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**Federal State Autonomous Educational Institution of Higher Education**

**PEOPLES' FRIENDSHIP UNIVERSITY OF RUSSIA**

**NAMED AFTER PATRICE LUMUMBA**

**RUDN University**

**Institute of Medicine**

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educational division (faculty/institute/academy) as higher education programme developer

**COURSE SYLLABUS**

**Bioelements in Medicine**

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course title

**Recommended by the Didactic Council for the Education Field of:**

**31.05.03 Dentistry**

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field of studies / speciality code and title

**The course instruction is implemented within the professional education programme of higher education:**

**Dentistry**

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higher education programme profile/specialisation title

**2026**

## 1. COURSE GOAL(s)

The goal of the course is to equip students with the knowledge of the biological role of macro- and microelements and their implications for human health.

- formation of clinical thinking in students for diagnosis, evaluation of disease prognosis and successful treatment;
- application of new methods and schemes of correction of various metabolic disorders and pathological processes.

## 2. REQUIREMENTS FOR LEARNING OUTCOMES

Mastering the course (module) "Bioelements in Medicine" is aimed at the development of the following competences /competences in part: GC-1, GC-5, GPC-5, GPC-7, GPC-8, PC-1, PC-5, PC-11, PC-15, PC-16.

*Table 2.1. List of competences that students acquire through the course study*

Competence code	Competence descriptor	Competence formation indicators (within this course)
GC -1	Able to carry out a critical analysis of problem situations based on a systematic approach, to develop a strategy for action	GC 1.1 Knows: methods of critical analysis and evaluation of modern scientific achievements; basic principles of critical analysis
		GC 1.2 is able to: acquire new knowledge based on analysis, synthesis, etc.; collect data on complex scientific problems related to the professional field; search for information and solutions based on actions, experiments and experience
		GC 1.3 Has practical experience: research of the problem of professional activity with the use of analysis, synthesis and other methods of intellectual activity; development of an action strategy for solving professional problems
GC-5	Able to analyze and take into account the diversity of cultures in the process of intercultural interaction	GC 5.1 Knows: the main categories of philosophy, the laws of historical development, the basics of intercultural communication; the main concepts of human interaction in the organization
		GC 5.2 Is able to: correctly and easily present professional information in the process of intercultural interaction; observe ethical norms and human rights; analyze the features of social interaction, taking into account national, ethnocultural, and confessional characteristics

Competence code	Competence descriptor	Competence formation indicators (within this course)
		GC 5.3 Has practical experience in: productive interaction in the professional environment, taking into account national, ethno-cultural, and confessional characteristics; overcoming communication, educational, ethnic, confessional, and other barriers in the process of intercultural interaction
GPC-5	Able to conduct a patient examination in order to establish a diagnosis when solving professional tasks	<p>GPC 5.1 Knows the methodology for collecting anamnesis of life and diseases, complaints in children and adults (their legal representatives); the methodology for examination and physical examination; the clinical picture, methods for diagnosing the most common diseases; methods of laboratory and instrumental studies for assessing the state of health, medical indications for conducting research, rules for interpreting their results; the international statistical classification of diseases and health-related problems (ICD); conditions requiring medical care in emergency form</p> <p>GPC 5.2 is able to: collect complaints, anamnesis of life and disease in children and adults (their legal representatives), identify risk factors and causes of diseases; apply methods of examination and physical examination of children and adults; interpret the results of examination and physical examination of children and adults; diagnose the most common pathology in children and adults; identify risk factors for cancer; formulate a preliminary diagnosis, make a plan for conducting laboratory, instrumental and additional studies in children and adults in accordance with the rules of medical care, clinical recommendations, taking into account the standards of medical care; send children and adults to laboratory, instrumental and additional studies in accordance with the current procedures for providing dental medical care, clinical recommendations, taking into account the standards of medical care; refer children and adults for consultations with specialist doctors in accordance with the procedures for providing medical care, clinical</p>

