MINISTRY OF HEALTH OF UKRAINE

ODESA NATIONAL MEDICAL UNIVERSITY

Departments of Pediatrics №2

CONFIRMED by

Vice-rector for research and educational work

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METHODOLOGICAL RECOMMENDATIONS ON PRACTICAL CLASSES FOR STUDENTS

International Medical Faculty, course 6

Educational discipline "**PEDIATRICS**"

Approved
at the meeting of the department of Pediatrics №2
Protocol No. 11 dated 28/08/2022

Head of the department of Pediatrics №2 _____ Tetiana STOIEVA
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1. **Topic № 11**
   Differential diagnosis of pneumonia in children. Leading clinical symptoms and syndromes, data of laboratory and instrumental studies in various clinical variants of pneumonia and its complications in children. Establishing a preliminary diagnosis. Patient management tactics in different clinical variants of the course of pneumonia and its complications. Emergency care for acute respiratory failure depending on the cause and degree of severity. Management of pneumonia in children in the context of Integrated management of childhood diseases. Prevention of pneumonia and its complications in children.
2. **Relevance of the topic.** Pneumonia is one of the most common childhood diseases. The incidence of pneumonia among children in Ukraine ranges from 4 to 20 cases per 1,000 children aged 1 month to 15 years. The high incidence of pneumonia in childhood is due to the anatomical and physiological characteristics of the respiratory organs and the characteristics of their immune system. The study of the clinical peculiarities of various forms of pneumonia in children, modern approaches to their diagnosis and treatment is a priority task of each pediatrician. In recent years, both worldwide and in Ukraine, the number of patients with a severe disease and the number of cases of late diagnosis of pneumonia have increased. The incidence of diagnostic errors in outpatient diagnosis is up to 20%, and the incidence of clinical-pathological disagreements is up to 30%. There has been an increase in the number of deaths from pneumonia since the mid-1980s. Pneumonia is the sixth leading cause of death in the United States. The problem of rational treatment of pneumonia is among the most relevant in modern pulmonology. Despite advances in the development of new antibacterial, antiviral, antirib and antiparasitic drugs, there is a widespread increase in the number and worsening of the effects of pneumonia. It is also important that the etiological structure and differential diagnosis of pneumonia have expanded significantly in recent decades and this process is likely to be continued. Along with the known pneumotropic infectious agents, new ones appeared (Legionella spp., Chlamidia pneumoniae, SARS, MERS, COVID-19, opportunistic infections, etc.), which significantly changed the traditional concepts about pulmonary inflammation. The choice of rational antibacterial therapy is thus one of the main components of successful children treatment and is of great importance in reducing mortality rates, preventing relapse and chronization of the process, as well as of social importance, reducing parents' stay on sick leave.
3. **Lesson objectives:**
   3.1. General objectives: To get acquainted with the modern definition of pneumonia, classification, criteria for diagnosis of pneumonia and complications of pneumonia, features of clinic of typical and atypical pneumonia, principles of therapy depending on the pathogen.
   3.2. Educational objectives: To learn about modern methods of treatment of pneumonia in children. Study the characteristics of therapeutic programmes for children with uncomplicated and complicated pneumonia, with the inclusion of secure, ethiopagenic and symptomatic treatments. Learn the principles of medical rehabilitation of children with pneumonia.
   3.3. Specific objectives:
   - to know:
   1. Etiological and pathogenic factors of pneumonia in children
   2. Concept of the complexity of therapeutic measures of the sanitary-hygienic and medical-protective regime
   3. The principle of a rational diet and a drinking regime
   4. Ethotropic therapy for pneumonia. Principles of Rational Antibiotic Therapy
   5. Pathogenic therapy for pneumonia
   6. Symptomatic therapy for pneumonia
   7. Principles for the medical rehabilitation of children with pneumonia

   3.4. Based on theoretical knowledge of the subject:
   - be able to:
   1. to conduct a survey and physical examination of patients with respiratory diseases;

2. to identify the main variants of the course of pneumonia in children;
3. to draw up a survey plan for a typical and atypical course of pneumonia in children;
4. to justify the use of invasive and non-invasive diagnostic methods;
5. to determine indications and contraindications for their implementation;
6. to carry out differential diagnosis of pneumonia and other pathologies of the respiratory system in children
7. to draw up a plan for the treatment of pneumonia and carry out primary and secondary prevention of respiratory diseases in children;
8. to carry out a life forecast for respiratory diseases.

- *to master with:*
- interpretation of data from laboratory and instrumental examinations in the case of respiratory diseases in children;
- diagnosis and emergency care for acute respiratory failure in children
- principles for the treatment, rehabilitation and prevention of respiratory diseases in children;
- moral, deontological and bioethical principles of a medical specialist and the principles of professional subordination in pediatrics.

4. Materials for classroom self-study (interdisciplinary integration).

Titles of previous disciplines	Acquired skills
Medical chemistry	Decipher biochemical parameters in health and disease in children
Medical and biological physics	Describe the operating principle of pulse oximeter, capnography, artificial lung ventilation apparatus
Anthropotomy	Know the anatomical features of the respiratory system in children
Histology, cytology and embryology	Know the cytoarchitectonics of the respiratory system in children
Physiology	Describe the normal physiology of the respiratory system in children of different ages. Draw the dissociation curve of oxyhemoglobin, pulse wave
Microbiology, virology and immunology	To give a clinical interpretation of changes in the immunogram in children with respiratory diseases. Determine the microbiological spectrum of infectious factors of respiratory diseases.
Pathomorphology	Classify diseases of the bronchopulmonary system
Pathophysiology	Describe the development mechanisms of pathological symptoms and syndromes in children with respiratory diseases.
Pharmacology	Calculate the doses of the main drugs used in the treatment of respiratory organs in children
Hygiene and ecology	Possess hygienic standards of nutrition and nursing of children
Pediatric propedeutics	Demonstrate the method of subjective and objective examination of the child
Nursing	Possess methods for the care of children with respiratory diseases
Medical psychology	Provision of psychological assistance to parents and children suffering from pathology of the bronchosetic system
Radiology	Describe changes on radiographs for various respiratory diseases in children

5. Content of the topic (theses).

1. Determination of pneumonia, etiology, pathogenesis.
2. Clinical-laboratory and instrumental criteria for the diagnosis of pneumonia in children.
3. Dif. diagnostics and features of the course of congenital and acquired pneumonia.

4. Dif. diagnostics and current characteristics of community-acquired and hospital-acquired pneumonia.
5. Features of the clinic and course of atypical pneumonia.
6. Features of the course of pneumonia, depending on the pathogen.
7. Complications of pneumonia: diagnosis, dif. diagnosis.
8. Therapeutic tactics in the treatment of pneumonia.
9. Features of the treatment of congenital pneumonia.
10. Features of the treatment of hospital-acquired pneumonia
11. Features of the therapy of atypical pneumonia.
12. Therapy of complicated pneumonia.
13. Features of the treatment of pneumonia in immunodeficiency states.
14. Definition, etiology, pathogenesis of respiratory failure in children.
15. DN classification, pathogenetic classification, functional classification of functional indicators of severity.
16. DN diagnostics
17. DN treatment (treatment of underlying pathology, ensuring airway patency).
18. Principles of oxygen therapy for DN.
19. Drug therapy for DN.
20. Indications for artificial lung ventilation, principles of artificial lung ventilation.

Pneumonia is a non-specific inflammatory disease of the lung tissue, diverse in etiology (in most cases, bacterial), which is characterized by lung damage with intraalveolar exudation and is accompanied by intoxication, respiratory disorders, local physical changes in the lungs and the presence of an infiltrative shadow on the chest x-ray.

Classification

Etiology of pneumonia	• **Bacterial** • **Viral** • **Viral-bacterial** • **Fungal** • **Parasitic**
Forms of pneumonia by morphology	• Focal • Focal - drainage • Segmental • Lobar • Croupous • Interstitial
Forms of pneumonia by localization	• one-sided • bilateral • total
The course of pneumonia	• Acute (up to 6 weeks) - not included in the diagnosis! • Protracted - 6 weeks - 8 months. • Recurrent: defined as 2 or (usually) several separate episodes of lower respiratory tract infection, usually accompanied by fever, leukocytosis, production of purulent sputum. These episodes are divided at an asymptomatic interval of at least 1 month or no change on the chest X-ray.
Types of pneumonia by the site of occurrence	• Community-acquired (home) - first 48 (72) hours of hospitalization or later 48 hours after discharge • Hospital-acquired (nosocomial, hospital) - in a hospital, after 48 hours upon admission, no later than 48 hours after discharge • Congenital (intrauterine) - in the first 72 hours after birth

	• Aspiration • Ventilation • In patients with immunodeficiency
Types of pneumonia by complications	• Uncomplicated • Complicated: • Pulmonary (bacterial destruction of the lungs, ascess, gangrene of the lung, atelectasis, bronchiectasis, bullae) • Pleural (pleurisy) • Pulmonary pleural (pneumothorax, pyothorax) • Infectious-toxic - bacterial shock, sepsis, DIC • Inflammation of other organs
By severity	• Moderate severity* • Severe

* According to the 2013 WHO guidelines and recommendations for the treatment of children 2-59 months of age with cough and / or shortness of breath, there are severe pneumonia and non-severe pneumonia

The etiology of pneumonia depends on many factors, both external and internal:
1. Condition of occurrence
2. Age
3. Previous AB therapy
4. Concomitant diseases, previous conditions
5. Vaccination status
6. Epidemic situation
7. Season

Classification of pneumonia by site of occurrence suggests the most likely causative agent of pneumonia, making it easier to choose the starting empirical therapy.

Classification of pneumonia by site of occurrence	**The most common pathogen**
Community-acquired (home)	Viruses, *Str. pneumoniae, Hib, Mycoplasma pneumoniae, Legionella pneumophila, St. aureus, Chlamydia psitacci, Chl. pneumoniae*
Hospital-acquired (nosocomial, hospital)	*Pseudamonas aureginosa, Enterobacter, Klebsiella pneumoniae*
Congenital (intrauterine)	CMV, *Str. agalacticae, E. coli, Klebsiella pneumoniae,*
Aspiration	*Bacteriodes flagilis, Fusobactum*
Ventilation	*Haemophilus influenzae , Streptococcus pneumoniae* , methicillin - se nsitive *Staphylococcus aureus*/*Enterobacteriaceae , Pseudomonas aer uginosa , Acinetobacter spp* .,Methicillin- resistant and *St . a ureus , Moraxella catarrhalis*
In immunodeficiency patients	CMV, *Pneumocystis carnii (jirovecii),* fungus

The role of viruses in the emergence of community-acquired pneumonia in children

1. 17.9-73.5% of all community-acquired pneumonia (CAP) in children of viral genesis
2. 80% of cases of CAP in children under 2 years old are caused by a viral infection
3. The virus can act as a direct pathogen or co-pathogen
4. Frequent causative agents of pneumonia among viruses are RS virus, rhinoviruses - more often in association with other viruses; influenza virus (A and B), parainfluenza virus, adenovirus, bocavirus, metopneumovirus, coronavirus (SARS, MERS, COVID-19).

