B FEDERAL STATE BUDGETARY EDUCATIONAL INSTITUTION
HIGHER EDUCATION INSTITUTION
«DAGESTAN STATE MEDICAL UNIVERSITY»
MINISTRY OF HEALTH OF THE RUSSIAN FEDERATION

APPROVED BY:

Vice-rector for academic affairs,

_____ Shakhbanov R.K.

"_29_" __августа__2018 y.

WORKING 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

MAKHACHKALA, 2018 г.

The working program of the discipline "**Medical informatics**" is designed on the basis of the curriculum Main Professional Educational Program of HE the specialty (direction) **31.05.01 General medicine**, approved by academic Council, Protocol №1 from August 30, 2018, in accordance with **FSES HE** on direction of training (specialty) **31.05.01 General medicine**, approved by order **№. 95** of the **Ministry of Education and Science of the Russian Federation of 09.02. 2016** year.

The working program of the academic discipline was approved at the meeting of the Department of Biophysics, Informatics and Medical devices of September 1, 2018, Protocol № 1.

The work program has been agreed with:

1. **Director of the Scientific Medical Library of DSMU** _____ **(V.R. Musayewa)**
2. **Head Educational and Methodological Department for Quality Control of Education** _____ **(A.M. Karimova)**
3. **Dean of the Faculty of General medicine** _____ **(R.M.Ragimov)**

Compilers:

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3. Assistant of the Department of Foreign and Latin languages, Candidate of Philology Sciences, Associate Professor **M.A. Magomedova**

1. The reviewer:
Head of the General and Biological Chemistry Department of DSMU, Professor E.R. Nagiyev

2. The reviewer:
Head of department of theory and methodology of physics teaching of DSPU, Doctor of Physical and Mathematical Sciences, Professor G.M. Magomedov

CONTENTS

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.

2. 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.

3. 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.

4. 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	72	72	72
	Credit units	6	2	2	2

4.1. 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	Primary statistical processing of quantitative features. Characterization of biological objects as complex stochastic systems. The selective method of observation is the main

		using MS Excel	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 $\chi 2$ – 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	

5.3. Name of lecture topics and number of hours of academic discipline

№	Name of topics of lectures of the academic discipline	Number of hours		
		II	**V**	**X**
	Section 1. Basic technologies for the presentation and processing of medical information			
1	Basic concepts of medical informatics.	2		
2	Hardware and software of information processes. Data transmission technology in information systems.	2		
3	Modeling physiological and pharmacokinetic processes.	2		
4	Medical information. Computer analysis of medical data.	2		
5	Medical information systems.	2		
6	Medical instrument and computer systems.	2		
7	Computer communications in medicine. Telemedicine.	2		
	Section 2. Statistical apparatus for data interpretation in evidence-based medicine.			
1	Basic concepts and methods of evidence-based medicine. Ethical aspects of clinical research. Mathematical apparatus for the analysis of medical information.		2	
2	Statistical processing of medical and biological data and publication of the results of scientific medical research		2	
3	Medical decision support systems. The concept of artificial intelligence methods, neural networks and machine learning		2	
4	Information technologies to support decision-making in medicine and healthcare		2	
	Section 3. Medical Information Systems (MIS). E-health			
1	Medical and technological information systems. Mobile technologies in medicine.			2
2	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			2
3	Systems for the automation and management of MO activities. Organization of medical data security.			2
4	MIS classification. Concept and technologies of building E-health			2
5	Components of the unified state information system in the field of health care (Unified State Health Information System) (Federal Register of medical organizations, Federal Register of Medical Workers, System for maintaining regulatory and reference information, Medical Registers, etc.) Portal of continuing medical education			4
6	Telemedicine technologies. Prospects of healthcare informatization			2
	Total	**14**	**8**	**14**

5.4. NAMES OF TOPICS OF PRACTICAL AND LABORATORY CLASSES WITH INDICATION OF THE NUMBER OF HOURS

№	Names of topics of practical classes of the basic part of the discipline on the FSES	Number of hours		
		II	V	X
	Section 1. Basic technologies for the presentation and processing of medical information			
1	Computer hardware and software. System software. Basic principles of work in Windows OS.	2		
2	Creation of complex medical documents using the MS Word text processor.	4		
3	Statistical processing and analysis of medical and biological research data using MS Excel.	4		
4	Purpose and main functions of the MS PowerPoint computer presentation system.	2		
5	Internet tools for searching professional information on specific areas of medical knowledge.	2		
6	Algorithms for modeling physiological processes for solving clinical problems.	2		
7	Automated workstation (AWP) of a doctor - basic functions and principles of work.	2		
8	Information-probabilistic diagnosis of diseases.	2		
9	Computer differential diagnosis of diseases.	4		
10	Creating and working with a medical database in Access and FoxPro	4		
11	Computer (software) modeling of pharmacokinetics and hemodynamics.	4		
12	Intermediate knowledge control	2		
	Section 2. Statistical apparatus for data interpretation in evidence-based medicine.			
1	Fundamentals of evidence-based medicine. Types of biomedical research. Levels of evidence		3	
2	Research planning. Organization of the research database		3	
3	Software for statistical analysis of research results		3	
4	The use of specialized software for the description and presentation of aggregate statistical data		2	
5	Application of specialized software for statistical analysis of quantitative characteristics		2	
6	Application of specialized software for statistical analysis of qualitative characteristics		3	
7	Application of specialized software for correlation analysis of biomedical data		3	
8	Basic approaches to statistical modeling		3	
9	Intermediate control on the topic "Application of specialized software for statistical analysis of biomedical research results"		3	
10	Use of scientific and medical information resources. Working with health system directories		2	
11	Medical information resources on the Internet. Online data sources for evidence-based medicine		3	
12	Internet resources: state information systems and electronic		2	

	services in healthcare and social sphere			
13	Use of digital medical services within the unified information space in healthcare		2	
	Section 3. Medical information systems (MIS). E-health			
1	Maintaining electronic medical records within the MIS MO			6
2	Work with organizational and administrative subsystems of the MIS MO (automatic write-off of medicines, schedule maintenance, dispatching of diagnostic studies, reporting, analytical modules)			8
3	Application of medical and diagnostic software and hardware complexes for solving professional tasks			8
4	Decision support in medicine. The concept of " Intelligent Automated Workplace			8
5	Medical registers. The principle of construction and maintenance.			6
	TOTAL	**34**	**34**	**36**

5.5. INDEPENDENT WORK OF THE STUDENT IN THE DISCIPLINE

№	Controlled competencies	Name of the discipline section	Types of Independent Student Work	Total hours		
				II	**V**	**X**
1	GPC-1, GPC-6, PC-4, PC-20	**Section 1** Technical base of medical informatics. Information systems hardware and software.	Abstract writing. Preparation for intermediate knowledge control	8	10	6
2	GPC-1, PC-4, PC-20	**Section 2** Basic information transformation technologies	Preparation for current classes. Preparation for intermediate knowledge control	8	10	8
3	GPC-6, PC-4, PC-20	**Section 3** Statistical processing of medical data	Preparation for current classes. Preparation for intermediate knowledge control	8	10	8
			Total hours per semester	**24**	**30**	**22**

Topics of essays for independent work of students

№	Section	Topics of essays
1	*1*	Possibilities of mathematical modeling of functional systems of the body.
		Methods for automating diagnostic studies.
		Automated medical systems of medical institutions.
		Modern operating systems, their varieties and differences.
		Types of search engines on the Internet
2	**2**	Medical informatics methods as an evidence-based medicine tool.
		Simulation training in medicine
		Computer simulation programs used in teaching medical students.
3	**3**	Telemedicine in the system of practical health care.
		The history of the development of telemedicine in Russia.
		Modern medical information computer technologies as applied to solving problems in medicine and healthcare.

