**FEDERAL STATE BUDGETARY EDUCATIONAL INSTITUTION**

**HIGHER EDUCATION INSTITUTION**

«DAGESTAN STATE MEDICAL UNIVERSITY»

**MINISTRY OF HEALTH OF THE RUSSIAN FEDERATION**

***Abstract***

***of the work program of the discipline***

**«** Medical informatics»

**Discipline index – Б1. Б. 11**

**Specialty (direction):**  31.05.01 - General medicine.

**The level of higher education -** specialty

**Graduate qualification:** Physician

**Faculty of** General medicine

Department of Biophysics, Informatics and medical equipment

**Form of training:** full-time

**Course:** 1, 3, 5

**Semester** 2 – Б1. Б. 11. 1 - Basic technologies for the presentation and processing of medical information.

**Total labor intensity (in credits / hours)**: 2 C.U./ 72 hours

**lectures** - 14 hours

**practical classes** - 34 hours

**independent work of the students** **–** 24 hours

**form of control:** credit

**Semester** 5 – Б1. Б. 11. 2 - Fundamentals of biomedical statistics and data interpretation in evidence-based medicine.

**Total labor intensity (in credits / hours)**: 2 C.U./ 72 hours

**lectures** - 8 hours

**practical classes** - 34 hours

**independent work of the students** - 30 hours

**form of control:** credit

**Semester:** 10 – Б1, Б. 11. 3 - Medical information systems. E-health.

**Total labor intensity (in credits / hours)**: 2 C.U./ 72 hours

**lectures** - 14 hours

**practical classes** - 36 hours

**independent work of the students** - 22 hours

**form of control:** credit

1. THE PURPOSE AND OBJECTIVES OF LEARNING THE EDUCATIONAL DISCIPLINE

E-health is a new paradigm for protecting the personal and public health of citizens, implemented on the basis of the comprehensive use of information and communication technologies.

E-health implies a systematic approach to solving the entire spectrum of problems of public health protection, implemented on the basis of a comprehensive electronic document management, which necessarily includes personal medical data, providing quick access to all information, the possibility of its joint remote analysis by doctors and contacts of doctors with patients based on telemedicine technologies.

The development of electronic and digital health care dictates the need to deepen and expand the discipline "**Medical Informatics**" taught within the specialties "General Medicine".

The purpose of mastering the discipline "Medical Informatics" is to master the basics of medical informatics and the practice of using modern information and telecommunication technologies in medicine and health care; formation of professional competencies:

* readiness to solve standard tasks of professional activity using information, bibliographic resources, biomedical terminology, information and communication technologies and taking into account the basic requirements of information security;
* readiness to maintain medical records;
* the ability and readiness to use social and hygienic methods for collecting and medical and statistical analysis of information on indicators of public health;
* readiness for analysis and public presentation of medical information based on the methods of mathematical statistics and evidence-based medicine;
* ability and readiness to work with high-tech medical equipment integrated with medical information systems, including for use in telemedicine applications.

**The tasks** of studying the discipline include:

* + study of the theoretical foundations of informatics, hardware and software for information processing;
  + study of basic technologies for transforming information used to solve problems of medicine and health care;
  + the formation of ideas about the methods of informatization of medical activities, automation of clinical trials, informatization of management in the health care system;
  + studying the means of information support for the treatment and diagnostic process, digital tools of professional activity, information sources and media;
  + mastering the skills of using electronic medical documents and digital medical services in practice.
  + mastering by the student of practical skills in the use of medical information systems for the purposes of diagnosis, prevention, treatment and rehabilitation.