The role of various bacteria in the occurrence of community-acquired pneumonia in children, depending on age (according to ERS, 2014)

Bacteria	Infants	1-3 months	4 months - 4 years	5-18 years
Str. pneumoniae	+	+++	++++	+++
Hib	+	+	+	+ \ -
Str. Pyogenes	-	+	+	+
St. aureus	++	++	+	+
Str. agalacticae	+++	+	-	-
E. coli	++	+	-	-
Mycoplasma pneumoniae	-	+	++	++++
Chl. pneumoniae	-	+	+	++
Legionella pneumophila	+	+	+	+
Chl. trachomatis	+	++	-	-
Bordetella pertussis	+ \ -	++	+	+

Pathogenesis

Ways of penetration of the pathogen into the lung tissue:

1. Aerogenic: aspiration of secretions of the upper respiratory tract (*Str. Pneumoniae, Hib, gram - negative bacteria, anaerobes) /* inhalation of aerosol *(M. Pneumoniae, Chl. Pneumoniae, L. Pneumophila, Chl. Psitacci).*
2. Lymphogenous / hematogenous (often *St. Aureus*)

Factors leading to the development of the disease:

1. Violation of local bronchopulmonary protection
2. Decreased body reactivity
3. Violation of microcirculation of the lungs

The main links of pathogenesis:

1. Fixation and reproduction of an infectious agent
2. Intoxication because of absorption of microorganism toxins
3. The action of microbial toxins → violation of capillary permeability → serous edema → fibrinous edema
4. DN - restrictive type associated with excluding parts of the lungs from the act of breathing
5. Hypoxemia - respiratory acidosis, hypercapnia, mixed type DN → hypoxia (tissue)
6. Circulatory disturbances, overloads of the IWC - CH

7. Water-electrolyte disturbances are associated with DN (shortness of breath → perspiration → dehydration)
8. Metabolic disorders
9. Violation of acid-base balance → metabolic acidosis
10. Activation of free radical oxidation.
11. Changes in the coagulation properties of blood (hypocoagulation, disseminated intravascular coagulation syndrome)

Clinic and diagnostics
The incidence of pneumonia in children is very diverse. However, diverse syndromes usually accompany the disease:

1. **Syndrome of intoxication**
2. **Respiratory Failure Syndrome**
3. **Syndrome of local changes**
4. **Syndrome of the general inflammatory response**

Intoxication syndrome	➢fever (sometimes with chills) ➢decreased appetite ➢headache ➢violation of emotional tone ➢disturbance of consciousness / sleep ➢convulsions ➢nausea / vomiting
Respiratory failure syndrome	➢ tachypnea / dyspnea / apnea episodes ➢pallor of the skin ➢cyanosis (peripheral, central, total) ➢breathing efforts ➢stridor ➢participation of auxiliary muscles ➢retraction of the compliant areas of the chest (primarily retraction of the lower edge of the chest) ➢swelling of the wings of the nose ➢ speaking difficulty (for children with verbal skills) ➢feeling short of breath, fear, anxiety ➢ impaired consciousness
Local change syndrome	➢lag of one half of the chest in the act of breathing ➢local enhancement of voice jitter ➢local shortening of percussion sound (early sign) ➢weakened or bronchial breathing over the site of shortening of the percussion sound ➢crepitations ➢fine bubbling wet rales ➢increased bronchophonia on the affected side ➢X-ray: homogeneous infiltration of the area of the pulmonary field, infiltration of the lungs roots on the side of the lesion with enlarged lymph nodes, increased pulmonary pattern in the perifocal zones
Syndrome of general and local inflammatory response	➢cough (producing phlegm) ➢enlargement of the cervical, axillary lymph nodes ➢chest pain ➢abdominal pain ➢loose stools / diarrhea (in children, associated with secondary infection of the gastrointestinal tract when sputum is swallowed)

	➢hematological signs (depending on the nature of the pathogen): leukocytosis / leukopenia, neutrophilia, neutropenia, lymphocytosis, accelerated ESR

Respiratory failure classification:

Degree	Symptoms	
	Older children	Young children
RF-1	shortness of breath occurs during normal physical activity	shortness of breath, tachycardia on exertion: sucking, screaming, excitement RaO 2 is 80-65 mm Hg.
RF-2	shortness of breath with little exercise	Shortness of breath, tachycardia at rest, its significant increase during exercise. Minor cyanosis of the lips, acrocyanosis. Inflation of the wings of the nose, retraction of the intercostal spaces when breathing. The child is sluggish, irritable. RaO 2 is 65-50 mm
RF-3	significant dyspnea at rest	Shortness of breath up to 80-100 breaths per minute at rest. General cyanosis of the skin, mucous membranes. The auxiliary muscles take part in the act of breathing. Hypoxic encephalopathy (impaired consciousness, convulsions) may develop. RaO 2 is below 50 mm

According to the unified approach to examining a patient ABCDE with pneumonia, the main changes can be observed when performing steps A and B:
A (airway): patency can be destroyed by mucus or stridor.
B (breath):
1. RR - tachypnea
2. Breathing effort - difficulty in inhaling or exhaling
3. Chest retraction - retraction of the lower edge of the chest
4. Respiratory noises - characteristic local changes
5. SpO2 – decrease

The variety of symptoms and associated conditions can make it difficult to diagnose pneumonia. It is customary to highlight the frequent symptoms of pneumonia, which can help in differential diagnosis.

Frequent symptoms	**Fever with chills, decreased / lack of appetite, cough, tachypnea / dyspnea, shortened percussion sound, crepitus, fine bubbling rales, weakened bronchophonia on the affected side**
Rare symptoms	Chest pain, abdominal pain, impaired consciousness, convulsions, vomiting in young children
The combination of symptoms most likely to indicate a diagnosis of pneumonia	**Fever + tachypnea + localized respiratory depression + crepitus / wheezing = S 94%**

Laboratory tests
1. CBC: changes depend on the etiology: in PN caused by *Str. Pneumoniae*, - neutrophilic leukocytosis (> 15 g / l), a significant increase in ESR. There are no characteristic changes with viral, mycoplasma, chlamydial PN. Hyperleukocytosis (> 30 g / l) is with chlamydial PN in children during the first months of life.

2. Biochemical blood test: CRP, IL-1, -6, PCT (bacterial PN -> 1 ng / ml, viral - <1 ng / L, high predictive value, criteria for AB cancellation. But some scientific studies consider this indicator not informational and do not recommend using it to determine the possible etiology of pneumonia).

1. **Gram staining of sputum or bronchial exudate** and **bacteriological culture** (culture of material from the nose is not informative).
2. **Immunofluorescence methods** (some viruses).
3. **Serological research methods** (complement fixation reaction).
4. **Diagnostic pleural puncture with sowing the contents of the bacterial** flora (with hydrothorax).
5. **Tuberculin skin test** is carried out according to indications (contact with a patient with tuberculosis in history, stay in areas where tuberculosis is widespread).
6. **Bacteriological blood culture for sterility** according to indications.

Instrumental diagnostics

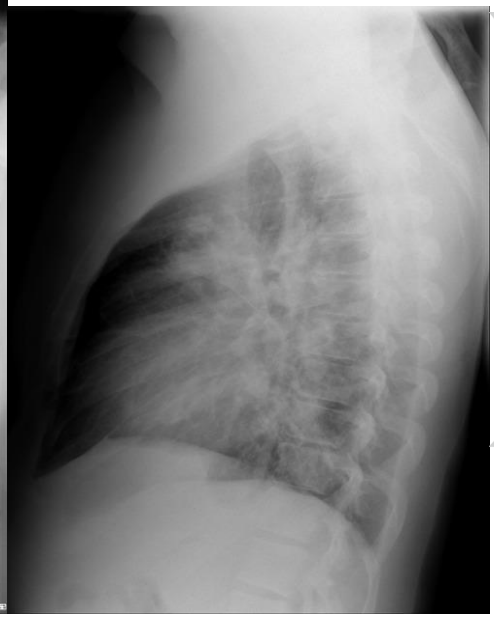
1. **Pulse oximetry**: performed for all children with suspected pneumonia and hypoxemia. The presence of hypoxemia should be the basis for making decisions on patient hospitalization, further diagnostic examination and the scope of treatment.

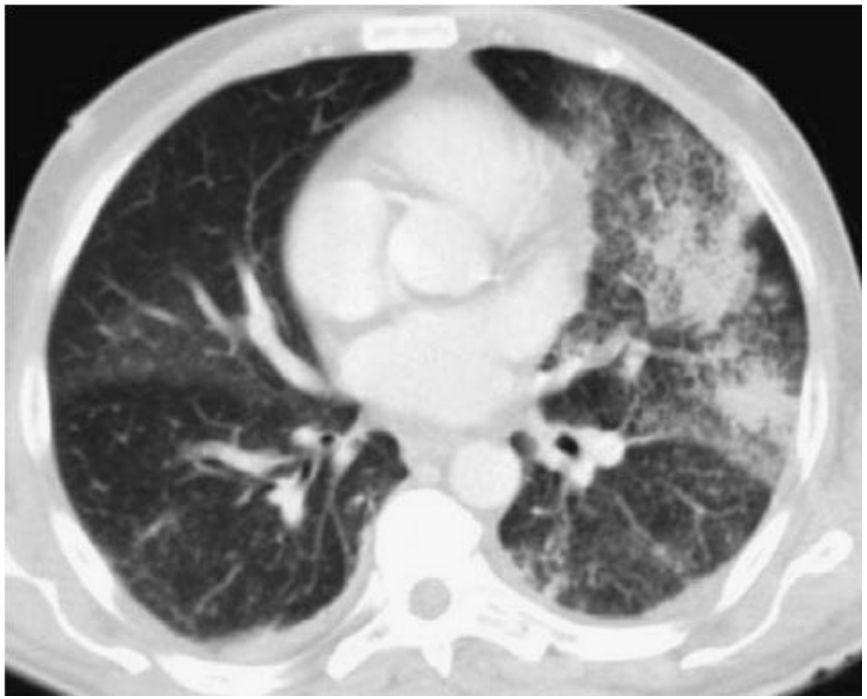
2. **X-ray of the chest organs:** focal, segmental or infiltrative changes, against the background of increased pulmonary pattern with a compacted root. A control study is indicated in the absence of an effect from treatment, a complicated course. False negative results: dehydration, neutropenia, pneumocystis etiology, early stage of the disease.

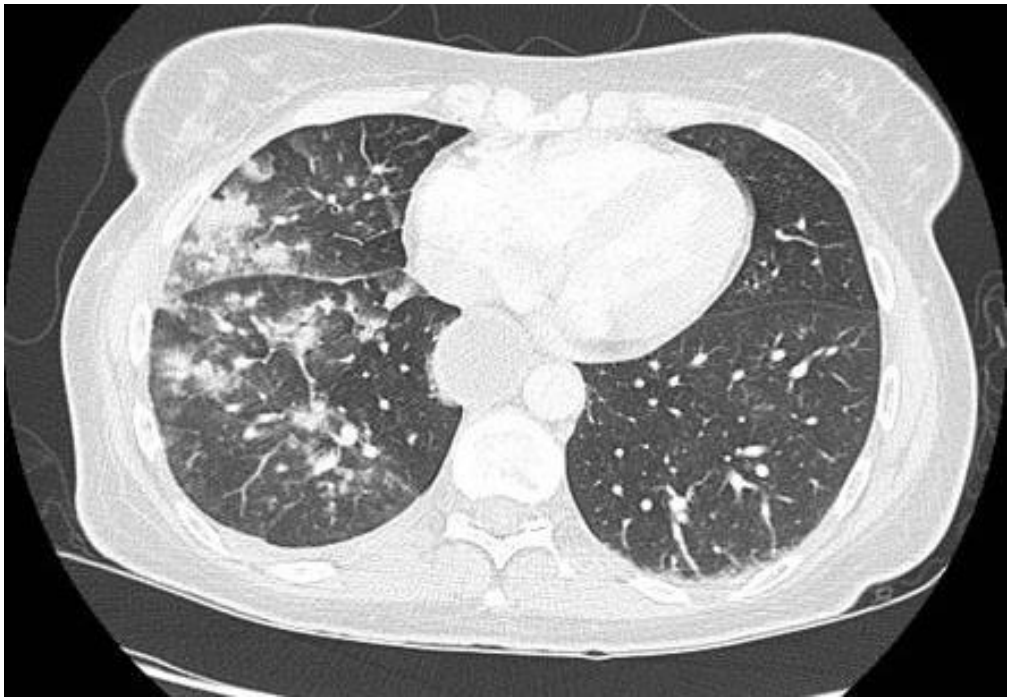
3. **CT scan of the chest**: suspicion of complications of pneumonia (eg, pleural effusion, etc.), insufficient effectiveness of antibiotic treatment.

4. **Ultrasound examination (ultrasound).** With pneumonia in the zone of inflammatory infiltration, the alveoli are filled with exudate, resulting in edema, increased blood circulation, the airiness of the lung tissue decreases, and the pulmonary parenchyma becomes denser. These changes make it possible to visualize altered lung tissue, determine the localization, length, structure, identify possible complications (destruction, pleural effusion, and atelectasis), conduct dynamic monitoring of the course of the disease during treatment and after clinical recovery. The first ultrasound examination of the lungs and pleural cavities is advisable to carry out for children with severe pneumonia upon admission to the hospital, immediately after performing a standard X-ray examination of the lungs in 2 projections. It is advisable to conduct an echographic examination of the lungs once every 10 days during the period of convalescence during the formation of fibrinothorax.