6. EDUCATIONAL-METHODOLOGICAL AND INFORMATION PROVISION OF TRAINING DISCIPLINE

6.1. Main literature

Printed sources:

№	Name	Author (s)	Year, the place of publication	Number of copies	
				In the library	At the department
1	Informatics Practical Course	Truzhenikova S.E., Atlukhanova L.B., Magomedov M.A., Azizkyanova A.E., Magomedova M.A.	Издательско-полиграфический центр ДГМУ, г.Мхачкала, 2019.	80	20

6.2. Additional literature

Printed sources:

№	Name	Author (s)	Year, the place of publication	Number of copies	
				In the library	At the department
1	Fundamentals of computers	V.Rajaraman	Asoke K Ghosh, Prentice-Hall, New Delhi, India, 1999.	-	1

7. LIST OF RESOURCES OF THE INTERNET INFORMATION AND TELECOMMUNICATIONS NETWORK:

8. INFORMATION TECHNOLOGY

The following educational technologies are used in educational work: lecture-visualization, lesson-conference, debate, brain storm, master class, "round table", discussion-forum, business and role-playing educational game, lesson using computers, student's research work, preparation and defense of abstracts, work with situational tasks and tests.

Criteria for evaluating the current control of academic performance (tests):

- ✓ «Excellent»: 91 - 100 %
- ✓ «Good»: 81 – 90 %
- ✓ «Satisfactory»: 60 – 80 %
- ✓ «Unsatisfactory»: < 60 %

9. EVALUATING TOOLS FOR CURRENT AND INTERMEDIATE CONTROL

a. Tests in accordance with the competencies for the current control

Competence code	Evaluation material
GPC-1	1. Types of medical information: a. alphanumeric information, visual information; b. analog information, discrete information; c. digital information, continuous information; d. commercial information, aesthetic information; 2. Medical information includes: a. everyday information; b. audio information; c. aesthetic information; d. production information; e. commercial information; 3. What medical information is called combined? a. medical information that is a combination of alphanumeric, audio, and statistical information; b. medical information that is a combination of continuous, digital, analog, and audio information; c. medical information, which is a combination of alphanumeric, visual, graphical and audio information; d. medical information, which is a combination of alphanumeric, analog, and discrete information; e. medical information, which is a combination of sound, dynamic, and statistical information; 4. The program executed directly by the computer is called: a. object module; b. source module; c. text module; d. translator module. 5. What is called a programming system? a. a set of tools designed to automate the execution of programs; b. a set of tools that provide automation of program development and debugging; c. a set of programs that directly ensure the performance of the work necessary for the user;; d. a set of programs designed to convert the source module into an object module. 6. What does the programming system include? a. programming languages, translators, linkers, interpreters, compilers; b. programming languages, interpreters, linkers, debuggers, assemblers, subroutine libraries; c. programming languages, subroutine libraries, debuggers, translators, linkers; d. translators, linkers, subroutine libraries.
GPC-1	7. The amount of information contained in the message about the occurrence of an event depends on the probability P of the occurrence of this event according to the following formula: a. $I=lg1/P^2$; b. $I=\log_2 1/P$; c. $I=\log_2 P$; d. there is no right answer. 8. To select a unit of information consider a message about the occurrence of an event with probability: a. P =1; b. P =0; c. P=1/2; d. there is no right answer. 9. Information units are: a. 1 bit, 1 byte, 1 KB, 1 MB, 1 GB; b. 1 bit, 1 byte, 1 KB, 1 MB, 1 Baud;

	c. 1 Дбайт, 1 Baud, 1 bit, 1 KB, 1 MB; d. 1 GB, 1 DB. 10. What is called an algorithm? a. numbered sequence of line; b. the performer's command system. c. the final sequence of commands that define the performer's actions. d. an unnumbered sequence of end strings. 11. Which document is the algorithm? a. safety regulations; b. cooking recipe; c. lesson schedule; d. class list. 12. Mass character is a property: a. information; b. algorithm; c. printer; d. ROM. 13. The program executed directly by the computer is called: a. object module; b. source module; c. text module; d. translator module. 14. What is a compiler? a. translator from low-level language; b. translator from Fortran c. translator from BASIC; d. translator from assembly language. 15. What are translators used for? a. to convert an object module to a source module. b. to run the program. c. to convert the source module to an object module. d. to create a command file. 16. What types of programming languages are divided into? a. low-level languages, high-level languages, Assembly languages; b. machine languages, low-level languages, high-level languages, algorithmic languages; c. algorithmic languages, machine code languages, macroassembler language, low-level language; d. machine command languages, low-level languages, algorithmic languages. 17. What is the name of the basic translator? a. interpreter; b. compiler; c. assembler; d. linker. 18. What is the name of the Pascal translator? a. interpreter; b. compiler; c. assembler; d. linker. 19. To convert the source module (Pascal language) to an object module, you must have: a. interpreter; b. interpreter and compiler; c. compiler and assembler; d. interpreter and assembler. 20. To describe branches in algorithms, use: a. GOTO command; b. IF/THEN command; c. "if" construction; d. "for" construction». 21. To describe cycles in algorithms, use: a. GOTO command; b. IF/THEN command; c. "if" construction; d. "for" construction». 22. To enter data from the keyboard in Basic, use the operator: a. PRINT; b. INPUT; c. REM; d. IF. 23. The Basic comment operator is: a. READ; b. CLS; c. CLOSE; d. REM. 24. To display data on the screen in BASIC, the operator is used: a. PRINT; b. INPUT; c. REM; d. IF. 25. The cycle operator in BASIC is: a. COLOR; b. CLS; c. FOR;. d. FULL.

	26. To set a list of constants in Basic, use the operator: a. DATA; b. INPUT; c. REM; d. IF. 27. The BASIC operator that changes the order of program execution is: a. REM; b. READ; c. GOTO; d. CLS. 28. The total clearance of a given drug from the body of a given patient is: a. the volume of blood plasma, purified from the drug in 30 seconds due to the total action of all excretory systems; b. the volume of blood plasma purified from the medicinal substance per unit of time due to the total action of all isolated systems; c. the volume of blood plasma, purified from the medicinal substance per unit of time due to the action of the excretory system of the kidneys; d. the volume of the drug excreted from the body per unit of time; 29. The mathematical model of a real system is: a. any mathematical description of this system; b. mathematical description of the system in the form of differential equations, which can be used instead of the system in solving some practical problems; c. mathematical description of the system, which can be used instead of the system in solving some practical or scientific problems; d. a mathematical description of the system in the form of differential equations, which can be used instead of the system in solving some practical or scientific problems. 30. The purpose of energy models is: a. reproduction of the structure of an object and the relationship of its parts; b. performing the functions of the object under study; c. description of the research object; d. description of quantitative relationships between the parameters of the studied biosystem. 31. The purpose of real models is: a. reproduction of the structure of the object and the relationship of its parts; b. performing the functions of the object under study. c. description of the research object; d. description of quantitative relationships between the parameters of the studied biosystem. 32. The purpose of information models is : a. reproduction of the structure of an object and the relationship of its parts; b. performing the functions of the object under study; c. description of the research object; d. description of quantitative relationships between the parameters of the studied biosystem.

