

**MINISTRY OF HEALTH OF UKRAINE
NATIONAL O.O. BOHOMOLETS MEDICAL UNIVERSITY
DEPARTMENT OF PEDIATRICS №2**

**GUIDELINES
to practical (seminar) classes
FOR STUDENTS**

Educational discipline Propaedeutic Pediatrics
Discipline "Health care"
Specialty 222 "Medicine"
Department of Pediatrics No. 2

Approved on methodic meeting of department of pediatrics №2 from « » august 2026.,
protocol №1

Considered and approved: CMC on pediatric disciplines from « » august 2026.,
protocol №1

Lesson topic: Anatomical and physiological features of the respiratory organs, methods of clinical examination of the respiratory organs in children.

Competencies: (formulation of competencies):

To know the anatomical and physiological features of the organs of the respiratory system at different age periods of a child's life and their clinical significance

To be able to conduct a clinical examination of children of different ages and evaluate the obtained data

Ability to abstract thinking, analysis and synthesis

Ability to learn and master modern knowledge

Knowledge and understanding of the subject area and understanding of professional activity when working with children of different ages and with diseases of the respiratory system in children.

The ability to make informed decisions when studying propaedeutics of pediatrics.

Ability to evaluate the data of clinical examination of the respiratory system in children of different ages.

The ability to analyze the leading symptoms and syndromes of diseases of the respiratory system in children of different ages.

Ability to evaluate the results of laboratory and instrumental methods of examination in diseases of the respiratory system in children of various ages.

The ability to diagnose emergency conditions based on clinical signs of damage to the respiratory system in children.

Purpose: 1. To lay the foundations of knowledge on the peculiarities of the development and formation of the respiratory system in children, its anatomical and physiological features in children of different ages.

2. To determine directions of formation of skills of clinical interpretation of objective examination, analysis of symptoms and syndromes in respiratory system lesions and assessment of results of laboratory and instrumental examination methods in diseases of this system in children of different ages.

Equipment - textbook, computer, mannequin, phonendoscope, spatula.

Lesson plan and organizational structure

Name of the stage	Description of the stage	Learning levels	Time
Preparatory stage	Organizational measures	*	10
The main stage	Test control on the subject of the lesson, checking and announcing the results.	**	20
	- theoretical survey; - clarification of the most important points regarding the application of various methods of assessing children's respiratory system; - students' work on acquiring skills for assessing the physical development of children of different ages;	*, **, ***	55
	- acquisition by students of the skills of providing recommendations to parents of children with physical development disorders. Solving problems according to the subject of the lesson	**, ***	20

The final stage	Analysis and assessment of student work results. Announcement of the topic of the next lesson, an indicative map for independent work with literature.	*	10
	Разом	2,5 академічних години	115

* Introductory, **reproducible, *** reconstructive, **** creative learning levels.

Literature:

1. Jan E Drutz. The pediatric physical examination: HEENT. 2021. UpToDate- online recourse. 2022. <https://www.uptodate.com/contents/the-pediatric-physical-examination-heent>
2. Nelson Textbook of Pediatrics, 21th Edition, 2019 by ROBERT M.KLIEGMAN, NATHAN J. BLUM, SAMIR S. SHAH, JOSEPH W. ST GEME III, ROBERT C. TASKER, KAREN M. WILSON, RICHARD E. BEHRMAN, P. pp. 2150-2166
3. Jan E Drutz. The pediatric physical examination: Chest and abdomen UpToDate- online recourse. 2022 <https://www.uptodate.com/contents/the-pediatric-physical-examination-chest-and-abdomen>
4. KatilovAV, Dmitriev DV, Dmitrieva KY, Makarov S.Yu. Clinical examination of the child - 2 nd ed. - Vinnitsa: New Book, 2019. - 520 p. стор. 116-170.

The respiratory system provides oxygen delivery according to the metabolic needs of the body and removes carbon dioxide. Disorders of ventilation, perfusion, diffusion, or respiratory control may result in respiratory failure. In children, the clinical manifestations of respiratory diseases are strongly influenced by age because airway anatomy, chest wall mechanics, lung volumes, and respiratory control mechanisms change considerably during growth. Relatively narrow airways, a more compliant chest wall, and lower respiratory reserves make infants and young children particularly vulnerable to respiratory disorders.