Competence code	Competence descriptor	Competence formation indicators (within this course)
		<p>recommendations, taking into account the standards of medical care; interpret and analyze the results of consultations with specialist doctors for children and adults; interpret and analyze the results of the main (clinical) and additional (laboratory, instrumental) methods of examination; conduct a differential diagnosis of diseases in children and adults; identify clinical signs of sudden acute diseases, conditions, exacerbations of chronic diseases without obvious signs of life threatening, requiring urgent medical care</p> <p>GPC 5.3 has practical experience in: collecting complaints, anamnesis of life and disease in children and adults (their legal representatives), identifying risk factors and causes of diseases; examining and physically examining children and adults; diagnosing the most common diseases in children and adults; identifying risk factors for major oncological diseases; forming a preliminary diagnosis, setting up a plan for conducting instrumental, laboratory, additional studies, and consulting specialist doctors; referral of patients for instrumental, laboratory, additional studies, consultations of medical specialists in accordance with the current procedures for providing medical care, clinical recommendations, taking into account the standards of medical care; interpretation of data from additional (laboratory and instrumental) examinations of patients; making a preliminary diagnosis in accordance with the international statistical classification of diseases and health related problems( ICD); conducting differential diagnosis of diseases; recognition of conditions that occur during sudden acute diseases, exacerbation of chronic diseases without obvious signs of a threat to the patient's life and requiring urgent medical care</p>
GPC-7	Able to organize work and make professional decisions in emergency situations, in emergency situations,	GPC 7.1 Knows: the method of collecting complaints and anamnesis from patients (their legal representatives); the method of physical examination of patients (examination, palpation,

Competence code	Competence descriptor	Competence formation indicators (within this course)
	epidemics, and in centers of mass destruction	<p>percussion, auscultation); the principles and methods of providing medical care to patients in emergency conditions, in emergency situations, epidemics and in foci of mass destruction in accordance with the procedures for providing medical care, clinical recommendations, taking into account the standards of medical care. clinical signs of major emergency conditions; principles of medical evacuation in emergency situations, epidemics and in foci of mass destruction; principles of work in foci of mass destruction</p> <p>GPC 7.2 is able to: recognize conditions that require the provision of medical care in an emergency form, including in the conditions of emergency situations, epidemics and in the foci of mass lesions that require the provision of medical care in an emergency form; organize the work of medical personnel in emergency conditions, in the conditions of emergency situations, epidemics and in the foci of mass lesions; provide emergency medical assistance to patients in conditions that pose a threat to the life of patients, including clinical death (stopping vital functions of the human body (blood circulation and / or breathing); use medicines and medical devices when providing medical care in emergency conditions; perform basic cardiopulmonary resuscitation; use personal protective equipment;</p> <p>GPC 7.2 is able to: recognize conditions that require the provision of medical care in an emergency form, including in the conditions of emergency situations, epidemics and in the foci of mass lesions that require the provision of medical care in an emergency form; organize the work of medical personnel in emergency conditions, in the conditions of emergency situations, epidemics and in the foci of mass lesions; provide emergency medical assistance to patients in conditions that pose a threat to the life of patients, including clinical death (stopping vital functions of the human body (blood circulation and / or breathing); use medicines and medical devices</p>

Competence code	Competence descriptor	Competence formation indicators (within this course)
		when providing medical care in emergency conditions; perform basic cardiopulmonary resuscitation; use personal protective equipment
GPC8	GPC-8. Able to use basic physical and chemical, mathematical and natural science concepts and methods in solving professional problems	<p>GPC 8.1 Knows: basic physical-chemical, mathematical and natural-science concepts and methods that are used in medicine</p> <p>GPC 8.2 is able to: interpret the data of the main physical-chemical, mathematical and natural-science research methods in solving professional problems</p> <p>GPC 8.3 Has practical experience: the use of basic physico-chemical, mathematical and natural science methods of research in solving professional problems</p>
PC-1	Capable of conducting diagnostics in children and adults with dental diseases, establishing a diagnosis	<p>PC 1.1. : General issues of organizing medical care for adults and children Anatomy of the head, maxillofacial region, features of blood supply and innervation structure of teeth Histology and embryology of the mouth and teeth, the main disorders of embryogenesis Anatomical and functional state of the maxillofacial organs, taking into account age The normal and pathological physiology of the dentoalveolar system, its relationship with the functional state of other systems of the body and the levels of their regulation The role of oral hygiene, nutrition and the use of fluorides in the prevention of dental and periodontal diseases Methods for collecting anamnesis of life and diseases, complaints from children and adults (their legal representatives) with dental diseases Goals and objectives of individual and professional oral hygiene Hygienic indexes and methods of their determination Methods of examination and physical examination, features of clinical dental examination in children and adults with dental diseases Clinical picture, diagnostic methods, classification of diseases of teeth, periodontal disease, oral mucosa, lips in children and adults Clinical picture, diagnostic methods, classification of diseases of the bone tissue of the</p>