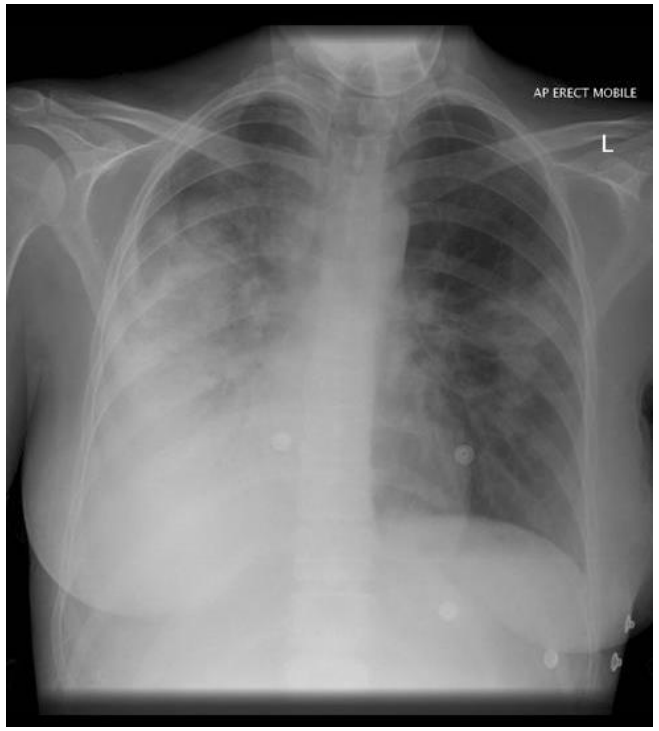
Multifocal pneumonia

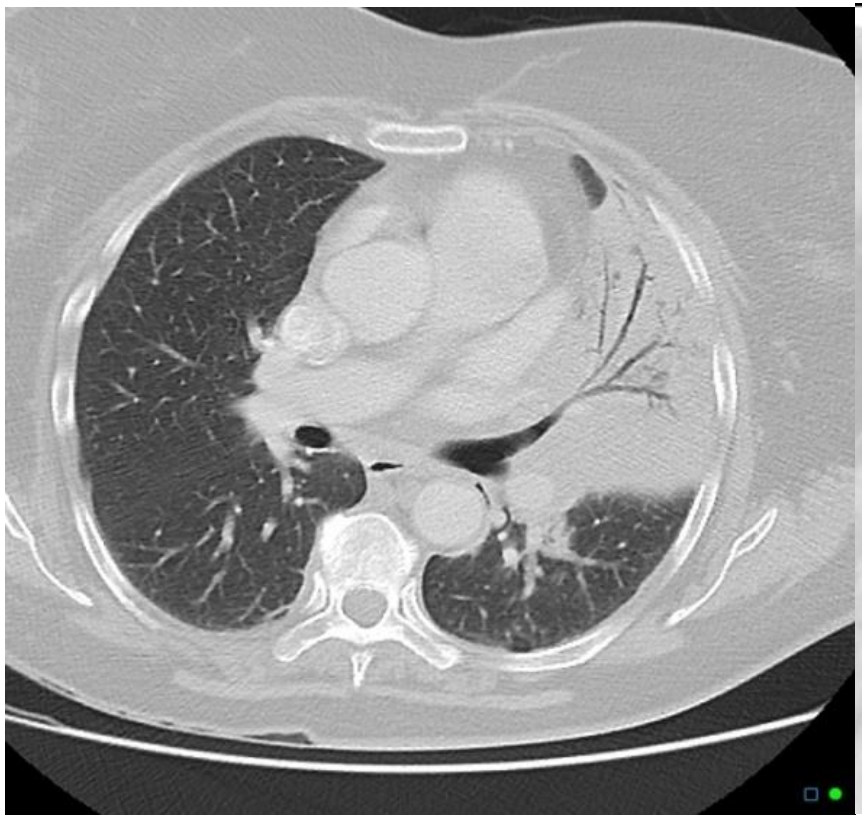


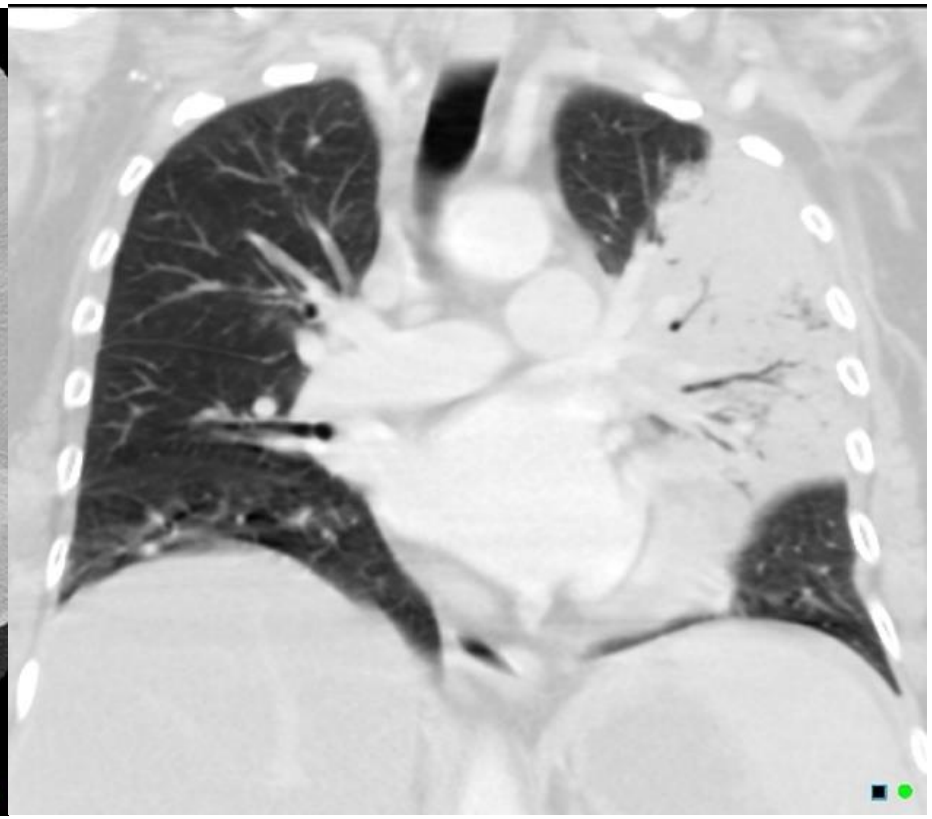




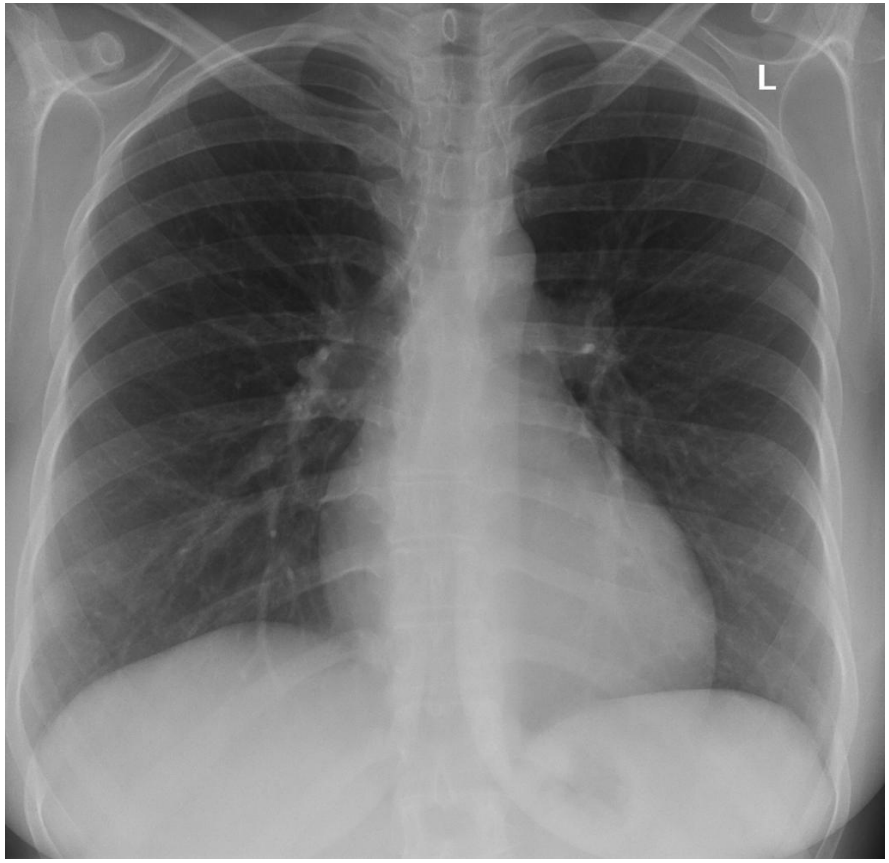
Lobar pneumonia, caused by Streptococcus pneumoniae (Dr. Gerald Diaz @GeraldMD)







