirm, as there is no definitive test able to distinguish between bacterial and non-bacterial origin
- In adults, investigations are not needed in mild cases
- There is a very low risk of pneumonia if all vital signs and auscultation are normal
- In persons requiring hospitalization, pulse oximetry, chest radiography and blood tests (complete blood count, serum electrolytes, C-reactive protein level, and possibly liver function tests) are recommended
- The diagnosis of influenza-like illness can be made based on the signs and symptoms; however, confirmation of an influenza infection requires testing.

Diagnosis

Physical Exam

- Physical examination may sometimes reveal low blood pressure, high heart rate, or low oxygen saturation
- The respiratory rate may be faster than normal, and this may occur a day or two before other signs
- Examination of the chest may be normal, but it may show decreased chest expansion on the affected side.
- Harsh breath sounds from the larger airways that are transmitted through the inflamed lung are termed bronchial breathing and are heard on auscultation with a stethoscope
- Crackles (rales) may be heard over the affected area during inspiration.
- Percussion may be dulled over the affected lung, and increased vocal resonance distinguishes pneumonia from a pleural effusion.

Diagnosis

Imaging

- A chest radiograph is frequently used in diagnosis
- In people with mild disease, imaging is needed only in those with potential complications, those not having improved with treatment, or those in which the cause is uncertain.
- If a person is sufficiently sick to require hospitalization, a chest radiograph is recommended
- Findings do not always match the severity of disease and do not reliably separate between bacterial infection and viral infection
- X-ray presentations of pneumonia may be classified as lobar pneumonia, bronchopneumonia , and interstitial pneumonia
- Radiologic findings may not be present in the early stages of the disease, especially in the presence of dehydration, or may be difficult to be interpreted in the obese or those with a history of lung disease.