Competence code	Competence descriptor	Competence formation indicators (within this course)
		<p>jaws, the peripheral nervous system of the maxillofacial region, and the temporomandibular joint in children and adults Methods of laboratory and instrumental studies for assessing the state of health, medical indications for conducting research, rules for interpreting their results Medical indications and counter-indications for the use of additional examination methods Medical devices used in the provision of medical assistance to children and adults with stomatological diseases International Statistical Classification of Diseases and Health-Related Problems (ICD) The procedure for providing medical assistance to the adult population in case of dental diseases Procedure for providing medical assistance to children with dental diseases Clinical guidelines for the provision of dental care Conditions requiring urgent medical care Sanitary and epidemiological requirements and issues of organizing sanitary and anti-epidemic (preventive) measures to prevent the occurrence and spread of infectious diseases</p> <p>PC 1.2 is able to: Collect complaints, anamnesis of life and disease in children and adults (their legal representatives) with dental diseases, identify risk factors and causes of dental diseases Interpret information received from children and adults (their legal representatives) with stomatological diseases Apply methods of examination and physical examination of children and adults with dental diseases Interpret the results of examination and physical examination of children and adults with stomatological diseases Diagnose pulp and periodontal diseases, periodontal diseases, oral and lip mucosa diseases in children and adults with dental diseases of the hard tissues of the teeth To diagnose in children and adults with dental diseases defects of teeth, dentition, dentoalveolar deformities and anomalies of teeth and jaws, complete absence of teeth and prerequisites for their development, injuries of teeth, bones of the facial skeleton and</p>

Competence code	Competence descriptor	Competence formation indicators (within this course)
		<p>soft tissues of the maxillofacial region Identify risk factors for cancer diseases of the maxillofacial region in children and adults with dental diseases Formulate a preliminary diagnosis, draw up a plan for conducting laboratory, instrumental and additional studies in children and adults with stomatological diseases in accordance with the procedures for providing medical care, clinical recommendations, taking into account the standards of medical care Refer children and adults with dental diseases to laboratory, instrumental and additional examinations in accordance with the current rules of dental medical care, clinical recommendations, taking into account the standards of medical care Refer children and adults with dental diseases for consultations with specialist doctors in accordance with the rules of medical care, clinical recommendations, taking into account the standards of medical care Interpret and analyze the results of consultations with specialist doctors for children and adults with dental diseases Justify the need and scope of additional examinations of patients (including X-ray methods) Interpret and analyze the results of the main (clinical) and additional (laboratory, instrumental) methods of examination in children and adults with stomatological diseases, including the data of X-ray methods Perform differential diagnostics of dental diseases in children and adults Formulate the final diagnosis in accordance with the International Statistical Classification of Diseases and Health-Related Problems (ICD) Identify clinical signs of sudden acute diseases, conditions, exacerbations of chronic diseases without obvious signs of life-threatening, requiring urgent medical care</p> <p>PC 1.3 has practical experience in collecting complaints, anamnesis of life and illness in children and adults (their legal representatives), identifying risk factors and causes of dental diseases Examination and physical examination of children</p>