Interstitial pneumonia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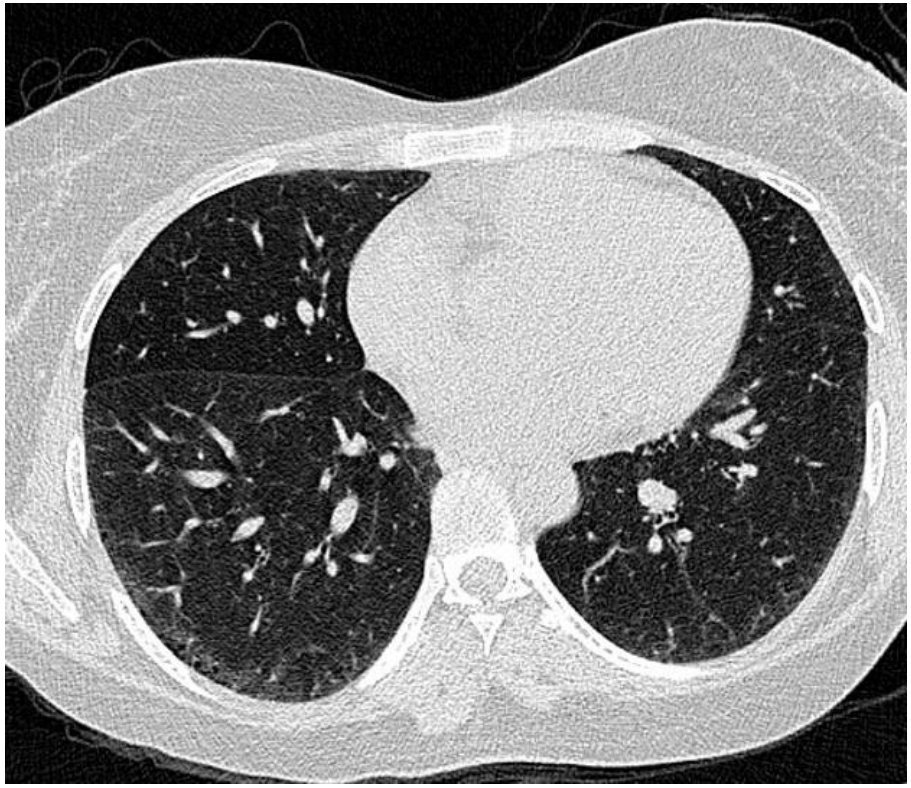
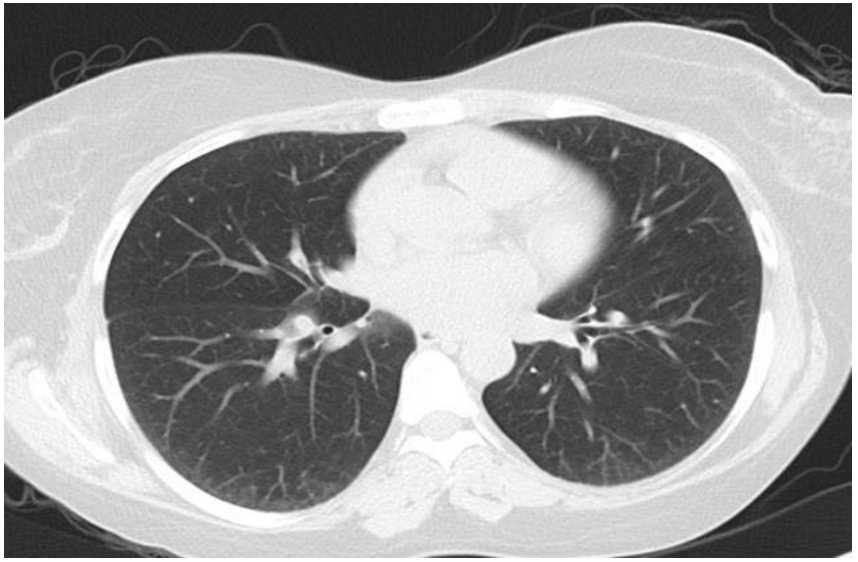
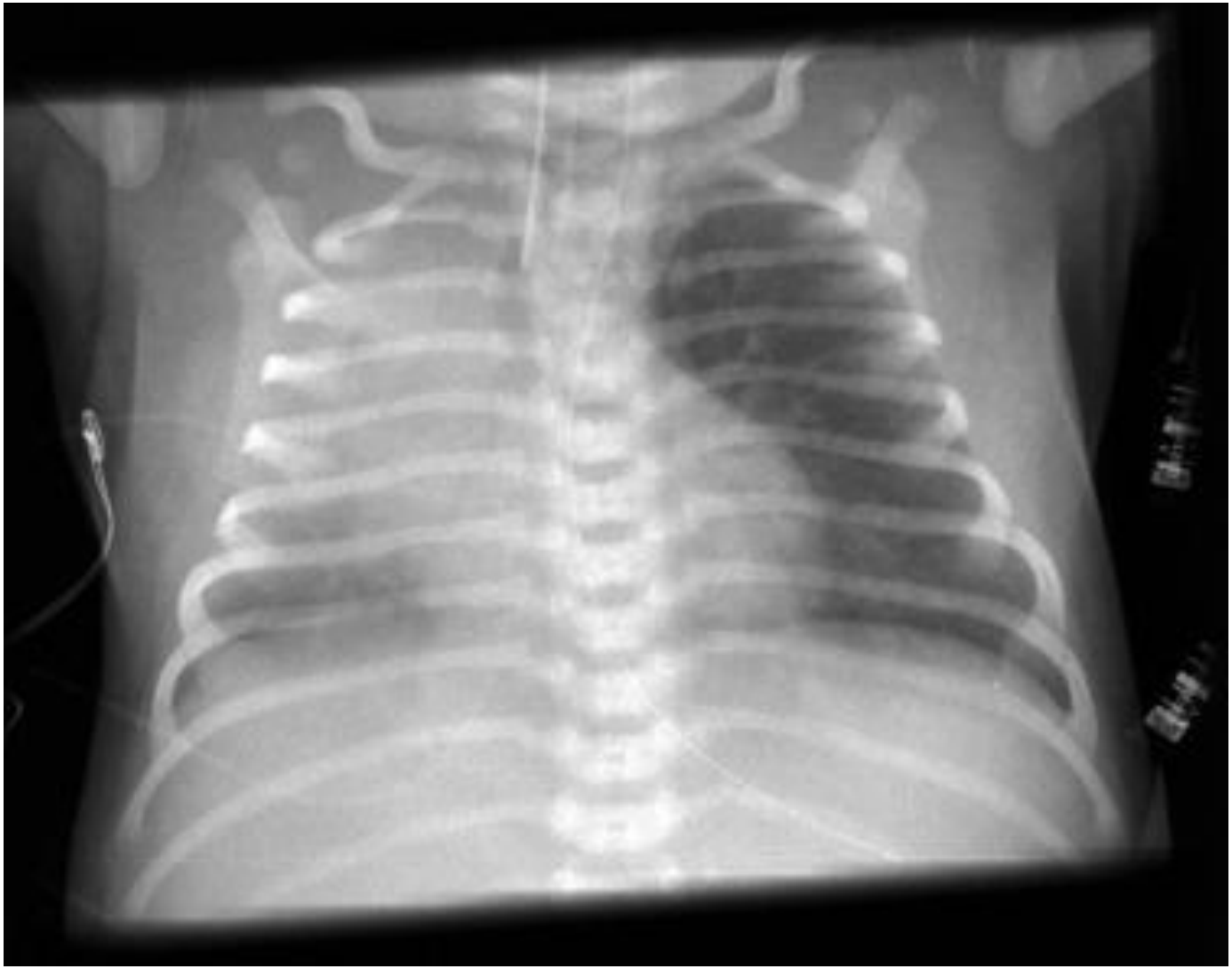
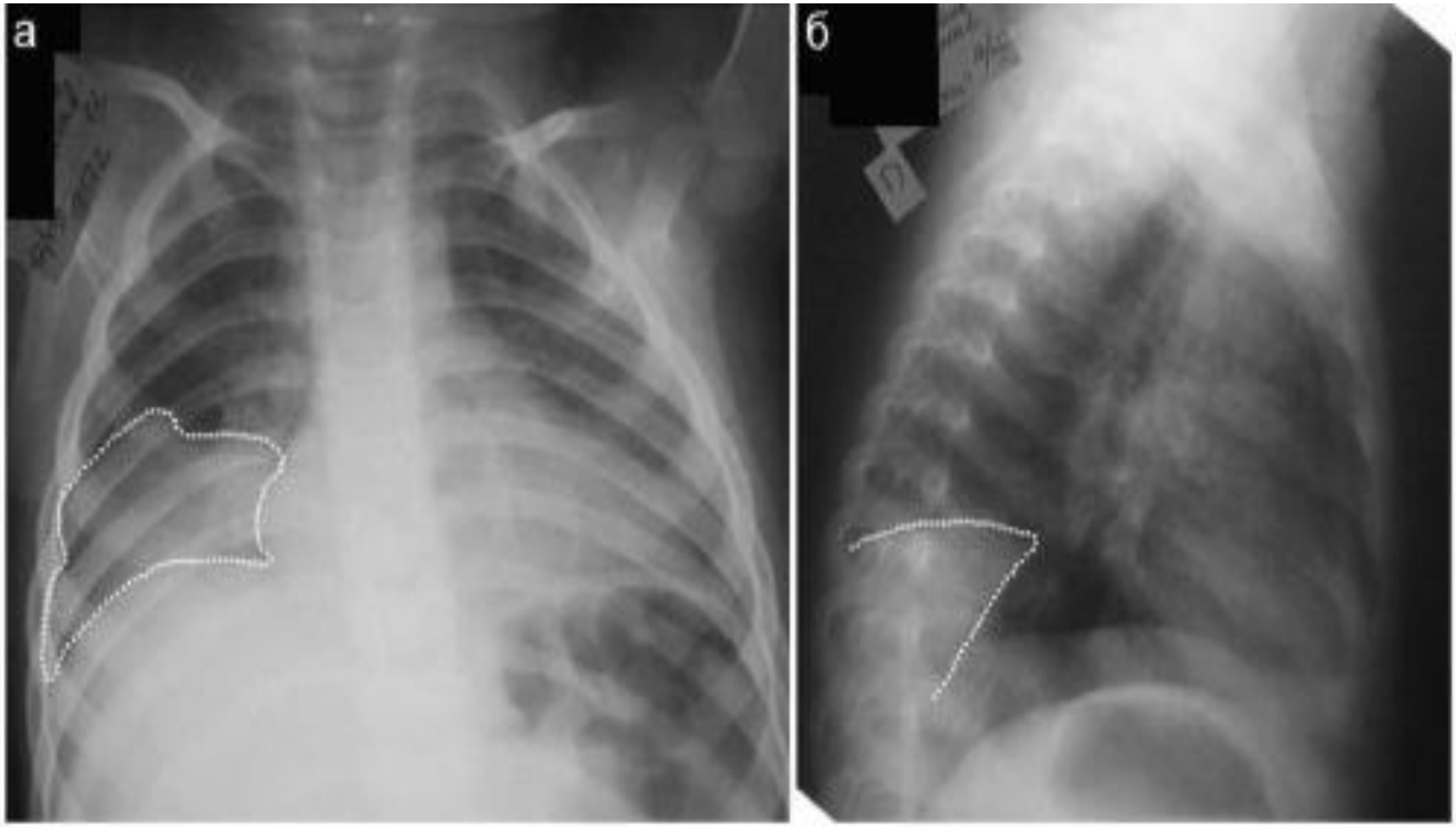




Aspiration pneumonia

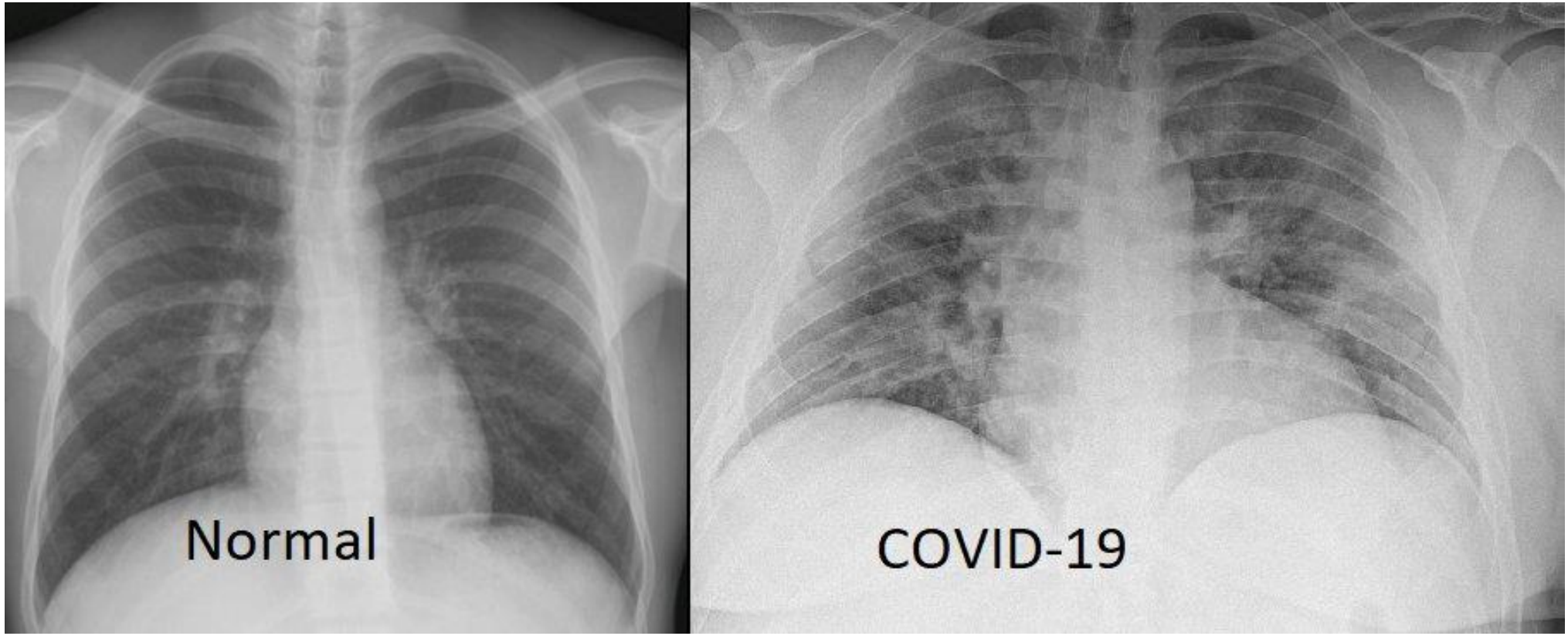


Segmental pneumonia



Pneumonia caused by Pneumocystis jirovecii

Typical COVID19 chest x-rays compared to normal.


Normal
COVID-19

Differential diagnosis of pneumonia with other diseases of the respiratory system in most cases does not present difficulties in the typical course and the absence of comorbid conditions.