GPC-1	33. The block diagram of modern computers functionally includes the following parts: a. input and output device, memory, processor; b. memory, processor, input and output device, control device; c. arithmetic-logical device, input and output device, processor; d. control device, monitor, input and output device, processor. 34. The most famous word processors are: a. WORD, Word Perfect; b. Excel, Quattro, CA-SuperCalc; c. dBase, Access, FoxPro; d. Power Point, Corel Draw; e. Word, ЛЕКСИКОН, Paradox. 35. The most famous spreadsheets are: a. WORD, Word Perfect, ЛЕКСИКОН; b. Excel, Quattro, CA-SuperCalc; c. dBase, Access, FoxPro; d. Power Point, Corel Draw; e. Word, ЛЕКСИКОН, Paradox. 36. Database management systems are: a. WORD, Word Perfect, ЛЕКСИКОН; b. Excel, Quattro, CA-SuperCalc; c. dBase, Access, FoxPro; d. Power Point, Corel Draw; e. Word, ЛЕКСИКОН, Paradox. 37. The most famous graphics systems are …? a. WORD, Word Perfect, ЛЕКСИКОН; b. Excel, Quattro, CA-SuperCalc; c. dBase, Access, FoxPro; d. Power Point, Corel Draw; e. Word, ЛЕКСИКОН, Paradox. 38. What is the operating system ? a. a set of programs and rules that ensure the operation of a computer; b. a set of software and language tools designed to maintain the functioning of the computer; c. a set of programs that organizes a dialogue with the user, management of the computer, its resources, launches application programs for execution; d. a set of tools designed to automate the execution of programs. 39. By structure, all files are divided into ...: a. tabular, graphic; b. graphic, text; c. text, binary; d. binary, tabular. 40. What are the main features of Windows 95 ? a. multitasking, unified hardware and software interface, text-based user interface, lack of multimedia principle; b. single-tasking, single graphical user interface, built-in multimedia support, a large number of applications; in. multitasking, unified hardware and software interface, unified graphical user interface, built-in multimedia support; d. unified user interface, unified graphical interface, unified hardware / software interface, built-in multimedia support, single-tasking. 41. List the Windows 95 operating system objects ? a. taskbar, start button, desktop, folders; b. desktop, files, folders; c. desktop, mouse, taskbar; d. desktop, folders, files, display panel; e. desktop, start button, trash folder. 42. What is Microsoft Word? a. operating system; b. word processor; c. graphics processor; d. text editor; e. operating shell. 43. What operations are performed with text using the Microsoft Word text processor? a. editing, input; b. input, editing, and formatting; c. input, formatting, and printing; d. drawing up tables and graphs; e. all specified items. 44. The cell address of a spreadsheet cell is a. any sequence of characters;

	b. the number of bytes of RAM allocated for the cell. c. a name consisting of the column name and the row number. d. address of the byte of RAM allocated for the cell. e. address of the machine word of RAM allocated for the cell. 45. An Excel spreadsheet is written for the environment: a. DOS; b. Windows; c. OS/2; d. Unix; e. FoxPro. 46. What is an Excel document (i.e., a processing object)? a. table data containing text and numbers; b. a file with an arbitrary name and the .xls extension. c. a file with a name made up of 8 Latin letters and the extension .xls. d. a table of source and custom data. e. a file with the name and extension .dbf. 47. What is the name of the processing object in Excel terms? a. a blank sheet; b. a working table; +c. a workbook; d. an electronic document; e. a spreadsheet. 48. What automation tools for entering data of the same type does Excel provide? a. auto-completion, auto-copying, auto-transfer; b. auto-change by numbers, auto-completion, auto-copy formulas; c. autocompletion, autocomplete with numbers, autocomplete with formulas; d. auto input of numbers, auto input of formulas, auto filling; e. autocomplete, autocopy, autocompletion.
PC-4	49. What studies are called cross-sectional studies? a. studies in which each patient is examined once; b. studies in which each patient is examined repeatedly at regular intervals; c. studies in which a certain group of patients is distinguished, among which there is a systematic repeated observation of the course of the disease; d. studies, during the observation of which changes in the course of the disease are often recorded, correlate them with the initial characteristics; e. studies in which there may be deliberate interference with the natural course of events 50. What is a prospective study? a. if a group of patients is specially formed in the study and then monitored once; b. if the study group of patients is specially formed and then purposefully periodically observed; c. if a group of patients is specially formed in the study and then examined at indefinite intervals; d. if a frequent change in the course of diseases is detected in the studied group of patients. 51. Under what conditions are longitudinal medical studies performed? a. selection of control and study groups of patients among whom there is a single observation of the course of the disease; b. selection of control and study groups and comparison of signs (symptoms) of chronic diseases; c. selection of a certain group of patients, among whom there is a repeated observation of the course of the disease; d. selection of a certain group of patients, among whom there is a single observation of the course of the disease; 52. What kind of research is called a population-based prospective study? a. if the health of the subjects is monitored regularly every 2 months; b. if a small sample from the population is selected for the study; c. if a large sample from the population is selected for the study; d. if the control over the state of health of the subjects is carried out regularly every

year.

53. What are the advantages of a prospective study with a retrospective collection of initial data?
   a. efficiency and cheapness; b. self-sufficiency;
   c. possibility of computer processing of initial data;
   d. the possibility of deliberate interference.

54. What longitudinal studies are called retrospective?
   a. longitudinal study of the control group in which changes in the course of the disease are often recorded;
   b. longitudinal study, which is carried out by analyzing the data already available in the medical documentation about the patient;
   c. a longitudinal study that compares data from the study and control groups.
   d. longitudinal study, where a large sample is selected for both research and control.

55. What studies are called prospective studies of causal factors?
   a. research that is carried out by analyzing data already available in medical documentation about patients;
   b. studies that often record changes in the course of the disease, correlate them with the original features, observe the appearance of new diseases;
   c. studies that select a large sample from populations;
   d. studies that can describe the picture of the disease in a population of patients at a specific stage of the disease, to establish a combination of symptoms corresponding to a particular phase of the disease.

56. What is the sample mean?
   a. the center of grouping of possible values of the investigated quantity;
   b. center of deviation of possible values in control and experimental groups;
   c. center of deviation of possible values of the sample size under study from possible values in the general population;
   d. geometric mean of possible values of the investigated quantity.

57. What determines the sample mean square deviation?
   a. the center of grouping of possible values of the investigated quantity;
   b. the degree of deviation of the sample means of the control and experimental groups;
   c. the degree of deviation of the values of the investigated quantity from the sample mean;
   d. the degree of deviation of the possible values of the sampled data from the possible values of the general population.