Anatomical and Physiological Features of the Respiratory System in Children

Nasal Cavity and Paranasal Sinuses

In infants and young children, the nasal passages are relatively narrow. Therefore, even mild mucosal edema or accumulation of secretions may significantly increase resistance to airflow.

Infants are **predominantly nasal breathers**. Consequently, nasal obstruction may considerably interfere with sucking, feeding, and sleep. However, the traditional statement that infants are able to breathe exclusively through the nose until 6–8 months of age is an oversimplification.

The ethmoid and maxillary sinuses are present at birth but are relatively small. The sphenoid and frontal sinuses develop and undergo progressive pneumatization later during childhood. Therefore, the occurrence and localization of sinusitis depend partly on the child's age.

Pharynx and Eustachian Tubes

The pharynx in infants and young children is relatively short and narrow. The lymphoid tissue of Waldeyer's ring develops actively throughout childhood.

In young children, the Eustachian tube is shorter, wider, and more horizontally positioned than in adults. These anatomical features facilitate the spread of infection from the nasopharynx to the middle ear. With increasing age, the Eustachian tube becomes more vertical, and the incidence of acute otitis media decreases.

Adenoid hypertrophy may cause nasal obstruction, mouth breathing, snoring, sleep-disordered breathing, altered voice resonance, and recurrent middle-ear disease.

Larynx

In children, the larynx is positioned higher and more anteriorly than in adults and has a smaller absolute diameter.

The subglottic region is a clinically important site of airway narrowing. The relatively loose mucosal and submucosal tissues predispose young children to rapid development of edema during inflammation.

Because airway resistance increases markedly as airway radius decreases, even a small degree of mucosal edema may cause significant airflow obstruction in a young child. This is one of the factors contributing to the increased susceptibility of young children to upper airway obstruction, particularly in croup.

Trachea and Bronchi

The trachea and bronchi in children have a smaller diameter, and their cartilaginous framework is more compliant than in adults. These features contribute to greater changes in airway caliber during respiration and increase susceptibility to airway obstruction.

Children, particularly infants and young children, are characterized by:

- relatively narrow airways;
- greater susceptibility to mucosal edema;
- lower ventilatory reserve;
- increased susceptibility to bronchial obstruction;
- increased risk of foreign-body aspiration.

History Taking and Presenting Complaints

The medical history is obtained from the parents or caregivers, with the child's participation whenever possible according to age and developmental level.

The major respiratory complaints include:

- nasal obstruction;
- rhinorrhea;
- sneezing;
- cough;
- noisy breathing;
- wheezing;
- stridor;
- dyspnea;

- chest pain;
- hemoptysis;
- voice changes;
- snoring;
- episodes of apnea;
- cyanosis.

The clinician should determine the onset and duration of symptoms, their diurnal variation, and their relationship to physical activity, sleep, feeding, exposure to allergens, respiratory infections, and tobacco smoke.

The history should also include previous or coexisting atopic diseases, recurrent pneumonia, aspiration, gastroesophageal reflux, immunodeficiency, cystic fibrosis, primary ciliary dyskinesia, and congenital airway abnormalities.

A family history of asthma, allergic disease, cystic fibrosis, and other hereditary respiratory disorders should also be obtained.

Assessment of Upper Respiratory Tract Symptoms

Rhinorrhea and Nasal Obstruction

The following characteristics should be assessed:

- duration of symptoms;
- unilateral or bilateral involvement;
- character of nasal discharge;
- presence of blood;
- unpleasant odor;
- associated sneezing, itching, or lacrimation;
- fever;
- degree of nasal obstruction.

Bilateral watery nasal discharge may occur in both viral and allergic rhinitis. Thick or discolored nasal secretions alone do not establish a bacterial etiology.

Unilateral purulent or foul-smelling nasal discharge in a child should raise suspicion of a nasal foreign body.

Severe nasal obstruction in a newborn requires exclusion of structural abnormalities, including choanal atresia.

Nasal polyps are considerably less common in children than in adults. Their presence, particularly in a young child, should prompt evaluation for an underlying disorder such as cystic fibrosis, primary ciliary dyskinesia, or chronic rhinosinusitis.