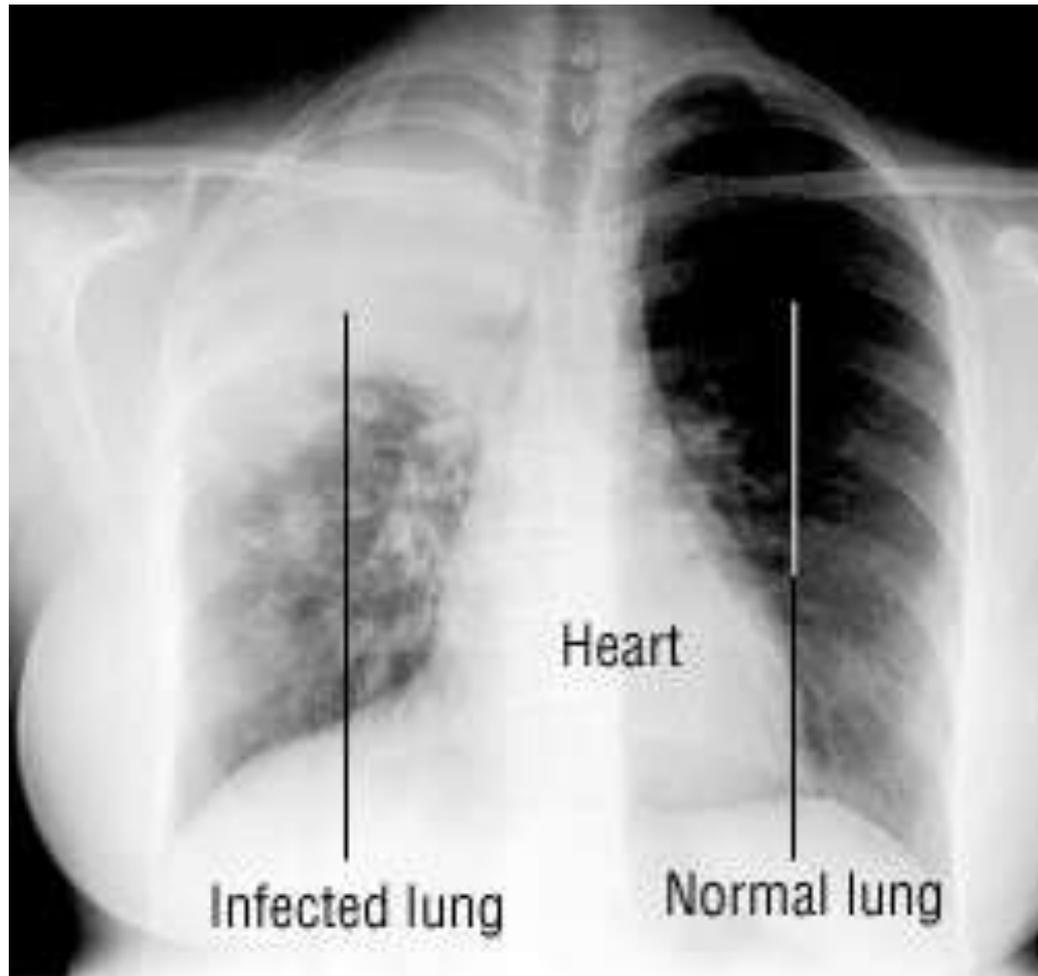
Diagnosis

Microbiology

- In patients managed in the community, determining the causative agent is not cost-effective and typically does not alter management
- For people that do not respond to treatment, sputum culture should be considered, and culture for *Mycobacterium tuberculosis* should be carried out in persons with a chronic productive cough
- Testing for other specific organisms may be recommended during outbreaks, for public health reasons
- In those hospitalized for severe disease, both sputum and blood cultures are recommended, as well as testing the urine for antigens to *Legionella* and *Streptococcus*
- Viral infections can be confirmed via detection of either the virus or its antigens with culture or polymerase chain reaction (PCR), among other techniques.[[]