58. What criterion is used to test the hypothesis of equality of variances?
   a. Fisher's criterion; b. criterion χ^2; c. Student's criterion; d. Pearson's criterion.

59. The χ^2 criterion is usually used in cases where is not possible to verify the validity of differences using ...
   a. Fisher's criterion; b. Student's test;
   c. correlation coefficient; d. asymmetry coefficient.

60. The statement is correct: the diagnostic specificity (Ds) of the test for a certain disease.
   a. is the percentage of the frequency of true positive test results in patients with this disease;
   b. is the percentage of the frequency of true negative test results in individuals without the disease;
   c. expressed as the percentage of true positive results to the total number of positive results;
   d. is expressed as the percentage of true negative results to the total number of negative results;

	e. expressed as the percentage of true results to the total number of results obtained. 61. The statement is correct: predictive significance of positive results (PS+) is ... a. the percentage of the frequency of true positive test results in patients with this disease; b. the percentage of the frequency of true negative test results in individuals without the disease; c. expressed as the percentage of true positive results to the total number of positive results; d. expressed as the percentage of true negative results to the total number of negative results; e. expressed as the percentage of true results to the total number of results obtained. 62. The statement is correct: predictive significance of negative results (PS-) is ... a. the percentage of the frequency of true positive test results in patients with this disease; b. the percentage of the frequency of true negative test results in individuals without the disease; c. expressed as the percentage of true positive results to the total number of positive results; d. expressed as the percentage of true negative results to the total number of negative results; e. expressed as the percentage of true results to the total number of results obtained. 63. The statement is correct: the diagnostic effectiveness of the test (DE) ... a. is the percentage of the frequency of true positive test results in patients with this disease; b. is the percentage of the frequency of true negative test results in individuals without the disease; c. expressed as the percentage of true positive results to the total number of positive results; d. is expressed as the percentage of true negative results to the total number of negative results; e. expressed as the percentage of true results to the total number of results obtained. 64. Student's test (t) allows you to find the probability that ...: a. both variances refer to the same population; b. both variances belong to two different populations; c. both averages refer to the same population; d. both averages refer to two different populations. 65. The level of significance is called ...? a. the maximum value of the probability of the occurrence of an event, less than which the event is considered practically impossible; b. the minimum value of the probability of the occurrence of an event, less than which the event is considered practically impossible; c. the maximum value of the probability of the occurrence of an event, more than which the event is considered practically impossible; d. the minimum value of the probability of the occurrence of an event, more than which the event is considered practically impossible.
PC-4	66. What is called computer diagnostics? a. the use of cybernetics methods and means of computer technology in the diagnostic process is called computer diagnostics; b. the use of the methods of computer technology and means of cybernetics in the diagnostic process is called computer diagnostics; c. the use of methods for collecting and processing information through computer technology in the diagnostic process is called computer diagnostics;

d. the use of cybernetic devices for processing medical information is called computer diagnostics.

67. The most common types of medical logic in computer diagnostics are:
a. deterministic; b. phase interval logic;
c. informational and probabilistic logic; d. all listed items.

68. What is the essence of deterministic logic?
a. this is the simplest diagnostic approach based on direct links between the presence (absence) of certain symptoms in a patient and the diagnosis of the disease;
b. it is a diagnostic approach that takes into account those symptoms that may be present in only a certain percentage of cases for each disease;
c. it is a diagnostic approach that takes into account only those symptoms that are most likely for each diagnosed disease;
d. it is a diagnostic approach that takes into account independent symptoms in a coded form.

69. The knowledge base of the expert system is created by:
a. a doctor who forms a request to the expert system;
b. specialist expert in the problem area;
c. software engineer; d. knowledge engineer.

70. The database of expert systems is created by::
a. a doctor who forms a request to the expert system;
b. specialist expert in the problem area;
c. software engineer; d. knowledge engineer.

71. An expert system is called:
a. a set of tools implemented on the basis of a personal computer for solving problems in a certain subject area;
b. complex software systems that accumulate the knowledge of specialists in specific subject areas and replicate this empirical experience for the advice of less qualified users;
c. a system of documents of the established form designed to register data reflecting the character, volume and quality of medical care provided to certain groups of the population or individuals;
d. a complex of administrative, economic, treatment-and-prophylactic, sanitary-anti-epidemic and other measures based on the use of mathematical and statistical methods, computing and organizational technology, as well as communication facilities.

72. Expert systems performing design allow:
a. describe the causes of diseases by symptoms;
b. predict the occurrence of certain events or phenomena based on the available data;
c. prepare a set of necessary documentation for creating objects with predefined properties;
d. to carry out continuous interpretation of data in real time and signaling about the exit of certain parameters outside the permissible limits.

73. Monitoring expert systems allow:
a. describe the causes of diseases by symptoms;
b. predict the occurrence of certain events or phenomena based on the available data;
c. make a decision on the impact on the system in order to maintain the controlled parameter in the specified values;
d. to carry out continuous interpretation of data in real time and signaling about the exit of certain parameters outside the permissible limits.

74. Forecasting expert systems allow:

a. describe the causes of diseases by symptoms;
b. predict the occurrence of certain events or phenomena based on the available data;
c. make a decision on the impact on the system in order to maintain the controlled parameter in the specified values;
d. to carry out continuous interpretation of data in real time and signaling about the exit of certain parameters outside the permissible limits.

75. The expert system consists of:
a. knowledge bases, databases; b. base conditions; c. solver (interpreter);
d. subsystems of explanations; e. intelligent knowledge base editor.

76. What is the dialogue mode?
a. users do not have direct access to the system, the programs they create are transferred to the system maintenance personnel, grouped into packages and executed;
b. users for the entire time of solving the problem have direct access to all hardware and software of the system;
c. the simultaneous access of many independent users to the resources of the computing system is provided;
d. the interaction of the user with the system occurs in such a sequence, which is determined by the speed of perception and analysis of the results inherent in a person;
e. information is extracted from a fixed solid medium and processed in accordance with the specified programs.

77. Choose the correct end of the sentence: The process of making a diagnosis is ...
a. ... recognition of the whole by its parts;
b. ... recognition of parts based on the analysis of the whole;
c. … Identifying the most likely disease by the nature of the symptoms;
d. ... a conclusion based on the collection and accumulation of information.

78. The statement is incorrect:
a. diagnostic process is the exchange of information between the patient and the doctor;
b. diagnosis is also information that is necessary in order to properly prescribe treatment;
c. medical prescriptions of a doctor is information that controls the activities of nursing staff;
d. the patient is a control element of the cybernetic process.

79. Choose the correct end of the definition: Clinical diagnosis is a process ...
a. ... of circulation of information in the “doctor-patient” system;
b. … of determining the nature of the disease based on the signs established during the examination of the patient;
c. … of determining the nature of the disease based on the history;
d. ... of determining of the typical symptom complexes and making a decision.

