MINISTRY OF HEALTH OF UKRAINE

ODESA NATIONAL MEDICAL UNIVERSITY
Department of Radiation Diagnostics, Therapy, Radiation Medicine and Oncology

CONFIRMED by

Vice-rector for scientific and pedagogical work

_____ Eduard BURIACHKIVSKYI

September 1st, 2023

WORKING PROGRAM IN THE DISCIPLINE «RADIATION MEDICINE»

Level of higher education: second (master's degree)

Field of knowledge: 22 «Health care»

Specialty: 222 «Medicine»

Educational and professional program: Medicine

2023

The academic curriculum is composed on the basis of the educational and professional program "Medicine" for the training of specialists of the second (master's) level of higher education in the specialty 222 "Medicine" of the field of knowledge 22 "Health care", approved by the Academic Council of ONMedU (protocol No. 8 of June 29, 2023).

Developers:
head of the department, assl. figure of science and technology of Ukraine, doctor of medicine, prof. Sokolov V. M.
Doctor of Medicine, Dorofeeva T. K.
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The academic curriculum was approved at the meeting of the department of radiation diagnostics, therapy and radiation medicine and oncology
Protocol No. 1 dated August 30, 2023.

Head of the department _____ Viktor SOKOLOV

Agreed with the PAC guarantor _____ Valeriia MARICHEREDA

Approved by the subject cycle methodical commission for therapeutic disciplines of ONMedU
Protocol No. 1 dated August 31, 2023.

Head of the subject cycle methodical commission for therapeutic disciplines of ONMedU

_____ Olena VOLOSHYNA

Reviewed and approved at the meeting of the department

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Protocol No. ___ of "___" _____ 20__

Head of Department _____ _____
(signature) (First Name Surname)

Reviewed and approved at the meeting of the department

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Protocol No. ___ of "___" _____ 20__

Head of Department _____ _____
(signature) (First Name Surname)

1. Description of the discipline:

Name of indicators	Field of knowledge, specialty, specialization, level of higher education	Characteristics of the discipline
Total number: Credits of ECTS: 1,0 Hours: 30 Content modules: 1	Field of knowledge 22 «Health care» Specialty 222 «Medicine» Level of higher education second (master's degree)	*Full-time (day) education* *Compulsory discipline*
		Course: 5
		Semester: IX - X
		Lectures (6 hours)
		Seminars (0 hours)
		Practical classes (14 hours)
		Laboratories (0 hours)
		Independent work (10 hours)
		including individual tasks (0 hours)
		Form of final control – Credit Test

2. The purpose and tasks of the educational discipline, competencies, program learning outcomes

The purpose is of this subject is a formation of knowledge, proficiency and skills of radiation medicine.

The tasks of the discipline are the following:

1. To determine etiological and pathological factors and clinical signs, diagnosis of acute radiation syndrome and providing acute medical care of injured people, and develop the skills necessary for supervision of a people who have been irradiated;
2. To determine etiological and pathological factors of chronic radiation syndrome and the tactics of supervision of people who have been irradiated;
3. To use methods for determining the impact of a small dosage of radiation on the human body and determine types of prevention, treatment, and minimization of harmful effect of radiation on the human body.

Integral competence:

IC. This includes typical and complex tasks, including the latest and innovative ones in the field of medicine. Quality of life is maintained with a high level of autonomy.