Symptoms	Disease		
	Pneumonia	Bronchitis	Bronchiolitis
Age of the child	any	any	get sick more often children from 5-6 months up to 2 years
Beginning	acute or gradual	gradual	gradual or sudden
Shortness of breath without signs of obstruction	characteristically	no	severe shortness of breath
Intoxication	there is	no	no
T > 38 °C	Lasts > 3 days while taking antipyretic drugs	not typical	not typical
Manifestations obstructive syndrome	not typical	not typical	expressed
Participation of accessory muscles in the act breathing	typical especially for children of early age	not typical	typical
Cyanosis	more often in the form of perioral cyanosis in children of early age	not typical	typical
Local symptomatic	Clear in children early age, clear in other periods	absent	Absent of characteristic manifestations "Wet lungs"
Laboratory data	leukocytosis, neutrophilia, ESR> 20 mm / h	leukopenia ESR-12-16mm / h is more often detected	there are no natural changes in the leukocyte formula
X-ray	the presence of focal or segmental infiltrative shadows	strengthening of the bronchovascular pattern and thickening it in the root zone	nonspecific manifestations - diffuse hyperventilation of the lungs, atelectasis are possible

Clinical features of the pneumonia course in children

	Clinical options	
	Typical	**Atypical**
Etiology	*Str. Pneumoniae , Hib , Moraxella catarrhalis*	*Mycoplasma pneumonia , Chl. pneumoniae, Legionella pneumophila*

Onset of the disease	Acute	Gradually (from prodromal phenomena)
Symptoms	- T body - 38°C and above 3 days - lack of appetite - sleep disturbance - lethargy - perioral cyanosis - tachypnea - cough - inflating the wings of the nose - "moaning" breathing, with the participation of auxiliary muscles.	- prolonged mild fever - general weakness - increased sweating - runny nose - prolonged, dry, whooping cough, manifestations of pharyngitis or tracheitis -extrapulmonary manifestations: - skin rashes (rashes around the joints) - myalgia (in the muscles of the back and thighs) - an enlargement of the cervical lymph nodes - conjunctivitis
Syndromes	1.Intoxicating 2 Respiratory failure 3.Gastrointestinal 4.Broncho-obstructive 5.Cardiorespiratory	a) with mycoplasma pneumonia: croup, abdominal, obstructive; b) with legionella and chlamydial pneumonia: - intoxicating - respiratory failure - urinary syndrome - obstructive
Physical data	Palpation: - increased vocal tremor over the site of lung infiltration Auscultatory: - increased bronchophonia (early symptom of infiltration) -local moist fine bubbling rales, crepitus Percussion: - local dullness (intensity depends on the size of the infiltration)	With mycoplasma etiology - a variant of "silent" pneumonia is possible (rare) - more often there are asymmetric, bilateral lesions, while scattered fine bubbling rales prevail auscultatory With chlamydial etiology - draws attention to the discrepancy between the symptoms of pneumonia in the mild signs of intoxication -Percussion - tympanic sound (no clinical signs of obstruction) - Auscultatory - fine bubbly wet rales on inhalation (more often on both sides) With legionella etiology - against a background of high fever and neurological symptoms (headache) - minimal physical findings
Laboratory data	In the CBC: anemia, leukocytosis. ESR > 20 mm / hour. CRP is positive.	Mycoplasma - little shift expressed (Leukocytes-N) SOE-20 - 30mm / hr, lymphocytosis

	Depending on the severity change: paO2 (decrease) and pCO2 (asc.)	Chlamydia and legionella: leukocytosis, neutrophilia, eosonophilia. ESR 30-40mm / h
X-ray examination	availability of local infiltrative shadows (depending on from forms of pneumonia), emphysema, strengthening of basal and pulmonary pattern	Mycoplasma - moderate emphysema, Peribronchial and perivascular infiltration, focal infiltrates, atelectasis. Legionella - massive infiltrates Chlamydial - hyperactivity, reinforced interstitial pattern, rough spotted draining shadows possible
Basic criteria diagnosis	1. Intoxication syndrome. 2. Syndrome of respiratory distress. 3.Local changes (percussion and auscultatory) 4.X-ray verification of local changes 5.Hemogram (leukocytosis, neutrophilia, ESR > 20 mm / h) 6. The effectiveness of antibiotic therapy.	- the same criteria are used - verification of the disease based on the detection of specific antigens by PCR or ELISA (detection of specific IgG and IgM) - isolation of pathogens from lung tissue, pleural fluid (in 6-10% of cases), sputum - effective antibiotic therapy (when using macrolides)
Complications	Pulmonary: 1 Abscess 2.Destruction 3.Pleurisy 3.Partial pneumothorax 4 Pyothorax Extrapulmonary: 1.Toxic-septic syndrome 2.Osteomyelitis, otitis media, meningitis, nephritis, etc.	Legionella: pleurisy, cardiovascular disorders, urinary syndrome (hematuria), lymphadenitis Mycoplasma: pleurisy (rarely), cervical lymphadenitis, hepatosplenomegaly. Chlamydia: pleurisy, sinusitis, myocarditis, endocarditis, cervical lymphadenitis

Clinical features of the course of pneumonia in children, depending on the pathogen

Pathogen	Clinical signs	Radiological	Haematological
Pneumococcus	Acute onset, chills, fever, vomiting, chest pain, cyclical flow, lytic decrease in temperature, local weakening of breathing, shortening of percussion sound, wheezing in the period of reverse development, viscous "rusty sputum"	Homogeneous infiltration of a lobe or segment. Significant pleural reaction Convex borders of the affected lobe	Severe neutrophilic leukocytosis Shift of the formula to the left, toxic granularity of neutrophils, aneosinophilia

Mycoplasma pneumoniae	Outbreak epidemics in close collectives Debut: rhinitis, pharyngitis, tracheo-bronchitis Severe manifestations of intoxication (headache, myalgia, arthralgia, weakness, sweating). The cough is dry, obsessive. The sputum is mucous. Little informative physical data. Small bubbling wet rales or dull crepitations over the affected area, lymphadenopathy	Focal infiltration, increased interstitial pattern	Normocytosis or leukocytosis, moderate increase in ESR
Chl. pneumoniae	Contact with poultry or wild birds, family or group outbreaks Acute onset, fever, intoxication, signs of ARVI. Cough with mucopurulent sputum, less often dry, sometimes whooping cough. Some patients have shortness of breath. Low-informative stetoacoustic data.	Focal-confluent infiltration of lung tissue, strengthening of the interstitial-vascular component	Leukopenia, ESR acceleration
β-hemolytic streptococcus	Similar to the clinic for pneumococcal pneumonia. The difference is the involvement of the interstitium in the process. The onset is gradual or acute. With percussion is shortening of the sound, with damage to the interstitium is tympanitis. Auscultatory: weakening of breathing over the lesion, with the resorption of the process, many moist, finely bubbly rales appear.	Focal or interstitial infiltrates	Leukocytosis

St. aureus	The main route is bronchogenic. Staphylococcal lung damage becomes an integral part of sepsis with hematogenous infection Severe intoxication Cough is with little phlegm, like raspberry jelly. The physical picture is characterized by a discrepancy between the extent of the lesion and the severity of the patient's condition. Percussion macrofocal nature of dullness Pulmonary complications (abscess, pleurisy, pyothorax, pyopneumothorax, bulla atelectasis)	Clinical and radiological signs of staphylococcal pneumonia proceed in the form of two variants: staphylococcal destruction of the lungs and staphylococcal infiltration. Segmental or polysegmental infiltrates are in the beginning	Hyperleukocytosis, shift of the formula to the left, significant increase in ESR
Pneumocystis jirovecii (ранее carinil)	• Immunocompromised host (HIV, transplant) • Often in HIV-positive patients with CD4 <200 The incubation period of PP is 1-2 weeks The most common symptoms of PN in HIV patients are: • shortness of breath (90-100% of cases); • fever (60%); • cough (50%). Treatment • Steroids for Pa02 <70 or A-gradient> 35 • Trimethoprimsulfamethoxazole (TMP-SMX)	Changes characteristic of the late stages of HIV infection are often recorded: • anemia; • leukopenia; • thrombocytopenia • increased ESR (always) up to 40-60 mm / h LDH is often elevated	A cloudy decrease in transparency, small focal shadows located symmetrically in both lung fields in the form of butterfly wings, a kind of "cotton" lung are determined in the basal parts of the lungs

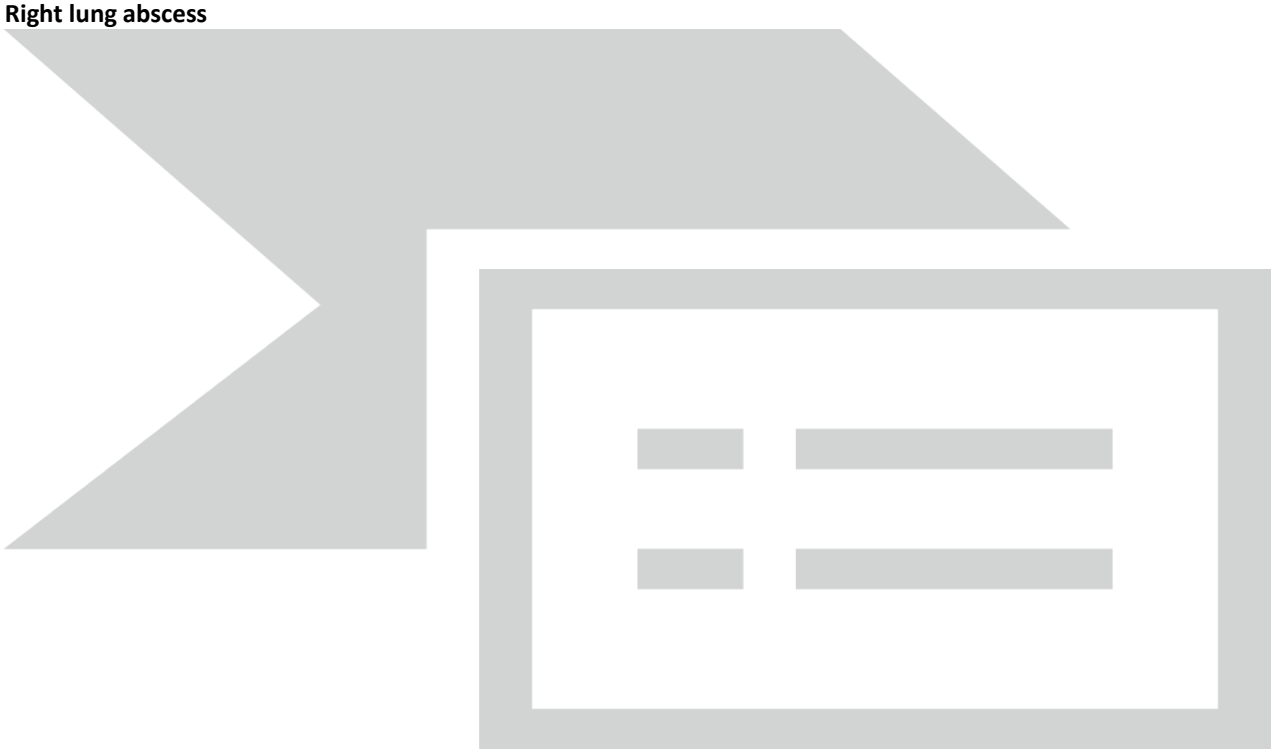
Complications of pneumonia

Complications	**Data**		
	Clinical	**Laboratory**	**Instrumental**
Pleurisy A) dry	- General intoxication - Pain in different parts of the chest cells, increases with	Leukocytosis, shift formulas left to combined with lymphopenia accelerated ESR.	radiographically: incomplete disclosure costo-diaphragmatic

	breathing, coughing - Forced position - Pleural friction noise	Decrease in albuminoglobulin coefficient.	sinus.
Pleurisy B) exudative	During the period accumulation of fluid children lie on sick side. On examination is asymmetry chest. Absolute dullness is with percussion in place effusion Auscultatory: - bronchial breathing is over zone of effusion, - sharp weakening breathing is in the zone of effusion.	Blood picture is not very specific: anemia, leukocytosis, neutrophilia, eosinopenia, monocytosis, lymphopenia, accelerated ESR	radiographically: homogeneous dense darkening, the shape of which depends on the localization of the exudate.
Pyothorax, purulent pleurisy is the result of infection reactive pleural exudate. It can be total and limited.	Gradual worsening of the condition. Dyspnea grows, hectic fever On examination - bulging of the affected half of the chest. Percussion - shortening of the sound. Auscultatory - weakening of breathing. Sometimes it is accompanied by abdominal syndrome (paresis bowel retention, stool and gas retention)	Hyperleukocytosis, shift of the formula to the left, accelerated ESR, anemia.	Diagnostic pleural puncture clarifies the nature exudate. X-ray: intense homogeneous darkening with a pronounced displacement of the shadow of the mediastinum in the direction opposite to the process.
Pneumothorax is the result of a breakthrough of a staphylococcal bull (accumulation of air in the pleural cavity). It can be simple and tension.	Sudden deterioration of the condition, coughing attack, short-term apnea, severe shortness of breath, anxiety. On examination is bulging of the affected half chest, tympanitis and impaired breathing on the affected side Worsening of an already severe general condition (apathy, anorexia, increase in T, torrential sweats, exacerbation of the face features).	There are changes on the hemogram, as in the case of pyothorax.	Air in the pleural cavity, displacement of the heart to the healthy side are on the roentgenogram

	Above the lesion is the shortening of the sound. Various moist rales are heard. There is amphoric breathing when an abscess is opened in the bronchi		
Abscess is when a cavity is formed due to purulent fusion of the focus of necrosis.	Worsening of an already severe general condition (apathy, anorexia, increase in T, torrential sweats, exacerbation of the face features). Above the lesion is the shortening of the sound. Various moist rales are heard. There is amphoric breathing when an abscess is opened in the bronchi	There are changes on the hemogram, as in the case of pyothorax.	Radiographically it is possible to find one or more cavities located more often subpleurally, which have a horizontal liquid level. Intense limited darkening is visible during the period of abscess formation
Infectious toxic shock	Hemodynamic disorder: hypotension, cold extremities, marbling of the skin, acrocyanosis, decreased urine output Uncorrected during oxygen therapy cyanosis of mucous membranes, tachypnea, impaired consciousness	Leukocytosis / leukopenia, thrombocytopenia	SaO2≤92, oxygenation index≤250

Right lung abscess



Exudative pleurisy

Pneumothorax

Criteria for diagnosis of pneumonia in children
According to the WHO recommendation (IMCI) in children under 5 years of age are cough / difficulty breathing + tachypnea / involvement of the lower edge of the chest / stridor.