80. Choose the correct statement:
a. analysis of the diagram of the diagnostic process leads to two stages of diagnosis;
b. analysis of the diagnostic process diagram leads to four stages of diagnosis;
c. analysis of the diagram of the diagnostic process leads to three stages of diagnosis;
d. analysis of the diagnostic process diagram is carried out in accordance with the plan of the clinical examination.

81. The diagnosis process does not include ...
a. collection of information about the patient, its registration and storage;
b. analysis of the collected information. Selection of the most significant data

indicating possible pathological abnormalities in the state of various organs and systems;
c. evaluate this data by comparing it with known symptoms of known diseases;
d. determination of the disease that has the highest probability as a result of primary treatment.

82. One of the practically important parameters of the "patient-doctor" system is ...
a. … time of information circulation;
b. … unambiguity of circulating information;
c. ... the universality of circulating information;
d. … time of validity of information.

83. There are the following types of patient-doctor systems:
a. operational, stationary; b. stationary, surgical; c. surgical, operational;
d. therapeutic, surgical; e. stationary, therapeutic.

84. The diagnostic algorithm is called ...
a. … a certain sequence of rules that determines the procedure for establishing a diagnosis;
b. … c certain sequence of rules, in which information about the signs of the patient's condition is compared with a set of signs that characterize typical diseases;
c. … certain actions in which the one with the highest probability is selected from among the possible diagnoses;
d. ... a certain way of comparing typical symptom complexes.

85. The diagnostic algorithm includes ...
a. … algorithms for evaluating information, algorithms for analyzing information, logical algorithms;
b. ... algorithms for evaluating information and logic algorithms;
c. ... algorithms for analyzing information and algorithms for evaluating information;
d. ... cyclic and branching algorithms.

86. Computer diagnostics is called the use ...
a. … of cybernetics methods and computer technology in the diagnostic process;
b. … of the methods of computer technology and cybernetics means in the diagnostic process;
c. ... of methods of collecting and processing information through computer technology in the diagnostic process;
d. ... of cybernetic devices for processing medical information.

87. An important role in computer diagnostics plays by ...
a. … reliability of primary data;
b. … amount of primary data;
c. … quality of primary data;
d. … quality and quantity of primary data.

88. The most common types of medical logic in computer diagnostics are:
a. deterministic; b. phase interval logic;
c. informational and probabilistic logic; d. all listed items.

89. The essence of deterministic logic is that it is ...?
a. the simplest diagnostic approach based on direct links between the presence (absence) of certain symptoms in the patient and the diagnosis of the disease;
b. a diagnostic approach that takes into account those symptoms that may be present in only a certain percentage of cases for each disease;
c. a diagnostic approach that takes into account only those symptoms that are most likely for each diagnosed disease;
d. a diagnostic approach that takes into account independent symptoms in coded

	form. 90. The basis of deterministic logic is ... a. a diagnostic table in the form of a matrix where conditional probabilities P (Si / Di) are indicated; b. diagnostic table in the form of a matrix with marks 1 and 0; c. Bayes's formula; d. phase interval logic. 91. The main disadvantage of deterministic logic is that it ...? a. takes into account the meaning of symptoms for various diseases; b. is based only on the presence or absence of a symptom and does not take into account its significance in various diseases; c. based only on the presence or absence of independent symptoms; d. is used only in the diagnosis of incompatible diseases. 92. Specify the types of signs used to describe the clinical information: a. high quality; b. integral; c. quantitative; d. ordinal. 93. The 1-st level of automation of the treatment and diagnostic process implements: a. using the databases offered by the system; b. entering information in free text; c. use of medical resources of the Internet; d. activation of intellectual capabilities of the system. 94. The 2nd level of automation of the treatment and diagnostic process implements: a. using the databases offered by the system; b. entering information in free text; c. use of medical resources of the Internet; d. activation of intellectual capabilities of the system. 95. The 3rd level of automation of the treatment and diagnostic process implements: a. using the databases offered by the system; b. entering information in free text; c. use of medical resources of the Internet; d. activation of intellectual capabilities of the system.
GPC-7	96. The procedure for entering information from the diagnostic terminal into the computer is carried out in the following modes: a. off-line mode, on-line mode; b. menu mode, off-line mode; c. command mode, on-line mode; d. on-line mode, menu mode. 97. What is the characteristic of the autonomous mode of entering information from the diagnostic terminal into the computer? a. information from the main memory is first transferred to an intermediate carrier, and only then, after the end of registration, it is processed on the processor; b. information is immediately processed by the processor without registration on an intermediate carrier; c. information is immediately processed by the processor, and only then the processing results are recorded on an intermediate carrier; d. there is no right answer. 98. What is the characteristic of the non-autonomous mode of entering information from the diagnostic terminal into the computer? a. information from the main memory is first transferred to an intermediate carrier, and only then, after the end of registration, it is processed on the processor; b. information is immediately processed by the processor without registration on an intermediate carrier; c. information is immediately processed by the processor, and only then the processing results are recorded on an intermediate carrier; d. there is no right answer.

	99. The whole variety of medical images can be reduced to two main groups: a. analog and continuous; b. matrix and discrete; c. analog and matrix; d. computer and discrete. 100. In the processing of medical and biological data on a computer, the following directions are observed: a. replacing a doctor with a computer to solve a limited range of diagnostic problems and such a distribution of work between a doctor and a computer, in which the computer is responsible for the formalized, laborious work of obtaining, primary processing and visual presentation of the data obtained, and the doctor is responsible for the diagnosis process; b. replacing a doctor with a computer for solving a limited range of medical problems and such a distribution of work between a doctor and a computer, when the doctor is assigned the formalized work of obtaining and visualizing data, and the computer is responsible for the diagnosis process; c. doctor's development of software for automated processing of medical and biological data; d. the development of the algorithm and software for the automated processing of medical and biological data is the responsibility of the doctor, and the implementation of this according to the appropriate programs is assigned to the computer. 101. The system of automated processing of medical and biological data includes: a. research object with sensors, measurement of quantitative characteristics, data transmission system, medical examination (assessment of qualitative characteristics), encoding, computer; b. medical examination (assessment of quantitative characteristics), encoding, computer, research object, sensors; c. research object with sensors, measurement of quality characteristics, data transmission system, modulation; d. computer, encoding, modulation, data transmission system. 102. Database management systems are used for ... a. storage of large arrays of numerical data and their automated processing; b. storage and automated processing of large amounts of data with a complex structure of links and links; c. automated transmission over the Internet of large amounts of medical data; d. creation of publishing systems. 103. What steps involved in creating a database file? a. creating a file structure and filling it with data; b. drawing up a table and its framing; c. creating a file structure, setting its type and filling it with data; d. drawing up a table, setting the file type, filling it with data. 104. What are the categories of workstation in medicine and healthcare? a. technical, functional, organizational and managerial; b. technological, organizational and managerial, integration; c. technological, administrative and organizational, integrated; d. administrative, managerial, functional, integrated; e. functional, integrated, administrative and management. 105. What types of workstation support exist? a. technological, integrated, organizational and methodological support; b. technical, software, organizational and methodological; c. functional, software, organizational and methodological; d. technical, software, special; e. technological, software, organizational and methodological.