General competencies:

GC1. The ability to abstract thinking, analysis and synthesis according to the requirements
GC3. Ability to apply knowledge in practical situations
GC4. Knowledge and understanding of the subject area and understanding of professional activity
GC5. Ability to adapt and act in a new situation
GC6. Ability to make informed decisions
GC7. Ability to work in a team
GC8. Ability to interpersonal interaction
GC10. Ability to use information and communication technologies
GC11. Ability to search, process and analyze information from various sources
GC12. Determination and persistence in relation to assigned tasks and assumed responsibilities

GC14. The ability to realize one's rights and responsibilities as a member of society, to be aware of the values of a public (free democratic) society and the need for its sustainable development, the rule of law, the rights and freedoms of a person and a citizen in Ukraine

GC15. The ability to preserve and multiply moral, cultural, scientific values and achievements of society based on understanding the history and patterns of development of the subject area, its place in the general system of knowledge about nature and society and in the development of society, technology and technologies, to use various types and forms of motor activity for active recreation and leading a healthy lifestyle
GC16. The ability to evaluate and ensure the quality of the work performed

GC17. The desire to preserve the environment

Special competencies are:
SC1. Ability to collect medical information about the patient and analyze clinical data
SC2. Ability to determine the necessary list of laboratory and instrumental studies and evaluate their results
SC3. Ability to establish a preliminary and clinical diagnosis of the disease
SC7. Ability to diagnose emergency conditions
SC8. Ability to determine tactics and provide emergency medical care
SC9. Ability to carry out medical evacuation measures
SC10. Ability to perform medical manipulations
SC16. Ability to maintain medical documentation, including electronic forms
SC23. Ability to develop and implement scientific and applied projects in the field of health care
SC24. Adherence to ethical principles when working with patients and laboratory animals
SC25. Adherence to professional and academic integrity, to be responsible for the reliability of the obtained scientific results
SC26. The ability to determine the management tactics of persons subject to dispensary supervision
SC27. The ability to diagnose and determine the management tactics of patients with extrapulmonary and widespread forms of tuberculosis, including co-infection of TB/HIV with a chemoresistant course

Program learning outcomes are:
PLO1. Have thorough knowledge of the structure of professional activity. To be able to carry out professional activities that require updating and integration of knowledge. To be responsible for professional development, the ability for further professional training with a high level of autonomy.
PLO2. Understanding and knowledge of basic and clinical biomedical sciences, at a level sufficient for solving professional tasks in the field of health care.
PLO3. Specialized conceptual knowledge that includes scientific achievements in the field of health care and is the basis for conducting research, critical understanding of problems in the field of medicine and related interdisciplinary problems.
PLO4. Identify and identify leading clinical symptoms and syndromes (according to list 1); according to standard methods, using preliminary data of the patient's history, data of the patient's examination, knowledge about the person, his organs and systems, establish a preliminary clinical diagnosis of the disease (according to list 2).
PLO5. Collect complaints, history of life and diseases, evaluate psychomotor and physical development of the patient, state of organs and systems of the body, based on the results of laboratory and instrumental studies, evaluate information regarding the diagnosis (according to list 4), taking into account the age of the patient.
PLO6. To establish a final clinical diagnosis by making a reasoned decision and analyzing the received subjective and objective data of clinical, additional examination, carrying out differential

diagnosis, observing the relevant ethical and legal norms, under the control of the managing physician in the conditions of the health care institution (according to the list 2).
PLO7. Assign and analyze additional (mandatory and optional) examination methods (laboratory, functional and/or instrumental) (according to list 4), patients with diseases of organs and body systems for differential diagnosis of diseases (according to list 2).
PLO8. To determine the main clinical syndrome or symptom, which determines the severity of the condition of the victim/victim (according to list 3) by making a reasoned decision about the condition of a person under any circumstances (in the conditions of a health care institution, outside its borders), including in conditions of emergency and hostilities, in field conditions, in conditions of lack of information and limited time.
PLO9. Determine the nature and principles of treatment (conservative, operative) of patients with diseases (according to list 2), taking into account the age of the patient, in the conditions of the health care institution, outside its borders and at the stages of medical evacuation, including in field conditions, on the basis of a preliminary clinical diagnosis, observing the relevant ethical and legal norms, by making a reasoned decision according to existing algorithms and standard schemes, in case of the need to expand the standard scheme, be able to justify personalized recommendations under the control of the head physician in the conditions of a medical institution.
PLO14. Determine tactics and provide emergency medical care in emergency situations (according to list 3) in limited time in accordance with existing clinical protocols and treatment standards.
PLO18. To determine the state of functioning and limitations of a person's vital activities and the duration of incapacity for work with the preparation of relevant documents, in the conditions of a health care institution, based on data about the disease and its course, peculiarities of a person's professional activity, etc. Maintain medical documentation regarding the patient and the contingent of the population on the basis of regulatory documents.
PLO21. Search for the necessary information in the professional literature and databases of other sources, analyze, evaluate and apply this information.
PLO32. To diagnose and determine tactics for managing patients with advanced and widespread forms of tuberculosis, incl. TB/VIL co-infection with chemoresistant transmission.