Diagnosis

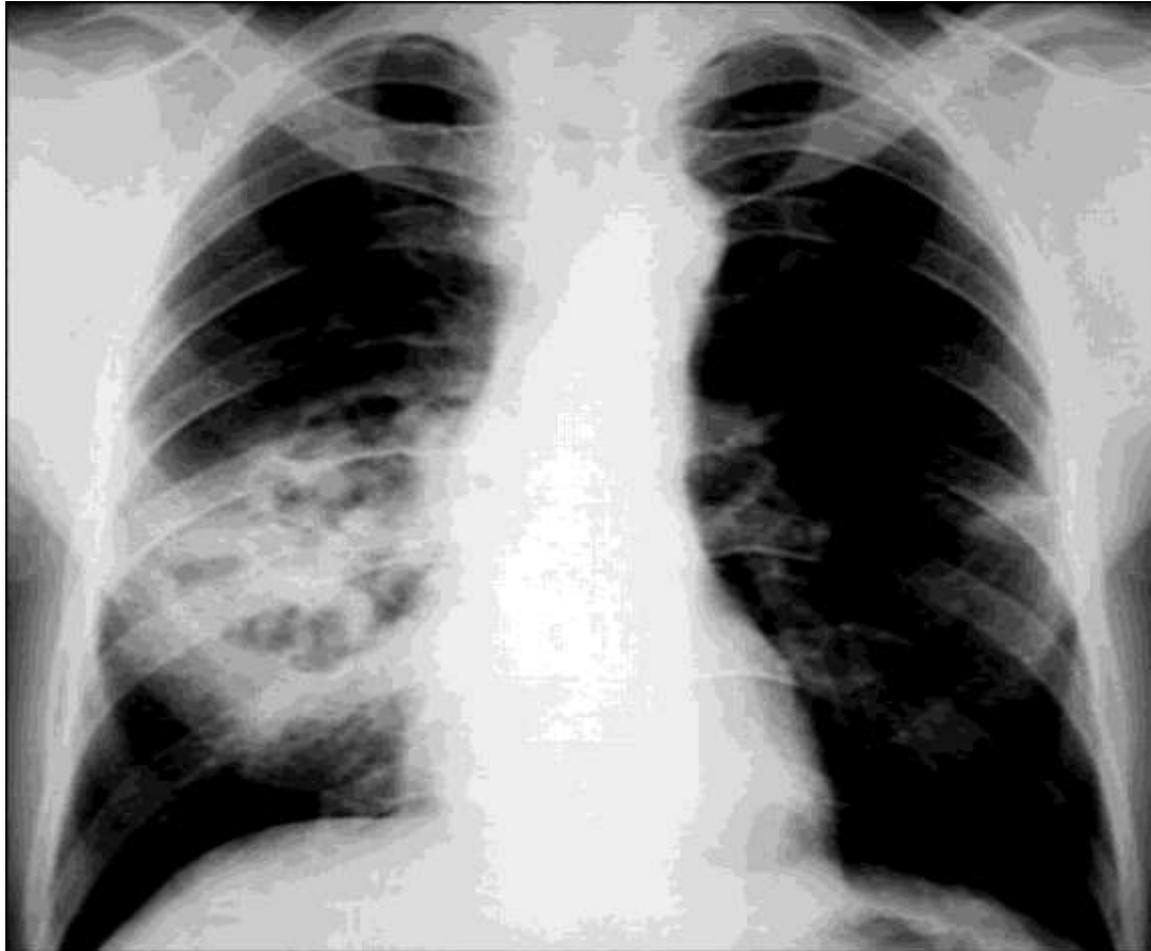
Imaging Studies



Pneumonia.

Diagnosis

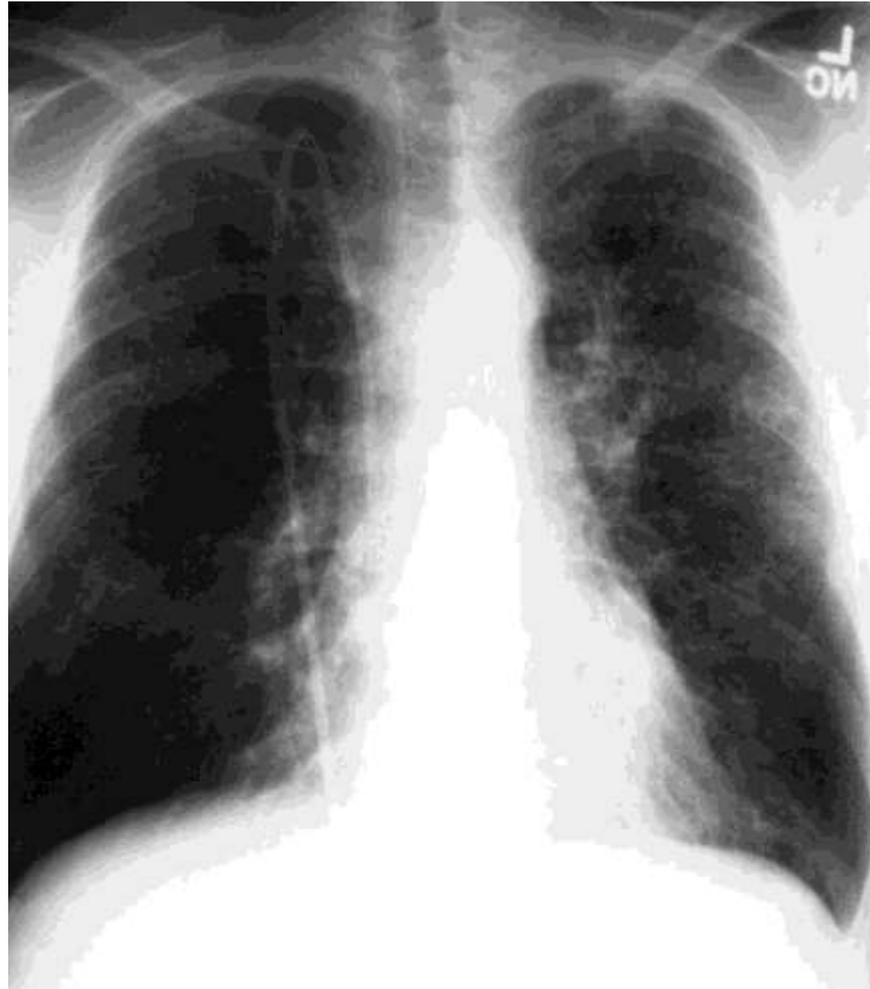
Imaging Studies



Lung abscess.