1. **LIST OF PLANNED LEARNING OUTCOMES**

**Competencies formed in the course of studying the discipline**

|  |  |  |
| --- | --- | --- |
| **№** | Name of category (group)  of competence | A graduate who has completed a specialist programme must have the following competences |
| **1** | **2** | **3** |
| **1** | **General professional competencies** | **GPC-1**- readiness to solve standard tasks of professional activity using information, bibliographic resources, medical and biological terminology, information and communication technologies and taking into account the basic requirements of information security |
| **Know:** basic principles of information processing and presentation; electronic information and library systems and medical databases, teaching resources on medicine; basic principles of information security when working with medical databases.  **Be able to:** apply information and communication technologies for the collection, storage and processing of biomedical data;  use modern means of the Internet to search and analyze professional information, focusing on the principles of evidence-based medicine;  use electronic information and library systems and medical databases.  **Possess:** the terminology associated with modern computer technologies as applied to solving problems of medicine; technology of search, storage, processing and presentation of medical information using modern information tools. |
| **GPC-6 - readiness to maintain medical records** |
| **Know:** the terminology associated with modern computer technologies as applied to solving problems of medicine; technology of search, storage, processing and presentation of medical information using modern information tools.  **Be able to:** use standard software for solving problems of practical medicine and maintaining medical records; apply medical information systems in professional activities.  **Possess:** terminology related to modern computer technologies as applied to solving health problems; basic methods of working with medical information using standard software tools;  skills in working with medical information systems. |
| **2** | **Professional competencies** | **PC-4 -** ability and readiness to use social and hygienic methods of collection and medical and statistical analysis. |
| **Know:** methods of collecting and medical and statistical analysis of information on health indicators of the population;  principles of automation of accounting and management of healthcare institutions using modern information technologies.  **Be able to:** collect and analyze medical and statistical data, including using standard and specialized software;  analyze and present information on public health indicators.  **Possess:** methods for calculating the main indicators of public health;  skills in working with standard and specialized software for the collection and analysis of medical and statistical data. |
| **PC-20 -** readiness for analysis and public presentation of medical information based on the methods of mathematical statistics and evidence-based medicine. |
| **Know:** principles, methods of mathematical statistics and evidence-based medicine;  electronic information and library systems and medical databases, teaching resources on medicine; basic principles of processing and presentation of biomedical information from the standpoint of mathematical statistics and evidence-based medicine.  **Be able to:** use modern Internet tools to search and analyze professional information, focusing on the principles of evidence-based medicine;  use electronic information and library systems and medical databases;  analyze and present medical information in accordance with the principles of mathematical statistics and evidence-based medicine.  **Possess:** terminology related to the principles and methods of mathematical statistics and evidence-based medicine;  skills to find professional information in reference  systems, scientific and medical services;  technology for analyzing biomedical data from the standpoint of mathematical statistics and evidence-based medicine;  ways of presenting the results of professional activity in public speaking. |

1. THE PLACE OF THE EDUCATIONAL DISCIPLINE IN THE STRUCTURE OF THE BASIC EDUCATIONAL PROGRAM (BEP) OF THE SPECIALIST

|  |  |  |
| --- | --- | --- |
| **№** | Name of category (group)  of competence | A graduate who has completed a specialist programme must have the following competences |
| **1** | **2** | **3** |
| **1** | **General professional competencies** | **GPC-1**- readiness to solve standard tasks of professional activity using information, bibliographic resources, medical and biological terminology, information and communication technologies and taking into account the basic requirements of information security |
| **Know:** basic principles of information processing and presentation; electronic information and library systems and medical databases, teaching resources on medicine; basic principles of information security when working with medical databases.  **Be able to:** apply information and communication technologies for the collection, storage and processing of biomedical data;  use modern means of the Internet to search and analyze professional information, focusing on the principles of evidence-based medicine;  use electronic information and library systems and medical databases.  **Possess:** the terminology associated with modern computer technologies as applied to solving problems of medicine; technology of search, storage, processing and presentation of medical information using modern information tools. |
| **GPC-6 - readiness to maintain medical records** |
| **Know:** the terminology associated with modern computer technologies as applied to solving problems of medicine; technology of search, storage, processing and presentation of medical information using modern information tools.  **Be able to:** use standard software for solving problems of practical medicine and maintaining medical records; apply medical information systems in professional activities.  **Possess:** terminology related to modern computer technologies as applied to solving health problems; basic methods of working with medical information using standard software tools;  skills in working with medical information systems. |
| **2** | **Professional competencies** | **PC-4 -** ability and readiness to use social and hygienic methods of collection and medical and statistical analysis. |
| **Know:** methods of collecting and medical and statistical analysis of information on health indicators of the population;  principles of automation of accounting and management of healthcare institutions using modern information technologies.  **Be able to:** collect and analyze medical and statistical data, including using standard and specialized software;  analyze and present information on public health indicators.  **Possess:** methods for calculating the main indicators of public health;  skills in working with standard and specialized software for the collection and analysis of medical and statistical data. |
| **PC-20 -** readiness for analysis and public presentation of medical information based on the methods of mathematical statistics and evidence-based medicine. |
| **Know:** principles, methods of mathematical statistics and evidence-based medicine;  electronic information and library systems and medical databases, teaching resources on medicine; basic principles of processing and presentation of biomedical information from the standpoint of mathematical statistics and evidence-based medicine.  **Be able to:** use modern Internet tools to search and analyze professional information, focusing on the principles of evidence-based medicine;  use electronic information and library systems and medical databases;  analyze and present medical information in accordance with the principles of mathematical statistics and evidence-based medicine.  **Possess:** terminology related to the principles and methods of mathematical statistics and evidence-based medicine;  skills to find professional information in reference  systems, scientific and medical services;  technology for analyzing biomedical data from the standpoint of mathematical statistics and evidence-based medicine;  ways of presenting the results of professional activity in public speaking. |