As a result of studying the discipline, the student has to

Know:

- clinic, diagnosis, and methods of treatment of intermittent disease, measures to prevent intermittent overexertion of people

Be able:

- collect data on patient complaints, medical history, life history to determine radiation damage to various organs and systems of the body.
- evaluate information about the diagnosis using a standard procedure, based on the results of laboratory and instrumental studies to determine radiation damage to various organs and systems of the body.
- determine the list of necessary clinical, laboratory and instrumental studies and evaluate their results.
- identify the leading clinical symptom or syndrome and on the basis of dosimetry, laboratory tests and clinical signs to diagnose radiation damage (severity, period of clinical course, etc.) Establish a preliminary diagnosis, make a differential diagnosis and determine the clinical diagnosis of the disease.
- determine tactics and provide emergency medical care to victims of ionizing radiation.
- plan and conduct sorting of victims according to the severity of the lesion, select the means and place of evacuation
- plan and carry out preventive prevention of radiation damage.

3. The content of the educational discipline

Topic №1. The subject of radiation medicine, its connection with other medical disciplines. History of development of radiation medicine.

Natural radiation background, its components and changes. Artificial sources of ionizing radiation and their application in the national economy. Discoveries of Wilhelm Conrad Roentgen x-ray, Henri Becquerel on the natural radioactivity of uranium, Marie Skladowska-Curie and Pierre Curie on the radioactive properties of polonium and radium.

Topic №2. Nature, types and properties of radiation. Dosimetry of ionizing radiation. The principle of construction of dosimeters, radiometers, their types. Assessment of the degree of radionuclide contamination of the environment, soil, water, and food products.

Principles of structure of dosimeters, radiometers, their types. Assessment of the degree of radionuclide contamination of the environment, soil, water, food. Permissible levels of dosing radiation (IR). Regulation depending on the categories of the population (Category A (specialists), Category B (staff), Category B the whole population). IP control levels. Radiation dose regulations. Units of radioactivity and radiation dose. Exposure dose. Absorbed dose. Equivalent dose. Effective dose. Types of devices for measuring dose and radioactivity.

Topic № 3. Biological action of ionizing radiation.

Dependence of the biological effect on the nature of the action of ionizing radiation, the volume of radiation, the radiosensitivity of body tissues. The concept of the risk of exposure to ionizing radiation on the human body. Radiation syndromes. Mutation genes and chromosomal aberrations. Radiosensitivity of the nucleus, DNA cleavage.

Topic № 4. Diagnostic and prognostic value of hematological, biochemical, cytogenetic and other research methods for the assessment of pathological changes in human organs and systems after exposure to ionizing radiation.

The effect of ionizing radiation on various organs and systems of the body: brain, heart, lungs, mucous membranes, digestive system, endocrine system. Primary physicochemical reactions of the body and various tissues to the effects of ionizing radiation. "Critical organs" (Bergonier-Tribondo theory).

Topic № 5. Types of radiation damage.