Cough

Cough is one of the most common symptoms of respiratory disease in children.

When assessing cough, the following characteristics should be determined:

- onset;
- duration;
- dry or wet character;
- paroxysmal nature;
- association with sleep;
- association with exercise;
- occurrence during or after feeding;
- post-tussive vomiting;
- sudden onset;
- hemoptysis;
- associated wheeze or stridor;
- impact on sleep and daily activities.

Classification According to Duration

In pediatric practice, **chronic cough is generally defined as daily cough lasting more than 4 weeks.**

Causes of chronic cough commonly encountered in adults should not automatically be extrapolated to children. The differential diagnosis in children depends substantially on age and clinical context.

Red Flags in a Child with Chronic Cough

Features that warrant further investigation include:

- persistent daily wet cough;
- sudden onset suggesting aspiration;
- cough associated with feeding;
- hemoptysis;
- recurrent pneumonia;
- failure to thrive;
- digital clubbing;
- chronic hypoxemia;
- persistent abnormal auscultatory findings;
- severe dyspnea;
- immunodeficiency;
- suspected structural airway abnormality.

Pertussis

Clinical manifestations suggestive of pertussis include:

- paroxysmal cough;
- repeated bursts of coughing;
- inspiratory whoop;
- post-tussive vomiting;
- cyanosis during coughing episodes;
- apnea, particularly in infants.

In young infants, the typical inspiratory whoop may be absent, and apnea may be a major or even the presenting manifestation.

General Examination of a Child with Respiratory Symptoms

Assessment of breathing begins **before the stethoscope is used**.

The clinician should assess:

1. general condition;
2. level of consciousness;
3. position of the child;
4. ability to speak, cry, or feed;
5. color of the skin and mucous membranes;
6. respiratory rate;
7. respiratory rhythm and depth;
8. work of breathing;
9. presence of noisy breathing;
10. oxygen saturation.

Respiratory Rate

Respiratory rate changes considerably with age and is one of the most important clinical parameters in the assessment of the pediatric respiratory system.

Approximate resting respiratory rates are:

Age	Respiratory rate, breaths/min
Newborn	30–60
Infant	30–50
1–3 years	24–40
4–5 years	22–34
6–12 years	18–30
>12 years	12–20

In infants, respiratory rate should preferably be counted for **a full minute** while the child is calm.

Crying, physical activity, fever, pain, and anxiety may increase the respiratory rate.

Clinical algorithms for children younger than 5 years with cough or difficulty breathing use age-specific thresholds for tachypnea. These thresholds are intended for the assessment of an ill child and should not be interpreted as identical to normal reference ranges.

Signs of Increased Work of Breathing

During inspection, attention should be paid to:

- tachypnea;
- nasal flaring;
- intercostal retractions;

- suprasternal and supraclavicular retractions;
- lower chest wall indrawing;
- use of accessory respiratory muscles;
- expiratory grunting;
- paradoxical thoracoabdominal movement;
- prolonged expiration;
- stridor;
- wheezing;
- inability to speak or feed normally because of breathlessness.

Altered consciousness, central cyanosis, marked respiratory muscle fatigue, and reduced intensity of breath sounds may indicate severe respiratory compromise.

In severe bronchial obstruction, wheezing may become less audible because of critically reduced airflow. Therefore, a **“silent chest” is not a sign of improvement and may indicate life-threatening airway obstruction.**

Pulse Oximetry

Pulse oximetry is an important component of the assessment of children with respiratory distress or acute lower respiratory tract disease.

SpO₂ should always be interpreted together with the child's clinical condition.

Measurement accuracy may be affected by excessive movement, poor peripheral perfusion, cold extremities, or incorrect sensor positioning.

It is important to remember that normal oxygen saturation does not exclude impaired ventilation or hypercapnia.

Examination of the Chest

The following should be assessed:

- shape of the chest;
- symmetry;
- relationship between the anteroposterior and transverse diameters;
- symmetry of respiratory movements;
- chest wall retractions;
- deformities;
- use of accessory respiratory muscles.

The chest of an infant is relatively rounded. With growth, the transverse diameter increases.

Persistent enlargement of the anteroposterior diameter in an older child may be associated with chronic pulmonary hyperinflation.