1. THE PLACE OF THE EDUCATIONAL DISCIPLINE IN THE STRUCTURE OF THE BASIC EDUCATIONAL PROGRAM (BEP) OF THE SPECIALIST

3.1. Requirements for entrance knowledge to study this discipline

The academic discipline "Medical Informatics" refers to the basic part of the disciplines of the curriculum of the main educational program of the specialty 31.05.01 - General medicine

To study this academic discipline, the following knowledge, skills and abilities are required, formed during the study of school courses in informatics, physics and mathematics.

**Knowledge:** the basics of mathematical analysis, probability theory and mathematical statistics (concepts and rules for using a mathematical apparatus); mathematical methods for solving intellectual problems and their application in medicine.

**Skills:** to use mathematical methods to the extent provided by the content of the sections of this Program; carry out mathematical processing of measurement results and other data; independently work with scientific and technical literature.

**Abilities:** using methods of statistical processing of results.

The teaching of this discipline is based on the following types of professional activity:

1. Medical.

2. Scientific research.

1. **WORKING HOURS OF THE EDUCATIONAL DISCIPLINE**

**AND KINDS OF EDUCATIONAL WORK**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Type of educational work | | Total hours | Semesters | | |
| 2 | 5 | 10 |
| Classroom lessons (total), including: | | 216 | 72 | 72 | 72 |
| Lectures (L) | | 36 | 14 | 8 | 14 |
| Practical lessons (PL), | | 104 | 34 | 34 | 36 |
| **Independent work of student (IWS)** | | 76 | 24 | 30 | 22 |
| **Type of intermediate certification** | Credit |  | offset | offset | offset |
| **TOTAL: Total labor intensity** | Hours | 216  6 | 72  2 | 72  2 | 72  2 |
| Credit units |

* 1. SECTIONS OF THE EDUCATIONAL DISCIPLINE AND INTERDISCIPLINARY RELATIONS WITH THE FOLLOWING DISCIPLINES

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **№** | **Name**  **subsequent**  **disciplines** | Sections of this discipline required to study subsequent disciplines | | |
| 1 | 2 | 3 |
| **1** | **Physics, mathematics** | + |  |  |
| **2** | **Normal physiology** | + |  |  |
| **3** | **Public health and health care, health economics** |  | + | + |
| **4** | **Propedeutics of Internal Diseases** | + |  | + |
| **5** | **Clinical laboratory diagnostics** |  | + | + |
| **6** | **Radiation diagnostics and therapy** |  | + | + |
| **7** | **Clinical pharmacology** | + | + |  |
| **8** | **Forensic Medicine** | + | + |  |
| **9** | **Hygiene** | + | + |  |
| **10** | **Medical rehabilitation** |  |  | + |
| **11** | **Anesthesiology, resuscitation, intensive care** | + |  | + |
| **12** | **Clinical Epidemiology** |  | + | + |