Acute radiation sickness caused by external irradiation. Etiology, pathogenesis, diagnosis, clinic, treatment, consequences of acute radiation sickness, medical and social examination. Acute local radiation lesions. Features of the clinic, diagnosis and treatment of people who have been exposed to combined radiation. Analysis of the most characteristic medical histories of people who have suffered from acute radiation sickness and local radiation injuries. Curation of patients who have suffered from acute radiation sickness or have internal diseases, the development of which is associated with the influence of radiation. Clinical analysis of patients and writing a medical history.

Topic № 6. Chronic radiation sickness.

Etiology, pathogenesis, diagnosis, clinic, treatment. Degrees of severity of chronic radiation sickness: mild, moderate, severe. Annual radiation dose: 0.7 - 1 Gr; clinical and laboratory characteristics of different degrees of severity of chronic radiation sickness.

Topic № 7. Long-term effects of ionizing radiation.

Stochastic and non-stochastic effects of radiation. Genetic, teratogenic and somatic effects of human exposure. The effect of small doses of ionizing radiation on the human body. Radiation lesions: intestinal syndrome, oropharyngeal, pulmonitis, radiation cataract, thyroid gland, CNS lesions, skin lesions.

Topic № 8. Toxicology of basic radionuclides.

Features of the clinic, diagnosis and treatment and prevention of radionuclides entering the human body. Effects of human internal irradiation. Alpha and beta radiation due to inhalation, through the digestive tract. Gamma and beta radiation due to exposure through the digestive tract and skin. The higher the specific ionization, the greater the biological efficiency.

Topic № 9. Medical and psychological aspects of large-scale accidents at nuclear power plants.

Equipment and operation of special medical institutions to provide assistance to persons exposed to ionizing radiation. Model of the Chernobyl accident. Demographic indicators after the Chernobyl accident. National Register of Ukraine of persons affected by the Chernobyl disaster: purpose, structure, purpose, tasks.

Topic № 10. Medical examination of personnel working with sources of ionizing radiation.

Groups of primary dispensary records, categories and levels of observation. Equipment and operation of special medical institutions to provide assistance to persons exposed to ionizing radiation. National program to eliminate the consequences of the Chernobyl accident: the formation of socio-environmental, legal and medical standards of assistance to victims, respectively, groups of dispensary accounting.

4. The structure of the educational discipline

Topic	Number of hours			
	Total	Including		
		L.	Pr.cl.	Ind.work
Topic 1. Subject matter of radiation medicine, its connection with other medical disciplines. History of development of radiation medicine. Natural radiation background and its components. Piece-by-piece sources of ionizing improminution.	6,0	2,0	2,0	2,0
Topic 2. Nature, types and properties of radiation. Dosimetry of ionizing radiation.	2,0			2,0
Topic 3. Biological action of ionizing radiation.	2,0		2,0	
Topic 4. Diagnostic and prognostic value of hematological, biochemical, cytogenetic and other methods of investigation for evaluation of pathological changes in human organs and systems after ionizing radiation.	2,0			2,0
Topic 5. Types of radiation injuries. Influence of ionizing radiation on the body. Acute and chronic effects of exposure.	4,0	2,0	2,0	
Topic 6. Chronic promenal disease.	2,0		2,0	
Topic 7. Distant effects of ionizing exposure.	2,0		2,0	
Topic 8. Toxicology of basic radionuclides.	2,0			2,0
Topic 9. Medical, social, environmental and psychological aspects of large-scale accidents at nuclear facilities. Medical consequences of a large-scale accident at nuclear facilities (Chernobyl accident).	4,0	2,0	2,0	
Topic 10. Dispensary examination of the personnel who work with ionizing radiation.	2,0			2,0
Topic 9. Medical, social, environmental and psychological aspects of large-scale accidents at nuclear facilities. Medical consequences of a large-scale accident at nuclear facilities (Chernobyl accident).	2,0		2,0	
Total	30,0	6,0	14,0	10,0

5. Themes of lectures / seminars / practical classes / laboratories

5.1. Themes of lectures

Themes	Number of hours
Introductory lecture. History of development of radiation medicine.	2,0
Influence of ionizing radiation on the body. Acute and chronic effects of exposure.	2,0
Medical consequences of a large-scale accident at the nuclear industry (the accident at the Chernobyl Nuclear Power Plant).	2,0
Total	**6,0**

5.2. Themes of seminars

Seminars are not provided.