Diagnosis

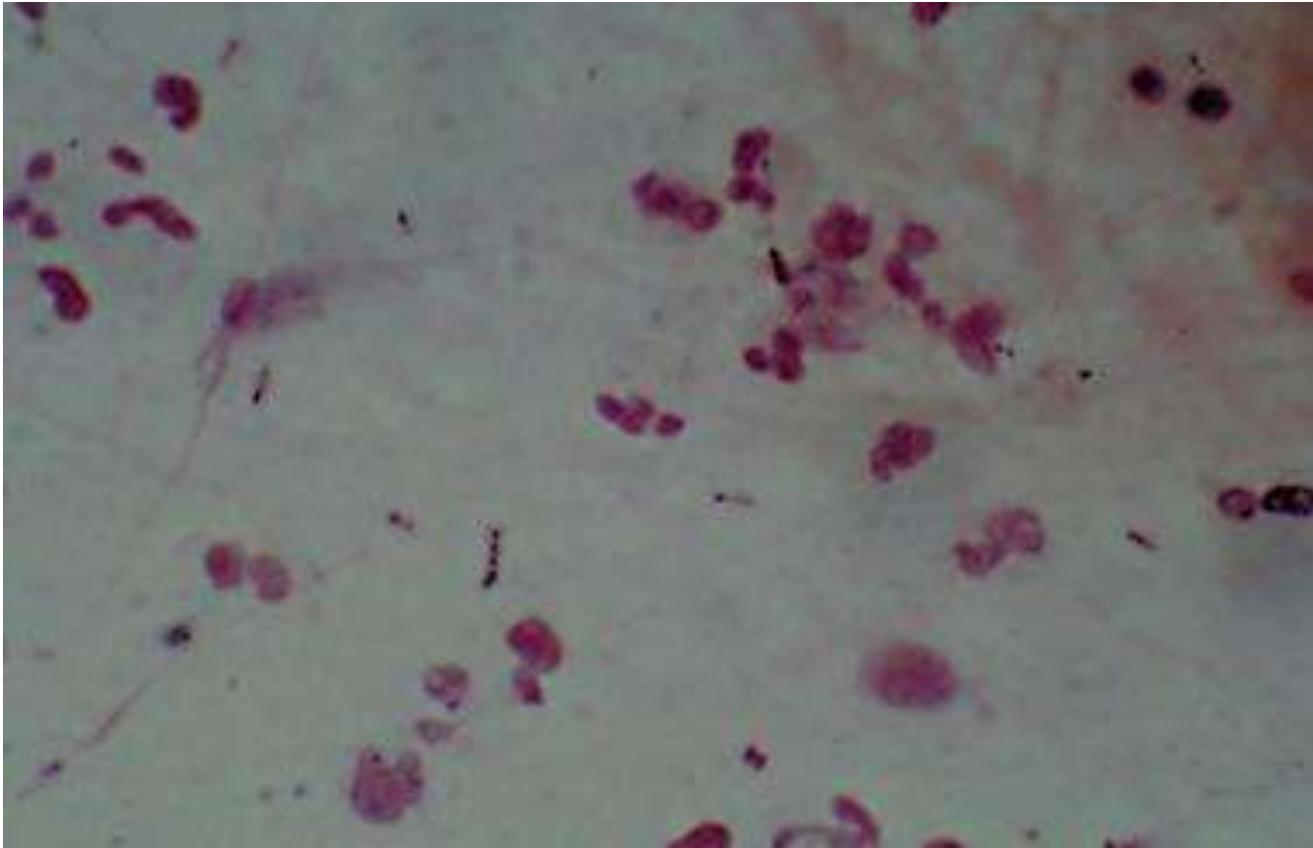
Imaging Studies



Influenza pneumonia.