**5. STRUCTURE AND CONTENT OF THE EDUCATIONAL DISCIPLINE**

**5.1 Sections of the academic discipline and competencies that must be mastered in their study**

|  |  |  |  |
| --- | --- | --- | --- |
| **№** | **Compe-tency number** | **Name of the discipline section** | **Section content** |
| **1** | **2** | **3** | **4** |
| **Section 1. Basic technologies for the presentation and processing of medical information** | | | |
| 1 | **GPC-1** | Basic concepts of medical informatics | **General concept of introduction to medical informatics.** History of Informatics. Basic concepts of informatics and cybernetics. Number systems. Definition of information. Information and data (amount of information, sources, methods of obtaining and types of data, storage information). Information Technology. Information units. Units of measure for memory size. |
| 2 | **GPC-1** | Technical means for the implementation of information processes. | **Medical Informatics Hardware.** Generations of computers. Characteristics of computers. Block diagram of a computer. CPU. Processor functions. Performance units. Characteristics of processors. Bus, its purpose. Random access memory. Permanent storage device. External storage devices. Sequential drives. Random access drives. Magnetic drives. Optical storage. Information input-output devices. Monitors. Printers. Scanners. Plotters. Modems. Multimedia. Virtual reality systems. |
| 3 | **GPC-6** | Software for the implementation of information processes. | Software. Information protection. Types of threats to information. Types of unauthorized use of information resources. Methods and means of building information security systems and their structure. Stages of creating information security systems. Classification of software. Operating systems (OS). OS tasks. OS functions. Windows operating system. OS file system. User interface. OS development. Service programs. Computer "viruses". Antivirus programs. Utility programs. Archivers. Programming languages. |
| 4 | **GPC-6**  **PC-4** | Organization of professional activity using Microsoft office tools | Text processing by means of MS Word. Features of the MS Word text editor. The principle of creating a table. Inserting graphic images into a document. Smart and Art WordArt objects. Processing of tabular data by means of MS Excel. Purpose of spreadsheets. Diagrams. Links. Built-in functions. Calculations in spreadsheets.  Processing of information by means of MS Access. The purpose of MS Access . Creating tables. Working with the database. Creating queries. Preparation of reports.  Creating presentations using MS PowerPoint. Possibilities of computer presentation technology. Changing the presentation. Rich Text features. Basic rules for creating a presentation. |
| 5 | **GPC-1** | Basic concepts and principles of working on the Internet | The concept of the information society. Informatization of the spheres of work and life. Local area networks. Global networks.  The Internet. Basic principles of the Internet. Basic concepts of the Internet. Internet resources. Hypertext concept. Email. Internet teleconferences. Internet software. Browsers. Search engines. The value of the Internet for society. Telecommunication technologies and Internet resources in medicine. Telemedicine concept. |
| 6 | **GPC-1** | Medical information systems. | The subject and objectives of medical cybernetics and informatics. Features of medical information. Basic concepts of medical informatics and cybernetics. Medical information systems. Information protection methods. Digital signature. Expert systems. Workstation of a doctor. Classes and types of medical information systems. The structure and main functions of automated medical technology information systems. Organizational and legal support of medical information systems. |
| 7 | **GPC-1**  **GPC-6** | Simulation of physiological processes. | Principles of creating computer mathematical models of pharmacokinetic, physiological and other processes occurring in the human body, for their subsequent use as part of automated systems to support medical decision-making (calculation of an individual regime for the selection of drugs, etc.). Types of mathematical models. Information model of the treatment and diagnostic process |
| 8 | **GPC-6**  **PC-4**  **PC-20** | The use of information systems in medicine and healthcare. Methods and means of informatization in practical medicine. | Organization of the technological process in a medical laboratory. The relevance of laboratory automation. The structure and functions of laboratory information systems. Medical instrument-computer systems for functional studies of physiological systems of the body. Computer processing and analysis of signals and images. Information support for the interpretation of the results obtained. |
| **Section 2. Statistical apparatus for data interpretation in evidence-based medicine.**  **Decision support in medicine and healthcare** | | | |
| 1 | **GPC1**  **PC-20** | Evidence-based medicine. Principles of evidence-based medicine. | Evidence-based medicine.  Definition of evidence. Aspects of evidence-based medicine. Conditions for the effective functioning of evidence-based medicine. Purpose, analysis and its types. Epidemiological indicators in the study of non-communicable diseases. Epidemiological characteristics of disease risk. |
| 2 | **PC-4** | Analysis of medical data using mathematical statistics | Basic concepts of mathematical statistics. Statistical distribution. Statistical distribution characteristics: absolute and relative distribution frequencies, histogram, polygon. Position characteristics and variations. Estimation of the parameters of the general population. |
| 3 | **PC -4** | Statistical processing of biomedical research using MS Excel | Primary statistical processing of quantitative features.  Characterization of biological objects as complex stochastic systems. The selective method of observation is the main method of scientific research. Tasks of statistical description of variables. Evaluation of the accuracy and reliability of numerical characteristics. The law of the normal distribution of a random variable. Determination of the statistical series of the distribution of a random variable based on the results of a sample observation. Primary statistical processing of medical experiment data. Testing the hypothesis of the normality of the distribution of a random variable using the Pearson agreement criterion in Excel. |
| 4 | **PC-20** | Statistical analysis of categorized data | Statistical indicators in medicine and their comparison. Parametric and nonparametric criteria.  Relative values in medical statistics. Evaluation of the significance of the difference in relative frequency values in independent samples by Pearson's χ2 – criterion. Nonparametric methods for assessing the significance of differences. The criterion of the Wald-Wolfowitz series, and the Mann-Whitney criterion and the Kolmogorov-Smirnov two-sample criterion. |