5.3. Themes of practical classes

№	Themes	Number of hours
1.	Topic 1. Practical class 1. Subject matter of radiation medicine, its connection with other medical disciplines. History of development of radiation medicine. Natural radiation background and its components. Piece-by-piece sources of ionizing impromination.	2,0
2.	Topic 3. Practical class 2. Biological action of ionizing radiation. Radiosensitivity of various body tissues.	2,0
3.	Topic 5. Practical class 3. Types of radiation injuries. Influence of ionizing radiation on the body. Acute and chronic effects of exposure.	2,0
4.	Topic 6. Practical class 4. Chronic radiation sickness. Etiology, pathogenesis, diagnosis, clinic, treatment	2,0
5.	Topic 7. Practical class 5. Distant effects of ionizing radiation. Stochastic and non-stochastic effects of radiation. The effect of small doses of ionizing radiation on the human body.	2,0
6.	Topic 9. Practical class 6. Medical, social, ecological and psychological aspects of large-scale accidents at nuclear plants (according to the model of the accident at the Chernobyl NPP). National register of Ukraine of victims of the Chernobyl disaster: goal. Structure, purpose, tasks. Equipment and operation of special medical facilities for providing assistance to persons exposed to ionizing radiation.	2,0
7.	Topic 9. Practical class 7. Medical, social, ecological and psychological aspects of large-scale accidents at nuclear plants (according to the model of the accident at the Chernobyl NPP). National register of Ukraine of victims of the Chernobyl disaster: goal. Structure, purpose, tasks. Equipment and operation of special medical facilities for providing assistance to persons exposed to ionizing radiation.	2,0
8.	**Total**	14,0

5.4. Themes of laboratories

Laboratories are not provided.

6. Independent work of the student

№	Themes	Number of hours
1.	The subject of radiation medicine, its connection with other medical disciplines. Artificial sources of ionizing radiation.	2,0
2.	Nature, types and properties of radiation. Dosimetry of ionizing radiation.	2,0
3.	Diagnostic and prognostic value of hematological, biochemical, cytogenetic and other methods of investigation for evaluation of pathological changes in human organs and systems after ionizing radiation.	2,0
4.	Toxicology of the main radionuclides. Effects of internal human irradiation.	2,0
5.	Dispensary examination of the personnel who work with ionizing radiation.	2,0
6.	**Total**	10,0

7. Teaching methods

Lectures.

Practical classes: conversation, consideration of presentations on the topics of practical classes, solution of clinical situational problems, analysis of the most characteristic disease histories of persons who suffered acute radiation sickness and local radiation injuries. Treatment of patients who have suffered acute radiation sickness or have internal diseases, the development of which is related to the influence of the radiation factor

Independent work: independent work with the textbook, independent solution of clinical tasks.

8. Forms of control and evaluation methods (including criteria for evaluating learning outcomes)

Ongoing control: oral survey, testing, assessment of performance of practical skills, solution of situational clinical tasks, assessment of activity in class.

Final control: Credit Test.

Assessment of the ongoing learning activity at the practical class:

1. Evaluation of theoretical knowledge on the subject of the lesson:
   - methods: survey
   - maximum score – 5, minimum score – 3, unsatisfactory score – 2.
2. Evaluation of the performance of test tasks by topics:
   - maximum score – 5, minimum score – 3, unsatisfactory score – 2.

The grade for one practical session is the arithmetic average of all components and can only have a whole value (5, 4, 3, 2), which is rounded according to the statistical method.