GPC-7	106. What groups can biomedical data be classified into? a. qualitative features, quantitative features, dynamic data, static pictures, dynamic pictures; b. static pictures, dynamic pictures, roentgenograms, ultrasound scans, quantitative signs; c. qualitative signs, quantitative signs, dynamic pictures, computed tomograms; d. computer tomograms, scintigrams, static pictures, qualitative signs, quantitative signs. 107. Qualitative features include: a. skin color, auscultatory phenomena, the presence of pain; b. the number of blood cells, the optical density of the x-ray, blood pressure; c. electroencephalogram, electrocardiogram, ballistocardiogram; d. roentgenogram, computed tomogram, ultrasound scan, scintigram; e. thermography, scintigraphy, biopotential field, electrocardiotopogram. 108. Quantitative features include: a. skin color, auscultatory phenomena, the presence of pain; b. the number of blood cells, the optical density of the x-ray, blood pressure; c. electroencephalogram, electrocardiogram, ballistocardiogram; d. roentgenogram, computed tomogram, ultrasound scan, scintigram; e. thermography, scintigraphy, biopotential field, electrocardiotopogram. 109. Dynamic data includes: a. skin color, auscultatory phenomena, the presence of pain; b. the number of blood cells, the optical density of the x-ray, blood pressure; c. electroencephalogram, electrocardiogram, ballistocardiogram; d. roentgenogram, computed tomogram, ultrasound scan, scintigram; e. thermography, scintigraphy, biopotential field, electrocardiotopogram. 110. Static paintings include: a. skin color, auscultatory phenomena, the presence of pain; b. the number of blood cells, the optical density of the x-ray, blood pressure; c. electroencephalogram, electrocardiogram, ballistocardiogram; d. roentgenogram, computed tomogram, ultrasound scan, scintigram; e. thermography, scintigraphy, biopotential field, electrocardiotopogram. 111. Dynamic paintings include: a. skin color, auscultatory phenomena, the presence of pain; b. the number of blood cells, the optical density of the x-ray, blood pressure; c. electroencephalogram, electrocardiogram, ballistocardiogram; d. roentgenogram, computed tomogram, ultrasound scan, scintigram; e. thermography, scintigraphy, biopotential field, electrocardiotopogram. 112. What is a feature? a. a patient characteristic that has only two meanings; b. a value characterizing any property of a process, phenomenon or system in absolute or relative units; c. characteristic of the patient, which has a certain number of gradations on the absolute scale; d. characteristic of a patient with a certain number of gradations on a relative scale. 113. What is a parameter? a. a patient characteristic that has only two meanings; b. a value characterizing any property of a process, phenomenon or system in absolute or relative units; c. characteristic of the patient, which has a certain number of gradations on the absolute scale; d. characteristic of a patient with a certain number of gradations on a relative scale.

	114. What is the name of the scientific research method based on the construction and study of models? a. model; b. modeling; c. physical modeling; d. biological modeling; e. mathematical modeling. 115. Which of the following models are used in medicine? a. mathematical; b. biological; c. physical; d. computer; + e. all of the above and below listed; f. cybernetic. 116. What model is called physical? a. these are physical systems with behavior similar to the modeled object; b. these are physical systems with behavior dissimilar to the modeling object; c. these are physical quantities that are used to quantitatively describe the processes in the modeled object; d. these are physical systems where some mechanical parameters of the objects under study are studied. 117. What models are called biological? a. these are the structures on which general biological patterns, pathological processes, drug action, treatment methods, etc. are studied; b. these are the biological structures on which the laws occurring in living nature are studied; c. these are the structures on which experiments are performed to identify anatomical pathology; d. phospholipid membranes and electronic devices. 118. What models are called cybernetic? a. these are various devices, most often electronic, with the help of which information processes in a living organism are modeled; b. these are various living organisms in which the processes of transferring information through neurons are studied; c. these are various electronic devices with the help of which the processes of memory modeling are studied; d. a computer with which the control processes in a living organism are simulated.
GPC-1	119. Which stage of biomedical research is complete without knowledge of the basics of mathematical statistics? a. formulation of goal and the planning experiment; b. data collection and their primary processing; c. hypotheses development and testing; d. building mathematical models; e. building biological and physical models. 120. What types of medical research are divided into? a. transverse and longitudinal; b. transverse and perpendicular; c. transverse and cyclic; d. longitudinal and branched; e. longitudinal and cyclic. 121. What is the essence of the black box method? a. without delving into the structure of the system and the device of its elements, to draw a conclusion about the principles of its operation, observing only the input and output data; b. without delving into the structure of the system and the device of its elements, to make a conclusion about its structure, observing only the input and output data; c. without delving into the structure of structural elements and functions of discrete phenomena, to make a conclusion about the principles of its operation, observing only the input and output data; d. based on functional and phenomenological data at the input and output to make

a conclusion about the principles of the system;
e. there is no correct answer.

122. What is a workstation?
a. a set of an automated software tools registered in a personal computer for solving problems in a certain subject area.
b. a set of hardware and technical means implemented on the basis of a personal computer for solving problems in a certain subject area.
c. a set of hardware and software methodological tools implemented on the basis of a personal computer for solving problems in a certain subject area.
d. a set of organizational and methodological tools implemented on the basis of a personal computer for solving problems in a certain subject area.
e. there is no correct definition.

123. External storage devices in medicine are mainly used for storage ...?
a. … archives of quantitative data; b. ... video archives;
c. ... archives of quality indicators; d.… data from continuous monitoring;
e. ... data during discrete monitoring.

124. What is needed to organize the work of the Local Computing Network?
a. link; b. network adapter; c. controller;
d. communication channel and network adapter;
e. communication channel, network adapter and controller.

125. What devices are used to enter medical records into a computer?
a. scanners, modems, digitizers, digital photo and video cameras;
b. scanners, digitizers, digital photo and video cameras;
c. scanners, graphic tablets, digitizers, digital photo and video cameras;
d. scanners, mice, digitizers, digital photo and video cameras;
e. zip devices, scanners, graphic tablets, digital photo and video cameras.

126. What devices are used to enter medical images into a computer?
a. scanners, modems, digitizers, digital photo and video cameras, as well as specially designed devices;
b. scanners, graphic tablets, digital photo and video cameras, as well as specially designed devices;
c. scanners, mice, digitizers, digital photo and video cameras, as well as specially designed devices;
d. scanners, graphic tablets, digitizers, photo and video cameras, as well as specially designed devices;
e. zip devices, scanners, graphic tablets, digital photo and video cameras.

127. What is included in the doctor's workstation software?
a. applied, system, network support; b. basic, network and special software;
c. basic, system, network and special; d. basic, applied, special and network;
e. computer, applied, special and network.

128. What are medical instrument-computer systems for?
a. for information support and automation of the diagnostic or treatment process carried out in direct contact with the patient's body;
b for information support of the diagnostic or treatment process in the mode of a posteriori processing;
c. to automate the diagnostic or treatment process in a dialoge mode;
d. to automate the diagnostic or treatment process in a time-sharing mode;
e. for the automation of the diagnostic or treatment process and information support in the mode of individual use.