Reduced movement of one side of the chest may occur in pneumothorax, atelectasis, pleural effusion, extensive consolidation, or other unilateral pulmonary disorders.

Palpation of the Chest

During palpation, the clinician assesses:

- tenderness;
- symmetry of chest expansion;
- position of the trachea;
- tactile fremitus when clinically appropriate.

Reduced expansion of one hemithorax may indicate localized disease.

Tactile fremitus may be increased over an area of pulmonary consolidation and decreased in pleural effusion or pneumothorax. However, its diagnostic usefulness is limited in infants and young children.

Percussion of the Lungs

Percussion should be performed systematically, comparing corresponding areas of the right and left hemithoraces.

The main percussion findings include:

Normal resonance — expected over normally aerated lung tissue.

Dullness to percussion may occur with:

- pulmonary consolidation;
- atelectasis;
- pleural effusion.

Hyperresonance may occur with:

- pulmonary hyperinflation;
- bronchial obstruction;
- pneumothorax.

Percussion is less informative in infants and young children because of their small chest size and the close proximity of thoracic and abdominal structures.

Auscultation of the Lungs

Auscultation should be performed systematically and symmetrically, comparing corresponding areas on the right and left sides of the chest.

The clinician should assess:

- intensity of breath sounds;
- symmetry of air entry;
- relationship between inspiratory and expiratory phases;
- presence of adventitious respiratory sounds.

In children, sounds originating in the nasopharynx and large airways are readily transmitted through the chest and may be mistaken for pulmonary sounds. Such sounds may change or disappear after coughing or clearance of upper airway secretions.

Adventitious Respiratory Sounds

Stridor

Stridor is a harsh, predominantly inspiratory sound indicating narrowing of the upper or central airways.

Inspiratory stridor most commonly indicates extrathoracic airway obstruction.

Biphasic stridor may indicate a relatively fixed obstruction of the larynx or central airway.

Possible causes include croup, laryngomalacia, foreign-body aspiration, laryngeal edema, and structural airway abnormalities.

Wheeze

Wheeze is a continuous musical sound, predominantly expiratory, produced by narrowing of the intrathoracic airways.

Polyphonic wheeze is more typical of diffuse bronchial narrowing, such as that occurring in asthma.

A **localized monophonic wheeze** should raise suspicion of focal bronchial obstruction, including a foreign body.

Rhonchi

Rhonchi are low-pitched continuous respiratory sounds usually associated with secretions or obstruction in the larger airways. They may change or disappear after coughing.

Crackles

Crackles are short, discontinuous respiratory sounds.

They may result from the opening of small airways and alveoli and may be heard in pneumonia, pulmonary edema, interstitial lung disease, and other pulmonary conditions.

Pleural Friction Rub

A pleural friction rub is a coarse, superficial sound produced by movement of inflamed pleural surfaces against each other during respiration.

Localization of Airway Obstruction According to Respiratory Sounds

For clinical examination, it is useful to distinguish:

Stertor — predominantly nasopharyngeal or oropharyngeal obstruction.

Stridor — laryngeal or tracheal obstruction.

Wheeze — bronchial obstruction.

Crackles — abnormalities involving small airways and/or the alveolar region.

Extrathoracic airway obstruction typically causes greater difficulty during **inspiration**.

Intrathoracic bronchial obstruction is more commonly associated with **prolonged expiration and wheezing**.

Signs of Pulmonary Consolidation

When a sufficiently large area of lung is consolidated, the following findings may occur:

- localized dullness to percussion;
- increased vocal resonance;
- bronchial breath sounds;
- localized crackles;
- egophony;
- reduced expansion of the affected side of the chest.

However, the absence of classical physical signs does not exclude pneumonia, particularly in infants and young children.

Digital Clubbing

Digital clubbing is enlargement of the distal phalanges accompanied by changes in the angle of the nail bed.

In children, clubbing is an important clinical finding that warrants further assessment.

Possible causes include:

- cystic fibrosis;
- bronchiectasis;
- chronic suppurative lung disease;
- cyanotic congenital heart disease;
- inflammatory bowel disease;
- chronic liver disease.

Digital clubbing should therefore not be considered simply a sign of “chronic hypoxia.”