Reliable diagnosis of PN: infiltration of lung tissue with Rg OGK + at least 2 signs:
1. Fever > 38°C during 3 days or more
2. Cough with phlegm
3. Physical symptoms of PN
4. Leukocytosis > 15G / L or p / I > 10%

Probable diagnosis: at least 2 symptoms without verification with Rg OGK:
1. Fever > 38°C for 3 days or more
2. Cough with phlegm
3. Physical symptoms of PN
4. Leukocytosis > 15G / L or p / I > 10%

An example of a diagnosis formulation:

Community-acquired pneumonia (pneumococcal etiology), right-sided focal (within the 5th segment), moderate, RF II stage.

The main directions of treating a patient with pneumonia:

1. Organization of the regime, care, nutrition. Mostly, typical community-acquired pneumonia in the absence of risk factors can be treated on an outpatient basis.
According to the IMCI strategy, in children under 5 years of age with cough and signs of danger (convulsions, refusal to eat, vomiting after eating or drinking, lethargy / unconsciousness) **OR** involvement of the lower edge of the chest OR stridor at rest are symptoms of severe pneumonia requiring immediate administration antibacterial drugs (according to WHO: ampicillin 50 mg / kg + gentamicin 7.5 mg / kg IM, if stridor - dexamethasone IM) and urgent hospitalization.

Общепринятыми показаниями к госпитализации являются:
1. Age ≤3 years.
2. Complications
3. No effect from ABT in 48 hours.
4. Respiratory failure of 2-3 degrees
5. Unstable hemodynamics
6. PED
7. Congenital and chronic diseases
8. Unfavorable social conditions

Indications for hospitalization	
infants	older children
SaO2 < 92%, cyanosis; respiratory rate > 70 per minute; labored breathing; intermittent apnea, wheezing; refusal to feed	SaO2 < 92%, cyanosis; respiratory rate > 50 / min; labored breathing; wheezing; signs of dehydration

Indications for hospitalization in the ICU:
1. RD requiring respiratory support
2. Sepsis
3. Impaired consciousness, cerebral edema, convulsions
4. Suspicion of exudative pleurisy, destruction of the lung, pio -, and pneumothorax;
5. Development of decompensation of vital functions.

The mode is selected individually, depending on the severity and well-being of the patient. It is necessary to provide a comfortable environment and sufficient aeration of the room. Food should be age appropriate, complete, easily digestible, and enriched with vitamins.

2. Etiotropic therapy.
Principles of etiotropic therapy for pneumonia:
- **empiricism:** prescribing a broad spectrum antibiotic active against the most likely causative agent for a given type of pneumonia and the patient's age, empirical antibiotic therapy is determined by the child's age and the severity of the disease
- **methods of administration of the antibacterial drug**: it can be administered orally for community-acquired pneumonia in children who are treated on an outpatient basis
- **grading:** the possibility of switching from parenteral administration of an antibacterial drug to oral administration within the same classification group
- **sufficient concentration** of the antibiotic in the foci of infection;
- **evaluation of the effectiveness of therapy:** after 48 hours for mild pneumonia and 24-48 hours for severe pneumonia. Therapy is considered *effective* when: lowering body temperature is below 37.5℃ in 24 - 48 hours with uncomplicated pneumonia and 48-72 hours with complicated pneumonia; improvement of the general condition of the child (restoration of appetite, reduction

of shortness of breath, normalization of laboratory blood counts). In this case, the starting antibiotic does not change.
Therapy is considered *ineffective* in the case of: persistence of fever above the specified time; deterioration of the general condition of the child; an increase in pathological changes in the lungs during an objective examination and on radiography of the lungs (the appearance of new focal infiltrates, their fusion, the appearance of pleural-pulmonary complications). In this situation, it is necessary to change the antibiotic, preferably already taking into account the bacteriological examination of sputum.
- **duration of antibiotic therapy.** The duration of the course is 7-10 days if there is a positive effect from the initial therapy.

Initial empiric therapy for pneumonia
All children with a clear, clinically diagnosed community-acquired pneumonia should receive antibiotics for both bacterial and viral etiology, since they cannot be clearly distinguished from each other (British Thoracic Society (BTS), 2011).

Antibiotic therapy for pneumonia in newborns

Pneumonia form	Etiology	Antibiotic	
		of choice	alternative
Early	*Streptococcus of group B, E. coli, Klebsiella spp., Listeria spp., S. aureus*	Ampicillin + aminoglycoside; ampilin / sulbactam + aminoglycoside	Cefotaxime + aminoglycoside
Late	*P. aeruginosa, Enterobacteriaceae, Staphylococcus aureus*	Ceftazidime + aminoglycoside; cefoperazone + aminoglycoside; Antipseudomonal penicillin + aminoglycoside	

According to modern concepts, the starting empirical therapy is divided into three lines:
1. 1st line - according to the strict recommendations of most experts, the treatment of all community-acquired pneumonia should be started with unprotected semi-synthetic penicillins (amoxicillin, ampicillin), since the most common pathogens of these pneumonias are not resistant to them.
2. 2nd line - cephalosporins of 2-3 generations.
3. 3d line (alternative) - macrolides (prescribed in the presence of contraindications to the 1 and 2 line of therapy and atypical pneumonia).

It is necessary to take into account the regional level of vaccination and the availability of vaccination in the patient against Str. pneumoniae, Hib, local regional resistance of these pathogens to unprotected semi-synthetic penicillins when choosing a line of therapy

The scheme of empirical antibiotic therapy of community-acquired pneumonia in children

	Empirical therapy

Age group Conditions of hospitalization	**community-acquired pneumonia of bacterial etiology**	**community-acquired pneumonia of atypical etiology**
Outpatient		
Children under 5 years of age	Amoxicillin 90 mg / kg per day in 2 reception. Possibly: amoxicillin clavulanate (for amoxicillin 90 mg / kg / day in 2 divided doses)	Azithromycin (10 mg / kg orally once on day 1, then 5 mg / kg once a day for 4 days).
Children over 5 years of age	Amoxicillin 45 - 90 mg / kg per day in 2 divided doses, but not more than 4 g / day. Macrolides can be added to β-lactam antibiotics for empirical therapy in children with suspected bacterial CAP who lack clinical, laboratory, and radiographic evidence to distinguish bacterial CAP from atypical CAP. Perhaps: amoxicillin clavulanate (amoxicillin 90 mg / kg / day in 2 divided doses; maximum dose 4 g / day).	Azithromycin (10 mg / kg orally once on day 1, then 5 mg / kg once a day for 4 days). The maximum dose of azithromycin in 1 day is 500 mg, then 250 mg for 4 days).
Stationary (regardless of age)		
Somatic department, minimal resistance pneumococcus, concomitant diseases, taking antibiotics in the last 3 months	Ceftriaxone (50-100 mg / kg per day in 1-2 doses) or ceftriaxone / sulbactam (50-70 mg / kg per day of ceftriaxone in 1-2 doses) or cefotaxime (150 mg / kg per day in 3 doses). Additionally vancomycin (15-20 mg / kg) or clindamycin (25-40 mg / kg / s) if MRSA is suspected.	Azithromycin (in addition to β-lactam antibiotics if the diagnosis of SARS is in doubt). Alternatives: clarithromycin or erythromycin, doxycycline for children> 7 years of age; Levofloxacin for children who have reached puberty or who cannot tolerate macrolides
Intensive care unit, significant pneumococcal resistance, complicated pneumonia	Ceftriaxone (50-100 mg / kg per day in 1-2 doses i.v.) or ceftriaxone / ulbactam (50-70 mg / kg per day of ceftriaxone in 1-2 doses i.v.). Additionally, vancomycin (40-60 mg / kg / s in 3-4 doses i.v.) or clindamycin (40 mg / kg / s in 3-4 doses i.v.) if MRSA is suspected. Alternative: levofloxacin (16-20 mg / kg / day in 2 divided doses for children from 6 months to 5 years old and 8-10 mg / kg / day once for children 5-16 years old iv; maximum daily dose is 750 mg).	Azithromycin (in addition to β-lactam antibiotics if the diagnosis is in doubt). Alternatives: clarithromycin or erythromycin, doxycycline for children > 7 years of age; levofloxacin for children who have reached puberty or who cannot tolerate macrolides.

Antibiotic therapy depending on the type of bacterial pathogen

Pathogen	Drug of choice	Alternative scheme
Streptococcus pneumoniae: 1 Penicillin-sensitive strains	Penicillin	Semisynthetic penicillins with clavulonic acid, cephalosporins, macrolides, fluoroquinolones, glycopeptides, carbopenems, chloramphenicol
Streptococcus pneumoniae strains resistant to penicillin but susceptible to 3rd generation cephalosporins	Cefotaxime (ceftriaxone)	
Streptococcus pneumoniae strains resistant to cephalosporin III and penicillin	Vancomycin + rifampicin with or without cefotaxime (ceftriaxone)	
Haemophilus influenzae type b	cefuroxime	Aminopenicillins with clavulonic acid, II-IV generation cephalosporins, macrolides, carbopenems, fluoroquinolones, chloramphenicol
Streptococcus B	penicillin	Semisynthetic penicillins, cephalosporins of I-III generations, glycopeptides, carbopenems, vancomycin, chloramphenicol
Listeria monocytogenes	Ampicillin with aminoglycoside	Vancomycin with aminoglycoside, trimethoprim / sulfamethoxazole
Esherichia coli, Klebsiella, Enterobacter	Cefotaxime (ceftriaxone)	Aminoglycosides, carbapenems, fluoroquinolones
Salmonella	Cefotaxime (ceftriaxone)	Cefepime, fluoroquinolones, chloramphenicol
Staphylococcus aureus: 1. Methicillin-sensitive strains	Oxacillin + aminoglycoside	Semi-synthetic penicillins with clavulonic acid, 1-2 generation cephalosporins, aminoglycosides, glycopeptides, carbopenems, fluoroquinolones.
Staphylococcus aureus: methicillin-resistant strains	tecoplanin	Vancomycin + rifampicin or vancomycin + aminoglycoside
Streptococcus A	penicillin	Semisynthetic penicillins, cephalosporins of I-III generations, glycopeptides, carbopenems, vancomycin, chloramphenicol
Pseudomonas	Ceftazidime + aminoglycoside	Betalactams with activity against pseudomonads (cefoperazone, cefepime, ticarcillin, imipenem, meronem, piperacillin) + aminoglycosides, fluoroquinolones

Mycoplasma pneumonie	Erythromycin or clarithromycin or azithromycin	macrolides
Chlamydia trachomatis	Erythromycin or clarithromycin or azithromycin	Macrolids, fluoroquinolones
Legionella	Erythromycin or azithromycin or clarithromycin	Macrolids, fluoroquinolones

Note: fluoroquinolones are used in children under the age of 13 for health reasons only.

Treatment of complications of pneumonia

Clinical variant of complication	**Therapeutic tactics**
Pleurisy exudative serous	Basic therapy. Two antibiotics, NSAID and pain relievers are prescribed. Pleural puncture for therapeutic purposes is indicated only in the presence of significant serous effusion, which makes breathing difficult and compresses the mediastinal organs.
Abscess, staphylococcal bullae, pyothorax	Are subject to treatment in the surgical department. Combined antibiotic therapy is prescribed: carbapenems (imepenem, cellastine, meropenem) with metronidazole or III-IV generation cephalosporins (cefuroxime, cefazolin). Surgical care is not required with bullae.
Pneumothorax (tense, "valve")	Emergency help is needed: puncture of the chest wall is done with a thick injection needle (closed tension pneumothorax is transferred to open). Transfer to the surgical department.
Infectious and toxic shock	Basic antibiotic therapy: cephalosporins I II-IV generation (ceftriaxone) and aminoglycosides. Syndromic therapy (elimination of toxicosis, metabolic disorders, SSF and others), prevention and treatment of DIC-syndrome, immunotherapy (immunoglobulin).