Criteria of ongoing assessment at the practical class

Score	Assessment criterion
Excellent «5»	The student is fluent in the material, takes an active part in the discussion and solution of situational clinical problems, confidently demonstrates practical skills during the examination of a sick child and interpretation of clinical, laboratory and instrumental studies, expresses his opinion on the topic, demonstrates clinical thinking.
Good «4»	The student has a good command of the material, participates in the discussion and solution of a situational clinical problem, demonstrates practical skills during the examination of a patient and the interpretation of clinical, laboratory and instrumental research data with some errors, expresses his opinion on the

	topic of the lesson, demonstrates clinical thinking.
Satisfactory «3»	The student does not have enough material, insecurely participates in the discussion and solution of situational clinical problems, demonstrates practical skills during the examination of the patient and interpretation of clinical, laboratory and instrumental studies with significant errors.
Unsatisfactory «2»	The student does not possess the material, does not participate in the discussion and solution of the situational clinical problem, does not demonstrate practical skills during the examination of the patient and the interpretation of clinical, laboratory and instrumental research data.

Credit is given to the applicant who completed all tasks of the work program of the academic discipline, took an active part in practical classes, completed and defended an individual assignment and has an average current grade of at least 3.0 and has no academic debt.
Assessment is carried out: at the last lesson before the beginning of the examination session - with the tape system of learning, at the last lesson - with the cyclical system of learning. The credit score is the arithmetic mean of all components according to the traditional four-point scale and has a value that is rounded according to the statistics method with two decimal places after the decimal point.

9. Distribution of points, obtained by the student

The obtained average score for the academic discipline for applicants who have successfully mastered the work program of the academic discipline is converted from a traditional four-point scale to points on a 200-point scale, as shown in the table:

Conversion table of traditional to multi-point

National score for the discipline	The sum of scores for the discipline
Excellent («5»)	185 – 200
Good («4»)	151 – 184
Satisfactory («3»)	120 – 150
Unsatisfactory («2»)	Less than 120

A multi-point scale (200-point scale) characterizes the actual success of each applicant in learning the educational component. The conversion of the traditional grade (average score for the academic discipline) into a 200-point grade is performed by the information and technical department of the University.

According to the obtained points on a 200-point scale, the achievements of the applicants are evaluated according to the ECTS rating scale. Further ranking according to the ECTS rating scale allows you to evaluate the achievements of students from the educational component who are studying in the same course of the same specialty, according to the points they received.

The ECTS scale is a relative-comparative rating, which establishes the applicant's belonging to the group of better or worse among the reference group of fellow students (faculty, specialty). An "A" grade on the ECTS scale cannot be equal to an "excellent" grade, a "B" grade to a "good" grade, etc. When converting from a multi-point scale, the limits of grades "A", "B", "C", "D", "E" according to the ECTS scale do not coincide with the limits of grades "5", "4", "3" according to the traditional scale. Acquirers who have received grades of "FX" and "F" ("2") are not included in the list of ranked acquirers. The grade "FX" is awarded to students who have obtained the minimum number of points for the current learning activity, but who have not passed the final examination. A grade of "F" is given to students who have attended all classes in the discipline, but have not achieved a grade point average (3.00) for the current academic activity and are not admitted to the final examination.

Applicants who study in one course (one specialty), based on the number of points scored in the discipline, are ranked on the ECTS scale as follows:

Conversion of the traditional evaluation and and ECTS scores

Score on the ECTS scale	Statistical indicator
A	The best 10% students
B	Next 25% students
C	Next 30% students
D	Next 25% students
E	Next 10% students

10. Methodological support

Work program of the discipline:

- Syllabus of the discipline
- Cathedral archive of radiographs in analog and electronic form.
- Methodical development of practical classes.

Electronic bank of test tasks by divisions of the discipline:

1. Ovcharenko O.P., Lazar A.P., Matyushko R.P. Fundamentals of radiation medicine. - Odessa, Odessa Medical University, 2017 .-- 208 p.