Examination of the Oropharynx and Tonsils

The clinician should assess:

- tonsillar size;
- symmetry;

- erythema;
- exudate;
- posterior pharyngeal wall;
- palate;
- uvula;
- oral mucosa.

Tonsillar exudate is not specific for streptococcal infection and may also occur in viral infections, including infectious mononucleosis.

Tonsillar size alone does not determine the need for tonsillectomy. Clinical significance is determined by recurrent infections, symptoms of upper airway obstruction, and sleep-disordered breathing.

Marked unilateral tonsillar enlargement requires assessment for a localized inflammatory process and, less commonly, neoplastic disease.

Signs of Severe Respiratory Compromise

Particular attention is required when a child has:

- central cyanosis;
- marked chest wall retractions;
- severe tachypnea;
- grunting;
- stridor at rest;
- markedly reduced air entry;
- a silent chest;
- altered consciousness;
- inability to speak, drink, or feed because of breathlessness;
- exhaustion;
- hypoxemia.

Sequence of Clinical Examination of a Child with Respiratory Symptoms

A rational sequence of examination is:

- 1. General assessment:** consciousness, behavior, position, skin color, ability to speak or feed.
- 2. Breathing:** respiratory rate, rhythm, depth, work of breathing, retractions, accessory muscle use, and noisy breathing.
- 3. Measurement of SpO₂.**
- 4. Examination of the upper respiratory tract:** nose, oropharynx, and tonsils.
- 5. Inspection of the chest:** shape, symmetry, and respiratory excursion.
- 6. Palpation.**

7. Percussion.

8. Auscultation: symmetry of air entry, duration of expiration, and adventitious respiratory sounds.

9. Clinical interpretation: determine whether the predominant pathology involves the upper or lower airways; whether the process is obstructive or parenchymal; whether abnormalities are localized or diffuse; and whether signs of respiratory failure are present.

The combination of medical history, inspection, respiratory rate, assessment of work of breathing, pulse oximetry, percussion, and auscultation forms the basis of the initial clinical evaluation of the respiratory system in children.

3. Questions for the lesson

1. Name the anatomical and physiological features of the nose and paranasal sinuses in children.
2. Name the anatomical and physiological features of the pharynx and larynx in children.
3. Name the anatomical and physiological features of the trachea in children.
4. Name the anatomical and physiological features of the bronchi in children.
5. Name the anatomical and physiological features of the lungs in children.
6. Name the anatomical and physiological features of the chest in children.
7. Types of percussion of lungs in children.
8. The sequence of percussion of lungs in children.
9. Standard types of sounds obtained by percussion.
10. Assessment of percussion note
11. The main rules of auscultation of lungs in children.
12. The technique of auscultation of lungs in children.
13. Standard types of sounds obtained by auscultation.
14. Assessment of auscultation
15. Normal breath sounds.
16. Bronchial breathing
17. Causes of bronchial breath sounds
18. Causes of diminished vesicular sound
19. Additional sounds: crackles, wheeze, pleural friction rub.
20. Causes of crackles
21. The differential diagnosis of crepitation and pleural friction rub.

Recommended literature.

Basic:

Nelson textbook 21th Edition by Robert M. Kliegman, MD, Joseph St. Geme, Nathan J. Blum, Samair S. Shan, Robert C. Tasker, Karen M. Wilson, Richard E. Behrman Видавництво: Elsevier, 2019. P. 3693-3704.

Additional:

1. Fundamentals of pediatrics according to Nelson. Karen J. Marcdante, Robert M. Kligman; translation of the 8th Eng. edition in 2 volumes. Scientific editors of the translation V.S. Berezenko, T.V. Rest Kyiv: VSV "Medicine", 2020.
2. Katilov O.V., Dmitriev D.V., Dmitrieva K.Yu., Makarov S.Yu. Clinical examination of a child. 2nd edition. Vinnytsia: Nova Kniga, 2019. 520 p.
3. Pediatrics: textbook. T.O. Kryuchko, O.Y. Abaturov, T.V. Kushnereva et al.ed. by T.O. Kryuchko, O.Y. Abaturov. Kyiv: AUS Medicine Publishing, 2016. 208 p. (p.39-49) ISBN 978-617-505-485-7.

The methodical guideline for practical class was made by assoc.pr. Mozyrska O.V.