3. Antiviral therapy. In a situation where the viral etiology of pneumonia is beyond doubt (existing contact, a clear clinical picture, typical hematological, radiological changes, the presence of laboratory confirmation of a viral infection), the child requires specific therapy:
• direct antiviral action: neurominidase inhibitors (oseltamivir, zanamivir), M2 channel blockers (amantadine, Remantadine).
• indirect antiviral action: donors of recombinant interferon (Viferon, Laferobion), inducers of endogenous interferon (Amizon, Amiksin, Isoprinosin).

4. Elimination of manifestations of RF (if necessary).
Indications for assisted respiratory support:
• $RaO2 \leq 60$
• $SpO2 < 90$

Indications for mechanical ventilation:
• respiratory arrest
• impaired consciousness
• hemodynamic disorders

+
• RaO2≤45
• PaCO2> 60
• acidosis

General principles of therapy for respiratory failure.
Oxygen therapy (duration 2-10 hours, oxygen is humidified and warm):
• **non-invasive**: free flow of oxygen, oxygen tent, nasal cannulas, oxygen mask. Different concentrations and flow rates of oxygen depending on the severity. So when SpO2 < 95, in accordance with the unified approach of patient examination ABCDE, the patient needs an oxygen mask with 100% oxygen 6-8 l / min.
• **CPAP:** bag, mask, endotracheal, nasopharyngeal tube, nasal cannulas. The initial pressure is 5-6 cm H2O. Control of respiratory effort, skin colour, PaO2, SpO2.
• **Ventilation:** low-frequency ventilation with positive end-expiratory pressure, high-frequency ventilation with low inspiratory pressure, intermittent mandatory ventilation**.**

Improvement of hemodynamics, microcirculation, oxygen transport from the lungs to tissues, improvement of tissue respiration function, elimination of violations of the oxygen-alkaline balance.
To improve microcirculation is aminophylline in / in 2.4% solution at a dose of 0.1 ml / kg for children under 1 year old, 1 ml per year of life for children over one year old; Xanthinol nicotinate. Improvement of hemodynamics - the use of cardiac glycosides (strophanthin or korglikon). Strofantin - 0.05% for children under 1 year old in a single dose of 0.1-0.15 ml 1-2 times a day intravenously in a 10% glucose solution slowly; after 1 year at a dose of 0.2-0.4 ml, depending on age, 10% glucose solution slowly (see protocols for the treatment of cardiovascular insufficiency).

5. Normalization of the drainage function of the bronchi: mucolytics, mucokinetics.
6. Anti-inflammatory therapy (if necessary). NSAIDs are recommended only for the period of fever. Routine use of corticosteroids is not recommended, however, their appointment in severe pneumonia accelerates the improvement of the condition and shortens the ICU staying.
7. Rehydration therapy. There are no significant fluid losses in pneumonia (except for perspiration losses), therefore, oral rehydration is prescribed according to the physiological need in all patients with uncomplicated pneumonia and in 80-90% of patients with complicated pneumonia. Oral rehydration is preferred. The volume of fluid per day for children under one year old, taking into account breast milk or milk formulas, is 140-150 ml / kg of body weight. It is recommended to use glucose-salt solutions for this purpose .

Prevention.
1. Vaccination
- against *Haemophilus influenzae type b* (all children who have reached 2 months of age)
- pneumococcal vaccine (children 2 years of age and older)\).
- against influenza (children 6 months and older)
2. Personal hygiene: brushing teeth 2 t / d
3. Remediation of chronic foci of infection.
4. Treatment of chronic diseases.

6. Materials for methodological support of the lesson.

6.1. Tasks for self-examination of the initial level of knowledge and skills / with the provision of samples of answers at the end of the block of tasks - tasks of the II level; tests of various types are also with standards of answers.

Self-testing materials

Test tasks:

1. A 3-month-old boy has anxiety, frequent shallow breathing, and coughing. Objectively: body t 0 - 38.4 °C, cyanosis of the nasolabial triangle, shallow breathing with the participation of auxiliary muscles, BH-60 in 1 min., fine bubbling moist rales are heard over the lungs, heart rate is 178 in 1 min., heart sounds are muffled. Blood: leukocytes -15.0 g / l; ESR - 22 mm / hour. Radiograph of the lungs: focal shadows of both lungs against the background of enhanced bronchopulmonary pattern, infiltrated roots. What is your diagnosis?

A Foreign body of the airway
B Broncho obstructive syndrome
C SARS, adenovirus infection
+ D Bilateral focal pneumonia
E SARS, respiratory syncytial infection

2. Child 5 years 5 days of illness with right-sided lower lobe pneumonia, the child's condition is deteriorated, there were pains in the abdomen when breathing, a sharp rise in temperature to 39.5°C, shortness of breath. Objectively: a serious condition due to intoxication and respiratory failure, dyspnoea of a mixed nature up to 35 in 1 min. The child lies on the right side, heart rate is 110 in 1 min. Percussion dullness of sound deal with the upper border, which goes from the spine outward to the inner corner scapula, and breathing is not audible in the same place. Leukocytosis is in the blood, neutrophilic shift is to the left, ESR is accelerated. What is your diagnosis?

A Pneumothorax
B Lung abscess
+ C Pleurisy
D Tuberculosis
E Lobar pneumonia

3. A 10-year-old child became acutely ill: increased body temperature, fever, dry painful cough, pain in the side, shortness of breath, pallor. Percussion on the left below the angle of the scapula is determined by the shortening of the percussion sound, auscultatory is weakened breathing. Exudative pleurisy is diagnosed. The fever disappeared on the 12th day on the background of therapy. Determine the etiology of pleurisy.

A Tuberculous
+ B Pneumococcal
C Allergic
D Tumor
E Traumatic

4. An 8-year-old girl suffers from left-sided community-acquired polysegmental pneumonia. There is an unstable perioral cyanosis. Dyspnea at rest is absent, but appears during physical exertion without the participation of auxiliary muscles. Moderate tachycardia. The ratio of pulse to respiration rate is 2.5: 1. The vital capacity of the lungs is reduced by 10%. The minute breathing volume is increased. What is the degree of respiratory failure in the patient?

A. TO 0
B. TO 1

C. TO 2
D. TO 3
E. TO 4

5. A child of 6 years old, suffered on the eve of SARS, was admitted to the clinic with complaints of an increase in t 0 to 39.5 0 C, general weakness, shortness of breath. On examination: moist cough, pale skin, bright blush. There is dullness of percussion sound in the lungs in the lower parts, weakening of breathing, crepitant moist fine bubbling rales, RR is 32 in 1 /, heart rate is 120 in 1 min, liver + 1 cm. In the KLA leukocytes are 16.0 x 10 9 / l, ESR - 28 mm / h s. Your preliminary diagnosis:
A Myocarditis
B acute bronchiolitis
C acute bronchitis
D Bronchial asthma
+ E pneumonia

6. A 6-year-old child is sick for the 2nd week, the body temperature is febrile, the cough is dry, and pains on the right side and shortness of breath have appeared. On physical examination: smoothness in the lower parts of the chest on the right; percussion - dullness of the pulmonary tone in the lower parts of the right; auscultation - in the place of dullness, breathing is sharply weakened. Make a preliminary diagnosis.
A Pneumothorax
B Bronchitis
C Lung atelectasis
+ D Pleurisy
E Lung tumor

7. The child is 8 years old. The condition is severe, lethargic, pale, perioral cyanosis. Expiratory dyspnea. Accessory muscles take part in the act of breathing. Percussion over the lungs boxed sound. Breathing is sharply weakened. Dry wheezing rales. Breathing rate is 40 per minute. The boundaries of cardiac dullness are not expanded. Heart sounds are muffled. Heart rate is 120. Blood pressure is 105/65 mm. Hg Liver +1 cm. Diuresis is according to age. What causes the severity of the condition?
A vascular insufficiency
B Heart failure
+ C respiratory distress
D renal failure
E liver failure

8. The child is 9 years old. With complaints of an exhausting cough with a small amount of sputum, which lasts about 3 weeks, X-ray examination of the lungs revealed small focal shadows in the right lower lobe. The disease began with catarrhal symptoms, subfebrile condition, intoxication syndrome. What the probable pathogen caused pneumonia in the child?
+ A Mycoplasma
B Afanasyev-Pfeiffer bacillus
C Staphylococcus
D Pseudomonas aeruginosa
E Pneumococcus

9. A child of 8 years old was admitted to the hospital. According to the mother, the child complains of a debilitating dry cough, lethargy, poor appetite, an increase in body temperature to 38°C for 2 weeks. The child was treated with amoxicillin outpatient. X-ray examination of the

lungs revealed small focal shadows in the lower right lobe. What starting antibiotic will you suggest?
A Amoxiclav
B Cefazolin
+ C Sumamed
D Gentamicin
E Ceftriaxone

10. A 10-year-old girl with bilateral pneumonia has increased shortness of breath, body temperature has risen to 39.7°C. Objectively: the right half of the chest lags behind in the act of breathing, the intercostal spaces are smoothed. Percussion tympanitis, auscultatory breathing over this area is absent. The borders of the heart are shifted to the left. The total number of leukocytes in the blood is 27.5 g / l. What is the most likely complication?
A Atelectasis
+ B Pyopneumothorax
C Hydrothorax
D Pneumothorax
E bronchiectasis

11. A 12-month-old child who is hospitalized with severe pneumonia, grade III respiratory failure, has an increase in the amount of sputum. The child cannot cough up on his own. What treatment tactics are advisable to apply?
+ A Perform continued nasotracheal intubation
B Assign parentally N-acetylcysteine
C Prescribe mucokinetics
D Create drainage position
E Assign vibration massage

12. The boy is 3 months old. There is anxiety, frequent shallow breathing, cough. Objectively: body t°C is 38.4°C, cyanosis of the nasolabial triangle, shallow breathing with the participation of auxiliary muscles, respiratory rate is 60 in 1 min. Humid rales are heard over the lungs, heart rate is 178 in 1 min., heart sounds are muffled. Blood: leukocytes are 15.0 g / l; ESR-22 mm / h. Radiograph of the lungs: focal shadows of both lungs against the background of enhanced bronchopulmonary pattern, infiltrated roots. What is your diagnosis?
A Broncho-obstructive syndrome
+ B Bilateral focal pneumonia
C SARS, adenovirus infection
D Foreign body of the airway
E SARS, respiratory syncytial infection

13. A 6-year-old child is ill for the 2nd week. The body temperature is febrile, the cough is dry, there are pains in the right side, shortness of breath. On physical examination: smoothness in the lower parts of the chest on the right; percussion - dullness of the pulmonary tone in the lower parts of the right; auscultation - in the place of dullness, breathing is sharply weakened. Make a preliminary diagnosis.
A Lung atelectasis
B Bronchitis
+ C Pleurisy case
D Pneumothorax
E Lung tumor

14. The child is 5 years old. There is the 5th day of the disease with right-sided lower lobe pneumonia. The child's condition deteriorated, there were pains in the abdomen when breathing, a sharp rise in temperature to 39.5 0 C, shortness of breath. Objectively: a serious condition due to intoxication and respiratory failure, dyspnoea of a mixed nature up to 35 in 1 min. The child lies on the right side, heart rate 110 is in 1 min. Percussion dullness of sound deal with the upper border, which goes from the spine outward to the inner corner scapula, breathing is not audible in the same place. Leukocytosis is in the blood, neutrophilic shift is to the left, ESR is accelerated. What is your diagnosis?
A Tuberculosis
B Lung abscess
C Pneumothorax
+ D Pleurisy
E Lobar pneumonia

15. A 10-year-old child became acutely ill: body temperature is increased, fever, dry painful cough, pain in the side, shortness of breath, pallor are appeared. Percussion on the left below the angle of the scapula is determined by the shortening of the percussion sound, auscultatory - weakened breathing. Diagnosed with exudative pleurisy. The fever disappeared on the 12th day on the background of therapy. Determine the etiology of pleurisy.
+ A Pneumococcal
B Tuberculous
C Allergic
D Tumor
E Traumatic

16. A 5-year-old child who is attending a kindergarten has been diagnosed with SARS. What antibacterial drug should be prescribed:
A fluoroquinolones
+ B macrolides
C First generation cephalosporin
D Second generation cephalosporin
E Third generation cephalosporin

17. A 5-year-old child who suffers from a gastro-pulmonary form of cystic fibrosis, began to show signs of right-sided lower lobe pneumonia on the 10th day of being in the hospital. Which pathogen is most likely to cause pneumonia in a child?
A Pneumocyst
+ B Pseudomonas aeruginosa
C Mycoplasma
D Colibacillus
E Pneumococcus

18. A child 5 years old from the date of birth 6-7 times a year suffers from acute respiratory infections, bronchitis, from the age of 4, sinusitis has joined. On the R-gram of the chest organs there is dextracardia, deformation of the bronchopulmonary pattern. Determine the most likely diagnosis:
+ A Kartagener's syndrome
B Allergic bronchitis
C Tetralogy of Fallot
D Deficiency? 1-antitrypsin
E Fibrosing alveolitis

19. A 12-year-old boy suffers from segmental pneumonia, not complicated pneumonia. What is the most likely causative agent of pneumonia in this case?
A Proteus mirabilis
B Staphylococcus aureus
C Chlamydia pneumoniae
D Mycoplasma pneumoniae
+ *E* Streptococcus pneumoniae

20. Boy is 8 years old. Has been ill for 5 days. Upon admission to the hospital, he was diagnosed with acute bilateral focal pneumonia, home, moderate severity, without complications, Respiratory failure is 0. Prescribe an appropriate starting antibiotic.
+ *A* penicillin.
B First generation cephalosporin.
C Second generation cephalosporin
D Antibiotic of the aminoglycoside series.
E Sulfanilamide.