11. Questions for the final control

1. Types and properties of ionizing radiation (alpha-, beta-, gamma-, neutrons, and X-radiation).
2. Concept of dose and dose rate. Exposure dose, absorbed dose, equivalent dose, effective equivalent dose. International System of Units (SI).
3. Methods of dose measuring. Types of dosimeters.
4. Radioactivity (concept, units, types of radioactive decay).
5. Methods of radioactivity measurement.
6. Natural and artificial sources of radiation. Their contribution to the to the total radiation dose of the population.
7. Fundamentals of Radiation Safety Standards.
8. Radiation situation after Chernobyl Nuclear Power Plant Incident.
9. Tasks and structure of special medical facilities that provide aid to people that suffered from excessive exposure of ionizing radiation.
10. Preventive measures during radioactive pollution of the environment.
11. Identification and assessment of radionuclide contamination of water and food.
12. The current view on main mechanisms of biological effect of ionizing radiation.
13. The role of free radicals in damaging cells due to ionizing radiation.
14. Pathogenesis of radiation injuries of tissues.
15. Radiosensitivity of different tissues of the body.
16. Value of hematological (hemato-morphological) research methods for detection of pathological changes in organs and organ systems after an exposure to ionizing radiation.
17. Principles of cytogenetic method and its significance for identifying pathological changes in organs and organ systems after an exposure to ionizing radiation.
18. Significance of biochemical, biophysical, and other methods of research for identification of pathological changes in organs and organ systems after an exposure to ionizing radiation.
19. Effect of ionizing radiation on blood-forming organs.
20. Effect of ionizing radiation on organs of the Digestive System.
21. Effect of ionizing radiation on Cardiovascular System.
22. Effect of ionizing radiation on Respiratory System.
23. Effect of ionizing radiation on Central Nervous System
24. Effect of ionizing radiation on Endocrine System.
25. Methods and significance of physical dosimetry for evaluation of injury level of people during Nuclear Power Plant Incidents.

26. Clinical and biological criteria of acute radiation syndrome (ARS) diagnostics.
27. Pathogenesis of ARS
28. General and clinical classification of radiation injuries.
29. Clinical signs of the primary reaction period.
30. Clinical signs of hidden (latent) period.

12. Recommended literature

Basic:

1. Ovcharenko O. P., Lazar A. P., Matyushko R. P. Fundamentals of radio medicine. - Odessa, Odessa Medical University, 2017 .-- 208 p.
2. Essential radiology for medical students, interns and residents // A. Ahuja. – OMF publishing. – 2017. – 518 p.

Additional:

1. Zhukova, T. O. Means of Protecting the Body from the Effects of Ionising Radiation study guide / T. O. Zhukova, V. F. Pocherniayeva, V. P. Bashtan. - K. : Medicine Publishing, 2019. - 112 p.
2.Kovalsky O. Radiology. Radiotherapy. Diagnostic Imaging: textbook for students of higher med. education establishments of IVth accreditation level / O. Kovalsky, D. Mechev, V. Danylevych. — 2nd ed. — Vinnytsia: Nova Knyha, 2017. — 504 p.
3. Jo-Anne O Shepard MD\Thoracic Imaging The Requisites (Requisites in Radiology) 3rd Edition\ March, 2018 \496 p.
4. Mista R., Planner A., Uthappa M. \ A-Z of Chest Radiology \ Cambridge University, 2017\224 p.
5. Chen M. Basic Radiology / Michael Y. M. Chen, Thomas L. Pope, David J. Ott. — 2nd ed. — McGraw Hill Professional, 2016. — 408 p

13. Electronic information resources

1) https://radiopaedia.org/articles/acute-radiation-syndrome?lang=us
2) https://radiopaedia.org/articles/dosimeters?lang=us
3) https://radiopaedia.org/articles/ionising-radiation?lang=us
4) https://radiopaedia.org/articles/radiation-therapy?lang=us
5) https://www.ncbi.nlm.nih.gov/pmc/articles/PMC1474274/