Competence code	Competence descriptor	Competence formation indicators (within this course)
		<p>and adults with stomatological diseases Diagnostics in children and adults: - dental caries, - non-carious lesions, - pulp and periodontal diseases, - periodontal disease, - the mucous membrane of the mouth and lips, - dental defects, - defects in the dentition, - dentoalveolar deformities, - anomalies of teeth and jaws, - complete absence of teeth</p> <p>Identification of risk factors for oncological diseases of the maxillofacial region in children and adults with dental diseases Formulation of a preliminary diagnosis, drawing up a plan for conducting instrumental, laboratory, additional studies, and consultations of specialist doctors in children and adults with dental diseases Referral of children and adults with dental diseases for instrumental, laboratory, additional studies, consultations of medical specialists in children and adults with dental diseases in accordance with the current procedures for providing dental medical care to adults and children, clinical recommendations, taking into account the standards of medical care</p> <p>Interpretation of data from additional (laboratory and instrumental) examinations of patients (including radiological methods) Setting up a preliminary diagnosis in accordance with the International Statistical Classification of Diseases and Health-Related Problems (ICD) Conducting differential diagnostics of dental diseases Making a final diagnosis in accordance with the International Statistical Classification of Diseases and Health-related Problems (ICD), Recognizing conditions that occur during sudden acute illnesses, exacerbation of chronic diseases without obvious signs of a threat to the patient's life and requiring emergency medical care</p>

### 3. COURSE IN HIGHER EDUCATION PROGRAMME STRUCTURE

The course refers to the core/variable/elective\* component of (B1) block of the higher educational programme curriculum.

\* - Underline whatever applicable.

Within the higher education programme students also master other (modules) and / or internships that contribute to the achievement of the expected learning outcomes as results of the course study.

*Table 3.1. The list of the higher education programme components/disciplines that contribute to the achievement of the expected learning outcomes as the course study results*

<b>Competence code</b>	<b>Competence descriptor</b>	<b>Previous courses/modules*</b>	<b>Subsequent courses/modules*</b>
GC -1	Able to carry out a critical analysis of problem situations based on a systematic approach, to develop a strategy for action	-	-
GC-5	Able to carry out a critical analysis of problem situations based on a systematic approach, to develop a strategy for action	-	-
GPC-5	Able to conduct a patient examination in order to establish a diagnosis when solving professional tasks	-	-
GPC-7	Able to organize work and make professional decisions in emergency situations, in emergency situations, epidemics, and in centers of mass destruction	-	-
GPC-8	Able to use basic physical and chemical, mathematical and natural science concepts and methods in solving professional problems	-	-

Competence code	Competence descriptor	Previous courses/modules*	Subsequent courses/modules*
PC-1	Capable of conducting diagnostics in children and adults with dental diseases, establishing a diagnosis	-	-

\* To be filled in according to the competence matrix of the higher education programme.

#### 4. COURSE WORKLOAD AND ACADEMIC ACTIVITIES

The total workload of the course “Bioelements in Medicine” is 3 credits (108 academic hours).

Table 4.1. Types of academic activities during the periods of higher education programme mastering (**full-time training**)\*

Type of academic activities	Total academic hours	Semesters/training modules
		1
Contact academic hours	51	51
including:		
Lectures (LC)	-	-
Lab work (LW)	-	-
Seminars (workshops/tutorials) (S)	51	51
Self-studies	15	15
Evaluation and assessment (exam/passing/failing grade)	6	6
<b>Course workload</b>	academic hours	<b>72</b>
	credits	<b>2</b>

#### 5. COURSE CONTENTS

Table 5.1. Course contents and academic activities types

Course module title	Course module contents (topics)	Academic activities types
1	1. Subject of medical elementology. Biological classification of chemical elements. The concept of bioelements.	S