6.2. The information necessary for the formation of knowledge and skills can be found in the textbooks:

- *basic:*

1. Volosovets O.P., Snisar V.I. Recommendations for heart-healthy reanimation for children. A methodical colleague. Dnipropetrovsk: ART-PRES, 2015. 48 p.
2. D 362 State form of medicines. Issue ten. Kyiv, 2018 https://moz.gov.ua/uploads/1/5052-dn_20180510_868_dod_2.pdf
3. Differential diagnosis of the most common diseases of childhood. Textbook / ed. V.M. Dudnyk, 1st edition. Vinnytsia: Nilan Ltd., 2017. 560 p.
4. Karen J. Markdante, Robert M. Kligman. Fundamentals of pediatrics according to Nelson: translation of the 8th English. edition: in 2 volumes. Volume 1. Kyiv: VSV "Medicine", 2019. XIV, 378 p.
5. Karen J. Markdante, Robert M. Kligman. Fundamentals of pediatrics according to Nelson: translation of the 8th English. edition: in 2 volumes. Volume 2. Kyiv: VSV "Medicine", 2019. XIV, 426 p.
6. Kryuchko T.A, Abaturov A.E, Kushnereva T.V Pediatrics: textbook (University IV level. A); under ed. Крючко, A.E. Abaturov. Kiev: VSI "Medicine", 2020. 224 p.
7. Emergencies in pediatric practice: Textbook. way. for students. med. HEI, interns. - 2nd type. Recommended by the Ministry of Education and Science, recommended by the Academic Council of NMU. O.O. Bogomolets / Marushko Y.V, Chef G.G etc. Kyiv: VSV "Medicine", 2020. 440 p.
8. Pediatrics: a national textbook: in 2 volumes / Ed. prof. Berezhnogo V.V Kyiv, 2013. Vol.1. Kyiv, 2013. 1040 p.
9. Pediatrics: a national textbook: in 2 volumes / Ed. prof. Berezhnogo V.V Kyiv, 2013. Vol.2. Kyiv, 2013. 1024 p.
10. Pediatrics: a textbook for students of higher education institutions, IV level accred. / for ed. prof. O.V Tyazhkoyi. View. 5th, ed. and add. Vinnytsia: Nova Kniga, 2018. 1152 p.
11. Maidannyk VюG, Yemchynska Ye.O. Clinical guidelines for the diagnosis and treatment of community-acquired pneumonia in children from the standpoint of evidence-based medicine. - K., 2014. - 43 p. http://pediatrics.kiev.ua/library/metod/5.pdf.

- *additional:*

1. Nyankovsky S.L, Babik I.V. Features of asthenic syndrome and autonomic disorders in children with community-acquired pneumonia. Child health. - №3 (63) 2015 – C. 16-21.

2. Pediatric immunology: textbook. for doctors-interns, doctors-cadets higher. med. inst. (Ph.D.) postgraduate. education, as well as for students., higher education teachers of the med. inst. of the IV level of accreditation / ed. prof. L.I Chernyshova, A.P Volokha. - K.: Medicine, 2013. - 719 p.
3. Order of the Ministry of Health of Ukraine № 18 from 10.01. 2005 About the statement of protocols of rendering of medical care to children on a specialty "Children's pulmonology".

6.3 Orientation map for independent work with literature

№	Main tasks	Instructions	Answers
1	2	3	4
1.	Read the literature and the purpose of the lesson	Form definition of pneumonia	To know that this is an acute inflammatory disease with a predominant involvement of the respiratory parts in the pathological process and the presence of intra alveolar inflammatory exudate
2.	Epidemiology	Know the prevalence of pneumonia among the child population.	To know the incidence of pneumonia in the child population in Ukraine (10-15%) and in different age groups; mortality from pneumonia in different regions of Ukraine ranges from 1.5 to 6 per 10,000 children, and respiratory diseases are 3-5% in the structure of mortality in children in the first year of life
3.	Etiology.	list specific pathogens depending on the child's age, immune reactivity, season, epidemiological situation, and the place of infection	Community-acquired - 1-6 months - Chlamidia trachomatis, Pneumocystis carinii, H.influenzae, 6 months - 6 years - S. pneumoniae, H.influenzae, M.pneumoniae, Chlamidia pneumoniae; 7-15 years - S. pneumoniae, H.influenzae, M.pneumoniae, Chlamidia pneumoniae, viruses, fungi. Nosocomial: St. aureus, Гр (-) флора: E.coli, Klebsiella pneumoniae, Proteus spp, цитробактер, P. Aeruginosa. Perinatal: intrauterine infection Chlamidia trachomatis, mycoplasma hominis, Citomegalovirus, Ureoplasma urealyticum. Postnatal infection St. aureus, Branchamella catharalis, influenza viruses, parainfluenza, herpes, enteroviruses. Aspiration: anaerobic flora (bacteroids). Against the background of immunodeficiency: P. aeruginosa, P carinii, Citomegalovirus, fungi.

4.	Pathogenesis	To know the leading mechanisms of the pneumonia pathogenesis.	The basis of pathogenesis is specific and nonspecific mechanisms: to know the role of infectious toxicosis, respiratory failure, hypoxia, water-electrolyte disturbances associated with DN, metabolic disorders (metabolic acidosis), the role of activation of free radical oxidation and the peculiarities of changes in blood coagulation properties.
5.	Classification	To know the pneumonia classification	To be able to diagnose pneumonia by localization, form, course, presence of complications. To know the criteria for assessing the severity of respiratory failure.
6.	Clinic	To describe the clinical picture	To know the difference in the clinic of pneumonia in newborns, young children and older children, the peculiarities of the course of the disease, depending on the pathogen. To know the criteria for assessing the severity of pneumonia in children.
7.	Diagnostics	To know the basis of the diagnosis of pneumonia in children.	To know the basic criteria for the diagnosis of pneumonia in children. To be able to evaluate the results of laboratory and instrumental research methods.
8.	Treatment	Principles of etiotropic, pathogenic, symptomatic treatment of pneumonia	Etiotropic treatment: Choice of initial antibiotic, dose and route of administration, frequency of administration, course of treatment, possibility of step a / b therapy, possibility of combination therapy

7. Materials for self-control of the quality of training.

Questions for self-control

1. Etiological and pathogenetic factors of pneumonia in children.
2. Classification of pneumonia in children.
3 Clinical signs of respiratory failure in children.
4. Differential diagnosis of pneumonia in children.
5. Treatment of patients under different clinical variants of pneumonia flow.
6. Prevention of pneumonia and its complications in children.
7. Treatment of patients under various clinical variants of complications of pneumonia in children.
8. Diagnosis of pneumonia in children: use of laboratory and instrumental methods.
10. Treatment of pneumonia in children.
11. Prevention and prognosis of the course of pneumonia in children.
12. Complications of pneumonia in children.

Tasks

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<tr><td colspan="2">No. 1 A child of 8 years old was admitted to the clinic with complaints of pain in the right half of the abdomen, high body temperature, vomiting, and coughing. He has been ill for 2 days, has not been treated at home. On examination, the child's condition is severe, the right half of the chest lags behind the left when breathing, mixed dyspnoea, breathing rate is 1 minute. With percussion, there is a dull sound below the angle of the scapula, in the same place - breathing is not heard. Bronchial breathing is on the left. Pulse is 120 beats per minute. The borders of the heart are slightly shifted to the left. Heart sounds are slightly muffled. The abdomen is soft and painless. The liver protrudes from the hypochondrium by 1 cm. The stool is unremarkable.</td></tr>
<tr><td>Task
1. What diseases should be used for differential diagnosis?
2. Which of them is most likely in this patient?
3. Schedule the necessary examinations to confirm the diagnosis
4. What kind of specialist consultation is needed?
5. In which specialized department should the patient be treated?
6. Principles of patient treatment.</td><td>Answer
1. Pneumonia, exudative pleuritis.
2. Complete blood count, chest x-ray in two projections, pleural puncture.
3. Consultation with a pediatric surgeon.
4. In the surgical department.
5. Antibacterial therapy in accordance with the etiology of the pathogen and the sensitivity of the microorganism to antibacterial agents, oxygen and aerotherapy. Vitamin therapy, correction of metabolic disorders, treatment of toxic syndromes, stimulating therapy, correction of immune disorders.</td></tr>
<tr><td colspan="2">№2 A child aged 1 year 8 months was hospitalized for cough, fever, general weakness. The child was sick for 2 weeks. All this time, there was a steady increase in body temperature up to 39°C. The cough is rare. Treatment at home had no effect. The condition is severe. The skin and visible mucous membranes are pale. With percussion of the chest, there is a dullness of the percussion sound from the lower corner of the scapula to the left, which turns into dullness at the bottom; on auscultation - in the same areas breathing is weakened, in others is hard, single dry wheezing. BR is 36 in 1 min., HR is 110 in 1 min. Borders of relative cardiac dullness are normal, heart sounds are muffled. The abdomen is soft, the liver protrudes from under the edge of the costal arch by 4 cm. According to the X-ray of the chest organs: the left lung from the VI rib is unevenly intensely darkened, against the background of darkening, a round air cavity up to 3 cm in diameter and a second oval cavity of a smaller size are determined. Blood test: Hb - 100 g / l, er. - 3.51 T / L, leuk. - 14.8 g / l, f. -0%, p. - 15%, p. - 38%, limf. - 43%, m. - 4%, ESR - 20 mm / hour.</td></tr>
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1. To make a diagnosis.
2. On what basis is this assumption made?</td><td>Answer
1. Staphylococcal pneumonia.
2. The severity and duration of the course, the massiveness of the lesion, the presence of bulges in the lungs</td></tr>
</table>

8. Materials for classroom self-study:

8.1. The list of educational practical tasks that must be completed during the practical (laboratory) lesson:

1. To collect an anamnesis of illness and life, to choose information, testify in favor of the pathological process.
2. Demonstrate palpation, percussion (topographic and comparative) and auscultation of the chest.
3. To reveal the most informative signs of the disease during objective and laboratory-instrumental examination of the patient.
4. Give a clinical assessment of laboratory and instrumental data obtained during the examination of the patient.
5. To make a clinical diagnosis according to the generally accepted classification.
6. Determine the plan for the examination and treatment of this pathological condition.
7. To provide differential diagnostics of diagnosed pathology.
8. To write out prescriptions for prescribed drugs.
9. To develop a plan for the rehabilitation and dispensary observation of the patient.

9. Guidance materials for mastering professional skills:

9.1. Methodology for performing work, stages of implementation.

1. Oral questioning of students.
2. Supervision of patients on this topic.
3. Analysis of the medical history on this topic.
4. Drawing up a scheme of examination and treatment of the patient.
5. Demonstration of practical skills on the topic of the lesson.

10. Materials for self-control of mastering knowledge, abilities, skills provided for by this work.

10.1. Tasks

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Assignment 1. To make a diagnose. 2. On what basis is this assumption made?	Answer 1. Staphylococcal pneumonia. 2. The severity and duration of the course, the massiveness of the lesion, the presence of bulges in the lungs