Diagnosis

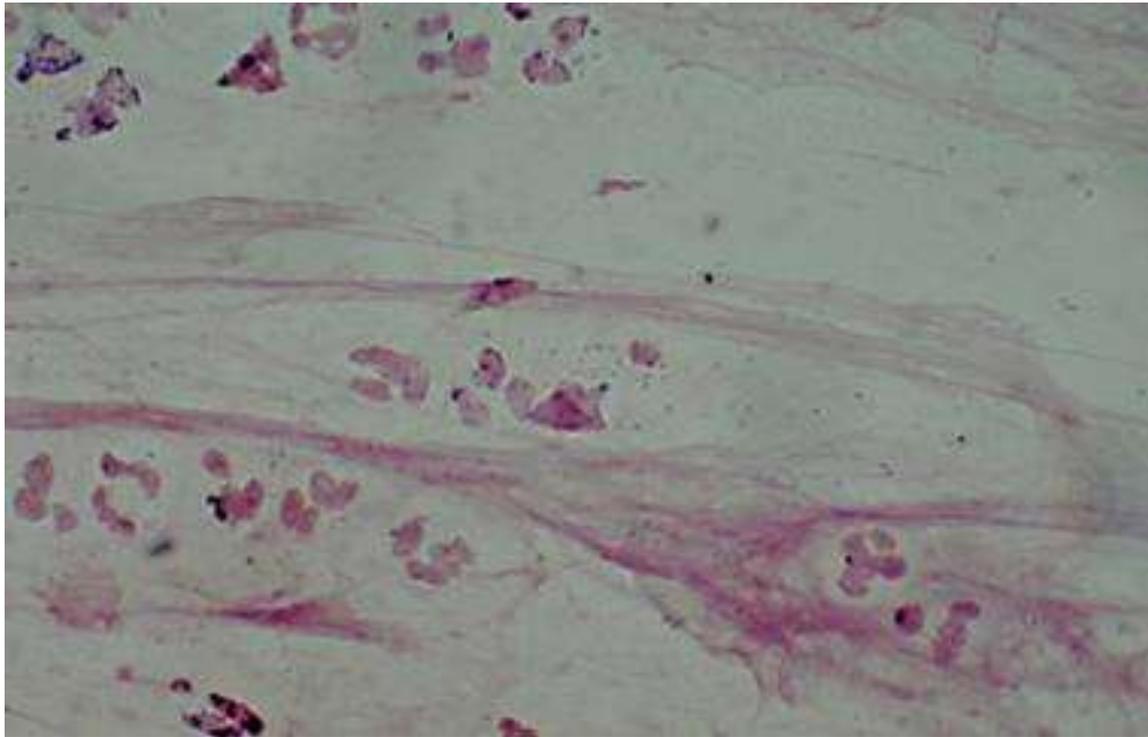
Gram stain



Streptococcus pneumoniae.

Diagnosis

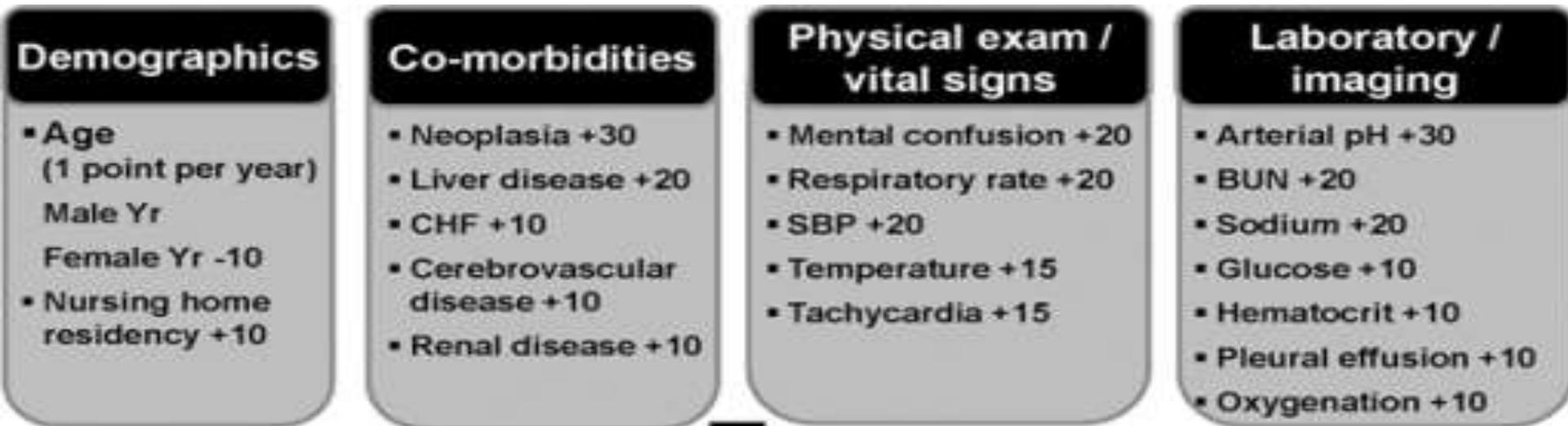
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Haemophilus influenzae.