| 5 | **PC-4**  **PC-20** | Statistical analysis of biomedical data using the Statistica package | The main tasks of the analysis of biomedical data. Analysis of qualitative and quantitative data.  Statistics as a science. The role of statistics in the professional activity of a doctor. Basic concepts of evidence-based medicine. Research planning. Description of qualitative features. Characteristic of the normal distribution. Scientific and statistical hypotheses, H0 and H1. Classification of statistical analysis methods. The significance of the biological or clinical interpretation of the data obtained. Brief description of the Statistica and SPSS packages. |
| 6 | **PC-20** | One-factor analysis of variance, Time series analysis. | Adjustable factor, factor levels. Factorial and random variance. Fisher coefficient, comparison with a critical value. The reliability of the analysis of variance.  Interval and moment time series. The main characteristics of the time series. Establishing the trend of a time series, coefficients in the trend equation. |
| 7 | **PC-20** | Correlation and regression analysis of medical research data | The essence of the functional and correlation relationship. Correlation coefficient and its properties. Assessment of the significance of the correlation coefficient. Estimation of the accuracy and reliability of the correlation coefficient by the Fisher auxiliary variable. Rank correlation coefficients. Coefficient and regression equation. Evaluation of the informativeness and significance of the regression equation, the significance of the coefficients of the regression equation. Prediction of the regression equation and assessment of its significance and reliability. |
| 8 | **GPC -1**  **GPC -6** | Computer modeling for solving pharmacokinetic problems | Computer implementation of one- and two-chamber pharmacokinetic models. Compartmental modeling. Chamber models of pharmacokinetics. Single-chamber pharmacokinetic model of intravenous administration. Description of the process of intravenous administration of the drug. Scheme of a single-chamber pharmacokinetic model. Mathematical description of a single-chamber pharmacokinetic model of intravenous administration. Mathematical description of a two-chamber pharmacokinetic model of intramuscular injection. Creation of a computer pharmacokinetic model of periodic intravenous administration for patients with different body weight and varying degrees of impairment of renal excretory function. Integrated and minimal models. |
| **Section 3. Medical Information Systems (MIS). E-health** | | | |
| 1 | **GPC -1**  **PC-4**  **PC-20** | Medical and technological information systems. Mobile technologies in medicine | Medical and technological systems and their purpose. The principle of analog-to-digital conversion of medical signals. The principle of analog-to-digital image conversion. Principles of medical signal processing and interpretation of the received information. Principles of processing and analysis of medical images. Medical instrumentation and computer systems for functional studies of physiological systems of the body. Informational support of the therapeutic and diagnostic process. |
| 2 | **GPC-6**  **PC-4**  **PC-20** | MIS for automating the activities of departments of the Ministry of Defense. Laboratory information systems. Systems for archiving and image processing. Medical data exchange standards | Information technology systems of departments of medical organizations.  The purpose of laboratory information systems and the basic requirements for them. The operating procedure of the laboratory information system (LIS). Integration of LIS with information systems of medical organizations. General principles of FOX construction. And problems of interaction with laboratory equipment. Systems for archiving, storing and managing images. PACS systems, their purpose and general principles of construction. Prospects for using PACS/RIS. The importance of standards in ensuring the interaction of medical information systems. HL7 standard. DICOM standard. |
| 3 | **PC-4** | Systems for the automation and management of MO activities. Organization of medical data security | Automation of the activities of medical organizations.  Levels of informatization of modern medical organizations. Functional purpose and general principles of organization of medical information systems. Information support of medical organization units. Information support of medical units. Information protection in medical information systems . Criteria for assessing the quality of medical organizations. Technological solutions of medical information systems. The technology of "cloud" computing in the automation of medical organizations. The scheme of building an automated information system of medical organizations. Problems of implementation of an automated information system of a medical organization. |
| 4 | **PC-20** | Classification of MIS. Concept and technologies for building e-health | Automated information systems of municipal, territorial and federal levels. Information systems of municipal and territorial levels. Federal-level information systems. The main types of problem-oriented information systems in healthcare. Methods of data presentation and processing in territorial and federal MIS. Organizational and legal support of the IIA. The main sources of information for automated information systems of municipal, territorial, federal levels of healthcare |
| 5 | **GPC-6** | Maintenance of electronic medical records within the framework of the MIS MO | Electronic medical history. National Standard of Electronic Medical History. EMC is the main tool for the formation and maintenance of medical documentation. Identification of the author of the electronic personal medical record. The role of Electronic medical history in the organization and management of the diagnostic and treatment process. |
| 6 | **GPC-6**  **PC-4**  **PC-20** | Components of the unified state information system in the field of healthcare Portal of continuing medical education | The concept of a unified state information system in the field of healthcare and its current state. Stages of creation of a Unified state information system in the field of healthcare and its current state. Monitoring of population groups and register functions. The principle of register construction. Directions of application of registers. Basic requirements for medical registers and construction technology. |
| 7 | **GPC-6** | Telemedicine technologies. Portal of continuing medical Education | Telecommunication technologies in medicine. Telemedicine. Definition, purpose and directions. Telemedicine network as an element of the unified information space of the healthcare system. Areas of work of telemedicine centers. The main tools of telemedicine. Stages of telemedicine development. Regulatory and legal framework for the development of telemedicine. Distance education. |
| 8 | **PC-4** | Prospects of healthcare informatization | E-health. The concept of e-health. The concept of creating a unified state information system in healthcare. "Cloud" computing in healthcare. A promising scheme of healthcare informatization. |