Introduction to Medical Elementology	2. Biogeochemistry and factors affecting the elemental status of the population.	S
2 General Elementology	3. Factors affecting the homeostasis of microelements. Interaction between microelements	S
	4. Elemental status of a person. Personalized assessment of human elemental status.	S
3 Particular Elementology	5. Elements-organogenes (carbon, oxygen, nitrogen, hydrogen): a role in the body; suction; excretion; associated diseases; sources.	S
	6. Macroelements (potassium, sodium, calcium, magnesium, phosphorus, sulfur, chlorine): role in the body; suction; excretion; deficiency and excess; toxicity; associated diseases; sources.	S
	7. Essential trace elements (iron, zinc, copper, manganese, chromium, cobalt, molybdenum, selenium, iodine): role in the body; suction; excretion; deficiency and toxicity; associated diseases; sources.	S
	8. Conditionally essential microelements (lithium, strontium, vanadium, nickel, tin, silicon, fluorine): role in the body; suction; excretion; deficiency and toxicity; associated diseases; sources	S
	9. Toxic and potentially toxic microelements (arsenic, aluminum, lead, cadmium, mercury): role in the body; suction; excretion; toxicity; associated diseases; sources.	S
4 The role of chemical elements in dentistry	10. Imbalances of chemical elements for various diseases of the oral cavity: caries, pulpitis, periodontitis, gingivitis, periodontitis	S

\* - to be filled in only for **full**-time training; *LC* - lectures; *LW* - lab work; *S* - seminars.

## 6. CLASSROOM EQUIPMENT AND TECHNOLOGY SUPPORT REQUIREMENTS

*Table 6.1. Classroom equipment and technology support requirements*

Type of academic activities	Classroom equipment	Specialised educational / laboratory equipment, software, and materials for course study (if necessary)
Lecture	A lecture hall for lecture-type classes, equipped with a set of specialised furniture; board (screen) and technical means of multimedia presentations.	
Lab work	A classroom for laboratory work, individual consultations, current and mid-term assessment; equipped with a set of specialised furniture and machinery.	List of specialised laboratory equipment, machinery, stands, etc.

Type of academic activities	Classroom equipment	Specialised educational / laboratory equipment, software, and materials for course study (if necessary)
Seminar	A classroom for conducting seminars, group and individual consultations, current and mid-term assessment; equipped with a set of specialised furniture and technical means for multimedia presentations.	List of specialised equipment, stands, visual posters, etc.
Computer Lab	A classroom for conducting classes, group and individual consultations, current and mid-term assessment, equipped with personal computers (in the amount of ___ pcs), a board (screen) and technical means of multimedia presentations.	List of specialised software installed on computers for mastering the discipline
Self-studies	A classroom for independent work of students (can be used for seminars and consultations), equipped with a set of specialised furniture and computers with access to the electronic information and educational environment.	

## 7. RESOURCES RECOMMENDED FOR COURSE STUDY

### *Main readings:*

- 1) An Introduction to Medical Elementology: A Textbook. I.V. Radysh, A.V. Rocky. - Moscow: PFUR, 2015. - 200 p.: ill. ISBN 978-5-209-06691-0.
- 2) Oberlis D., Harland V., Skalny A. Biological role of macro and microelements in humans and animals. - SPb.: Science, 2008. - 544 p.
- 3) Skalny A.V., Lakarova E.V., Kuznetsov V.V., Skalnaya M.G. Analytical methods in bioelementology. - St. Petersburg: Science, 2009. – 264 p.

### *Additonal readings:*

- 1) World Health Organization. (1996). Trace elements in human nutrition and health.
- 2) Skalny A.V. Bioelements and bioelementology in pharmacology and nutrition: fundamental and practical aspects // Pharmacology and nutritional intervention in the treatment of disease, Edited by Faik Atroshi. 2014.-P. 225-241.
- 3) Skalny A.V., Rudakov I.A. Notova S.V., Burtseva T.I., Skalny V.V., Baranova O.V., Gubaydulina S.G., Bioelementology: basic concepts and terms. IPK GOU OSU - Orenburg. - 2005. – 50 p.
- 4) Ibragimova M.Ya., Skalnaya M.G., Sabirova L.Ya., Skalny A.V., Zhdanov R.I. Exchange of macro and microelements in the human body. Modern methods of determining chemical elements in biological materials / Selected chapters of fundamental and translational medicine. R.I. Zhdanov, the manager. Ed. - Kazan: Kazan Publishing House. University. 2014. P. 330-346.
- 5) Skalny A.V. Microelements // Laboratory diagnostics of infectious diseases. Reference book / Ed. IN AND. Pokrovsky, M.G. Tvorogovoy, G.A. Shipulina. - Moscow: Publishing House BINOM, 2013 - 447- 467p.