Diagnosis

Pneumonia Severity Index



Risk class (Points)	Mortality (%)	Recommended site of care
I (<50)	0.1	Outpatient
II (51–70)	0.6	Outpatient
III (71–90)	2.8	Outpatient or brief inpatient
IV (91–130)	8.2	Inpatient
V (>130)	29.2	Inpatient

Management

- Oral antibiotics, rest, simple analgesics, and fluids usually suffice for complete resolution
- The elderly, or those with significant trouble breathing may require more advanced care
- If the symptoms worsen, the pneumonia does not improve with home treatment, or complications occur, hospitalization may be required
- The utility of chest physiotherapy in pneumonia has not yet been determined
- Non-invasive ventilation may be beneficial in those admitted to the intensive care unit
- Over-the-counter cough medicine has not been found to be effective nor has the use of zinc in children
- There is insufficient evidence for mucolytics.

Management

Bacterial 1

- Antibiotics improve outcomes in those with bacterial pneumonia
- Treatment before culture results with amoxicillin is recommended for community-acquired pneumonia, with doxycycline or clarithromycin as alternatives
- In North America macrolides, and doxycycline have displaced amoxicillin as first-line outpatient treatment in adults
- In children amoxicillin remains the first line
- For those who require hospitalization the use of a β -lactam plus macrolide or a fluoroquinolones is recommended

Management

Bacterial 2

- The addition of corticosteroids also appears to improve outcomes
- The duration of treatment has traditionally been seven to ten days, but the shorter courses (three to five days) are similarly effective
- Recommended for hospital-acquired pneumonia include third- and fourth-generation cephalosporins, carbapenems, fluoroquinolones, aminoglycosides, and vancomycin (often intravenously and used in combination).

Management

Viral

- Neuraminidase inhibitors may be used to treat viral pneumonia caused by influenza viruses (influenza A and influenza B)
- No specific antiviral medications are recommended for other types of community acquired viral pneumonias including SARS coronavirus, adenovirus, hantavirus, and parainfluenza virus
- Influenza A may be treated with rimantadine or amantadine, while influenza A or B may be treated with oseltamivir, zanamivir, peramivir
- These are of most benefit if they are started within 48 hours of the onset of symptoms
- Many strains of H5N1 influenza A ("bird flu"), have shown resistance to rimantadine and amantadine
- The use of antibiotics in viral pneumonia is recommended by some experts, as it is impossible to rule out a complicating bacterial infection.

Management

Aspiration

- In general, aspiration pneumonitis is treated conservatively with antibiotics indicated only for aspiration pneumonia
- The choice of antibiotic will depend on several factors, including the suspected causative organism and whether pneumonia was acquired in the community or developed in a hospital setting
- Common options include clindamycin, a combination of a beta-lactam antibiotic and metronidazole, or an aminoglycoside
- Corticosteroids are sometimes used in aspiration pneumonia, but there is limited evidence to support their effectiveness.

Prognosis

- With treatment, most types of bacterial pneumonia will stabilize in 3–6 days; it often takes a few weeks before most symptoms resolve; in the elderly or people with other lung problems, recovery may take more than 12 weeks; in persons requiring hospitalization, mortality may be as high as 10%, and in those requiring intensive care it may reach 30–50%
- Pneumonia is the most common hospital-acquired infection that causes death; before the advent of antibiotics, mortality was typically 30% in those that were hospitalized
- Complications may occur in particular in the elderly and those with underlying health problems.

Prophylaxis

- Early appropriate antibiotic therapy reduces mortality and morbidity
- Influenza and pneumococcal vaccination
- Targeted risk reduction, such as smoking cessation.

Abbreviations

- DRSP - *Streptococcus pneumoniae*
- MRSA - methicillin-resistant *Staphylococcus aureus*
- PCR - polymerase chain reaction
- RSV - respiratory syncytial virus
- SARS - severe acute respiratory syndrome

Diagnostic and treatment guidelines

[Guidelines for diagnosis and management of community- and hospital-acquired pneumonia in adults: Joint ICS/NCCP\(I\) recommendations](#)

[Guidelines for the Management of Adults with Hospital-acquired, Ventilator-associated, and Healthcare-associated Pneumonia](#)

[Infectious Diseases Society of America/American Thoracic Society Consensus Guidelines on the Management of Community-Acquired Pneumonia in Adults](#)

[Pneumonia in adults: diagnosis and management](#)

[Community-Acquired Pneumonia in Adults: Guidelines for Management](#)