5.2. Sections of the discipline, types of educational activities and forms

of current monitoring of progress and intermediate certification based

on the results of the discipline

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **№** | **Program section** | **Semester** | **Number of hours by type of activity** | | | | **Evaluation tools for monitoring progress and intermediate certification based on the results of mastering the discipline** |
| Lectures | Practical lessons | Independent work | Total |
| **1** | **Section 1. Basic technologies for the presentation and processing of medical information** | II | 14 | 34 | 24 | 72 | interview;  test control; essay;  practical skills |
| 2 | Topic 1. Preparing documents using a text editor |  |  |  |  | -//- |
| 3 | Topic 2. Storing and processing information using spreadsheets |  |  |  |  | -//- |
| 4 | Topic 3. Introduction to medical information systems |  |  |  |  | -//- |
| 5 | **Section 2. Statistical apparatus for data interpretation in evidence-based medicine** | V | 8 | 34 | 30 | 72 | -//- |
| 6 | Topic 1. Application of specialized software for statistical analysis of the results of biomedical research |  |  |  |  | -//- |
| 7 | Topic 2. Basics of evidence-based medicine. Online sources of evidence-based medicine data |  |  |  |  | -//- |
| 8 | **Section 3. Medical Information Systems (MIS). E-health** | X | 14 | 36 | 22 | 72 | -//- |
| 9 | Topic 1. Medical and technological information systems. Systems for automating the activities of departments and services (LIS, PAKS, RIS) |  |  |  |  | -//- |
| 10 | Topic 2. Management systems of the Ministry of Defense |  |  |  |  | -//- |
| 11 | Topic 3. Regional MIS. Unified State Information System of Health Care. E-health |  |  |  |  | -//- |
| **Total** | |  | 36 | 104 | 76 | 216 |  |

Types of control: **credit**.