6) Skalny A.V., Tsygan V.N. Pathophysiology of macro-and microelement exchange // Pathophysiology of Metabolism: a Textbook / Ed. V.N. Gypsy. - St. Petersburg: SpetsLit, 2013. - P. 262-333.

7) Skalny A.V. Chemical elements in human physiology and ecology. -M.: ONYX 21 Century: The World, 2004. -216 p.

8) Skalny A.V. Physiological aspects of the application of macro- and microelements. IPK GOU OSU - Orenburg, 2005. - 206 p.

9) Agadzhanyan N.A., Veldanova M.V., Skalny A.V. Ecological portrait of man and the role of microelements. -M., 2001. -236 p.

10) Skalny A.V., Rudakov I.A. Bioelements in medicine. -M.: ONYX 21 Century: The World, 2004. -272 p.

#### *Internet sources:*

a) Software OS Windows XP, Vista, 7; set of office programs OpenOffice.org (or MS Office 2003, 2007); Internet search engines FireFox or Explorer, Opera or other; software tools for knowledge control. Databases - Medline, Pubmed, Excel, etc.

6) RUDN Library site - Access mode: <http://lib.rudn.ru/> - from stationary computers of the PFUR

University library ONLINE - Access mode: <http://www.biblioclub.ru>

Book collections of the publishing house SPRINGER. - Access mode: [www.springerlink.com](http://www.springerlink.com)

Bulletin of the Peoples' Friendship University (Series "Medicine") - Access mode: <http://www.elibrary.ru/defaultx.asp>

Universal database East View. - Access mode: <http://online.ebiblioteka.ru>

Full-text collection of Russian scientific journals. eLibrary.ru - Access mode: <http://elibrary.ru/defaultx.asp?>

On-line access to journals. Information database on all branches of science and electronic delivery of documents. SwetsWise. - Access mode: <https://www.swetswise.com>

<http://quakes.globalincidentmap.com>

<http://www.globalincidentmap.com>

[http://earthquake.usgs.gov/earthquakes/recenteqsww/Quakes/quakes\\_all.php](http://earthquake.usgs.gov/earthquakes/recenteqsww/Quakes/quakes_all.php)

[http://www.thesis.lebedev.ru/forecast\\_activity.html](http://www.thesis.lebedev.ru/forecast_activity.html)

Electronic Library System PFUR - EBS PFUR: <http://lib.rudn.ru:8080/MegaPro/Web>

The educational portal of PFUR (<http://web-local.rudn.ru>)

University library online: <http://www.biblioclub.ru>

National digital resource "RUKONT": <http://rucont.ru>

IQlib: <http://www.iqlib.ru>

Science Direct: <http://www.sciencedirect.com>

EBSCO: <http://search.ebscohost.com>

Sage Publications: <http://online.sagepub.com>

Springer / Kluwer: <http://www.springerlink.com>

Taylor & Francis: <http://www.informaworld.com>

Web of Science: <http://www.isiknowledge.com>

University information system RUSSIA: <http://www.cir.ru/index.jsp>

The educational portal of the PFUR: <http://web-local.rudn.ru>

Consultant of the student <http://www.studmedlib.ru>

#### **DEVELOPERS:**

Assistant Professor  
of Department of Medical  
Elementology

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position, department

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signature

A.A. Skalny

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name and surname

**HEAD OF EDUCATIONAL DEPARTMENT:**

of Nursing Management

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name of department

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signature

A.V. Skalny

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name and surname

**HEAD**

**OF HIGHER EDUCATION PROGRAMME:**

First Deputy Director of Institute  
of Medicine for Academic  
Affairs in the field of Dentistry

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position, department

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signature

S.N. Razumova

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name and surname