129. What types are medical instrument-computer systems divided into by functionality?
a. specialized, single-function, multifunctional, electrographic;

b. specialized, instrumental, complex, radiographic;
c. electrographic, radiographic, complex, single-function;
d. specialized, multifunctional, complex;
e. multifunctional, single-function, specialized.

130. What are specialized medical instrument-computer systems for?
a. for conducting electrographic studies of a wide profile;
b. to conduct research of one type;
c. to conduct research of several types;
d. to provide comprehensive automation of an important medical problem;
e. for conducting broad-spectrum research in real time.

131. What classes are medical instrument-computer systems divided into by purpose?
a. systems for functional and morphological studies; b. monitor systems;
c. specialized (single-function) systems; d. multifunctional systems;
e. laboratory diagnostic decision support systems.

132. With the help of systems for carrying out functional and morphological studies:
a. studies of the circulatory system and respiratory system;
b. long-term continuous monitoring of the patient's condition in intensive care units;
c. continuous monitoring of the patient's condition in operating and postoperative departments;
d. X-ray examinations, magnetic resonance imaging;
e. thermal imaging research, radionuclide research.

133. Medical instrument-computer systems include the following types of support:
a. hardware and software, organizational and technical support;
b. hardware and technical support, methodological support;
c. medical supplies, hardware and software;
d. methodological support, organizational support, computer support;
e. hardware, communication, software.

134. What does the medical support of medical instrument-computer systems include?
a. methodological and organizational issues;
b. methodological and metrological issues;
c. metrological and organizational issues;
d. biomedical and technological issues;
e. technological and methodological issues.

135. What is meant by the hardware of a medical instrument-computer system?
a. means of obtaining biomedical information;
b. means for the implementation of therapeutic effects;
c. computer facilities;
d. means of communication;
e. all answers are correct.

136. What does the hardware part of a medical instrument-computer system include in the simplest typical case?
a. medical diagnostic device, interface device, algorithms that implement the functioning of the system;
b. mathematical methods for processing biomedical information, computer, interface device;
c. medical diagnostic device, computer interface device;
d. algorithms that implement the functioning of the entire system, equipment for the implementation of therapeutic effects, an interface device;
e. specialized microprocessor devices, diagnostic device, computer.

	1. What is a model? a. it is such a material or mentally imagined object, which in the process of research is replaced by a real object. b. it is such a material or mentally imagined object that, in the process of research, replaces the real object (the original object) so that its direct study gives new knowledge about the original object. c. replacement of the investigated object d. study of an artificial object 2. Modeling is ... a. model building process; b. replacement of a real object with an artificial one; c. the process of building, learning and applying models; d. process of applying models. 3. What models are most commonly used in biology and medicine? a. biological, physicochemical, informational, mathematical; b. informational, mathematical; c. mathematical and biological; d. physical and electrical; e. biological and physical. 4. Defining a mathematical model: a. description of any class of objects or phenomenon; b. description of a class of objects or phenomena using mathematical symbols; c. mathematical formulas and equations; d. physical description of the object; e. creating a diagram of the studied object. 5. What kinds of mathematical models do you know regarding the description of changes in processes over time? a. dynamic and statistical; b. static and statistical; c. dynamic and static; d. dynamic and differential; e. differential and integral. 6. Static models are described ... a. differential equations; b. integral equations; c. partial differential equations; d. algebraic equations; e. algebraic and differential Equations. 7. Dynamic models are described ... a. algebraic equations; b. integral equations; c. partial differential equations; d. differential equations; e. algebraic and differential equations. 8. What models do you know depending on the range of tasks to be solved? a. minimum and maximum; b. integrated and differentiated; c. maximum and differentiated; d. maximum and integrated; e. minimal and integrated. 9. Integrated models .... a. have a practical focus; b. are theoretical in nature and are aimed at decoding the structure of the system, the principles of its functioning; c. are theoretical and practical; d. are used, for example, to obtain specific recommendations for an individual patient or a group of similar patients. 10. Minimum models .... a. are theoretical in nature and are aimed at decoding the structure of the system, the principles of its functioning; b. are theoretical and practical; c. have a practical focus. In medicine, they are used, for example, in order to obtain specific recommendations for an individual patient or a group of similar patients;

d. are aimed at deciphering the structure of the system, the principles of its functioning, assessing the role of specific regulatory mechanisms.

11. Stages of creating a mathematical model:
a. 1. Creation of a qualitative (descriptive model) of the object;
2. Description of the object using different types (algebraic or differential).
b. 1. Creation of a qualitative (descriptive) model of the object;
2. Description of the object using equations of various types (algebraic or differential).
c. 1. Creation of a high-quality (descriptive) model of the object;
2. Description of the object using equations of various types (algebraic or differential;
3. Verification of the model (reproduction with the help of PC of certain simulated phenomena for which there is reliable experimental material);
4. Numerical experiments with the model.
d. 1. Description of the object using equations of various types (algebraic or differential);
2. Verification of the model (reproduction with the help of PC of certain simulated phenomena for which there is reliable experimental material);
3. Numerical experiments with the model.

12. Approaches for building mathematical models:
a. empirical and experimental; b. Experimental and theoretical;
c. theoretical and mathematical; d. integral and differential;
e. theoretical and integral.

13. The “black box” method is …
a. description of living systems in terms of input - state – output;
b. description of living systems in terms of input-output;
c. description of living systems in terms of input – state;
d. description of living systems in terms of state – output;
e. description of living systems in terms of output – output.

14. A compartment is ..
a. some amount of substance;
b. some amount of a substance released in the biological system;
c. a certain amount of a substance released in a biological system and having the property of unity;
d. a certain amount of a substance released in a biological system and does not possess the property of unity.

15. In which discipline are compartment and chamber models most commonly used?
a. in pharmacology; b. in biology; c. in pharmacodynamics;
d. in pharmacokinetics; e. in physiology.

16. The apparent volume is …
a. whole blood volume; b. the entire volume of inter tissue fluid;
c. such a hypothetical volume in which it would be necessary to dissolve the injected amount of the drug so that its concentration is equal to the concentration actually observed in the blood;
d. volume of a specific organ.

17. Clearance is ...
a. the amount of plasma released (purified) from the drug per unit of time;
b. the rate of excretion of the substance;
c. the injection rate;
d. the total rate of elimination of all substances from the body.

18. The minimum therapeutic concentration is ...
a. the minimum concentration of the drug, above which the drug begins to have a

	toxic effect; b. concentration of the drug, above which the drug ceases to have a therapeutic effect; c. concentration of the drug, below which the drug begins to have a toxic effect; d. the minimum concentration of the drug, below which the drug ceases to have a therapeutic effect. 19. The minimum toxic concentration is … a. the minimum concentration of the drug, above which the drug begins to have a toxic effect; b. the minimum concentration of the drug, below which the drug ceases to have a therapeutic effect; c. concentration of the drug, above which the drug ceases to have a therapeutic effect; d. the concentration of the drug, below which the drug begins to have a toxic effect. 20. To create mathematical models is used the law of conservaion of ... a. energy; b. momentum; c. substance; d. electric charge. 21. The implementation of the solution of the mathematical model on a computer is carried out according to ...? a. Laplace formula; b. law of conservation of substance; c. Euler's formula; d. Cramer's formula. 22. The mathematical model in the process of treatment can help ... (choose the most complete answer) a. to select the permissible dose of the injected substance and select the frequency (interval) of its administration; b. to select the frequency (interval) of drug administration; c. to determine the minimum toxic dose; d. to determine the minimum therapeutic dose; e. to determine the half-life of a substance.

Evaluation criteria for monitoring progress (interview on topics of practical lessons):

✓ « ***Excellent***»:
The student has a deep knowledge of the educational material on the topic of the practical lesson, formulated a complete and correct answer to the questions of the topic of the lesson, observing the logic of the presentation of the material, shows the assimilation of the relationship of the basic concepts used in the work, was able to answer all clarifying and additional questions. The student demonstrates knowledge of theoretical and practical material on the topic of the lesson..

✓ « ***Good***»:
The student showed knowledge of the educational material, mastered the basic literature, was able to answer almost completely all the additional and clarifying questions. The student demonstrates knowledge of theoretical and practical material on the topic of the lesson, allowing minor inaccuracies.

✓ « ***Satisfactorily***»:
The student has mastered the material of the practical lesson, did not answer all the clarifying and additional questions. The student finds it difficult to correctly assess the proposed problem, gives an incomplete answer, requiring leading questions from the teacher.

✓ « ***Unsatisfactory***»:
The student has significant gaps in knowledge of the basic educational material of the practical lesson, did not fully disclose the content of the questions, and could not answer the clarifying and additional questions. The student gives an incorrect assessment of the situation, chooses the wrong algorithm of actions. An unsatisfactory mark is given to a graduate who refused to answer the questions of the topic of the practical lesson.

At the end of each **SECTION** of the discipline, the following assessment tools are used to monitor progress:

b. Questions in accordance with the competencies for monitoring

Competency code	***Evaluation material***
GPC-1	1. What is medical informatics. What is the object and subject of its study. 2. The concept of information. Types of medical information. 3. Technical support of the information system. 4. Medical information - an object of processing on a computer. Binary number system. Information code. 5. Probabilistic determination of information. Amount of information, information units.
GPC-1	6. Entering, editing, formatting data and calculations in MS Excel. Data entry automation. Using complex formulas and standard functions. 7. The main stages of solving problems on a computer 8. Algorithm. Types of algorithms. Methods for describing algorithms. The concept of a diagnostic algorithm. 9. Concepts about algorithms for linear, branching and cyclic structures. 10. Programming system. Programming languages. Translators and their varieties. 11. Operators of the BASIC language for organizing cycles, conditional and unconditional jumps. 12. A numerical sequence a_1, a_2, a_3, ..., a_{35} is given. Make an algorithm and a program for calculating: a) the sum of the elements of this numerical sequence; b) the product of the elements of this numerical sequence; c) sums or products at any step of the cycle. 13. Create an algorithm and program for calculating the value of ***y***: $y = x^2 + 5x + 6$, if $x > 0$; $y = x^2 - 5x + 6$, if $x < 0$; $y = 6$, if $x = 0$. 14. Software (computer) modeling.
GPC-1	15. Basic configuration of a personal computer. 16. List the main devices of the basic configuration of a personal computer and indicate their purpose 17. Purpose of the processor. Characteristics of the main parameters of the processor. 18. Types of computer memory and their characteristics

	19. Internal and external computer memory and means of their implementation. Cache memory. Characteristics of RAM and permanent memory. 20. Storage devices. 21. Devices for data exchange. 22. Peripheral devices and their purpose. 23. Data output devices. 24. Data input devices. 25. The concept of computer software. Types of software. 26. System software. System programs. The composition of system programs and their purpose. 27. Operating system (general information). Operating system functions. 28. File system. Types and attributes of files. File structure. 29. Operating system MS Windows, its main objects and controls. 30. Requirements for Windows computer hardware. 31. The main features of Windows. 32. List the applied software and indicate their purpose. 33. Objects and controls MS Windows. 34. Context menu and its features. 35. Operations with file structure. 36. Word processors and editors, their similarities and differences. 37. List the main elements of the Microsoft WORD screen and describe the menu bar options. 38. Spreadsheets, their features and basic concepts. Areas of use. 39. MS Excel program and its versions. 40. Types of ensuring the functioning of AWP. Workstation technical support. 41. Special software AWP. 42. What operations are performed with text using the Microsoft Word word processor? 43. What are the steps to start and stop MS Word? 44. What is the Microsoft Word formatting panel responsible for? 45. What needs to be done to select a word, sentence, paragraph, rectangular fragment in Microsoft Word? 46. How is a piece of text copied? 47. How is a text fragment deleted? 48. How is a piece of text moved? 49. List examples of character formatting. 50. How to change the font of the selected text fragment? 51. How can you align already typed text? 52. How is the document saved? 53. How to create a table in MS Word? 54. How to launch the formula editor in MS Word? 55. What operations can be performed using the Items Edit, Insert, Tools, Window in the menu bar?

	56. How to copy a fragment using the context menu? 57. How to copy text using the menu bar? 58. To make the table look like a table and on the printout, you need to set the table frame. This can be done as follows…. 59. How to set the visible borders of the text area on the working area? 60. What program is used by MS Word to insert a diagram into a document? 61. How to insert a diagram into a document in MS Word? 62. In what case is the text underlined with a red line? 63. When is the text underlined with a green line?
PC-4	64. Features and general principles of statistical analysis of medical research data. 65. The structure and main options for medical research. 66. The concept of transverse and longitudinal medical research. 67. Prospective and retrospective medical research.
GPC-1 GPC-6	68. Expert systems. Their main areas of application and main components. 69. Assessment of the diagnostic effectiveness of the test. 70. Medical information systems and their varieties. 71. Medical information systems of the basic level. 72. Diagnosis from the point of view of cybernetics. The main stages in the development of medical diagnostics. 73. General requirements for workstation of various specialties and doctors - hospital specialists. 74. Basic requirements for a computer history of the disease. 75. Describe the basic structure of the computer history of the disease and the principles of information entry. 76. Information and reference and consultative diagnostic systems. 77. Computer diagnostics and its features 78. The main types of medical logic in computer diagnostics of diseases. Phase interval logic. 79. Deterministic logic. 80. The method of probabilistic diagnostics. Conditional and prior probabilities. Bayes' formula. 81. Make a program according to the following algorithm for the differential diagnosis of diseases (the algorithm is attached).
PC-4	82. The concept of an automated workstation (AWP) for a doctor. Categories of AWPs in medicine and healthcare. 83. Database management system. Basic concepts of FoxPro DBMS. 84. Types and characteristics of the FoxPro database fields. 85. Window for editing and editing the database. 86. Possibilities of database management systems in the construction of information systems.
GPC-1	87. The concept of the Internet. Dedicated and switched communication lines. 88. The concept of a network operating system (SOS). Protocol. 89. The most important information services for the AWS Internet.

	90. Local area networks (LAN). Peer-to-peer LANs. Network hardware. 91. Concepts about the network adapter, file server and modem. 92. Concepts about the bridge, router and gateway. 93. Communication channels, their types and characteristics.
	1. Indicate the sequence of actions in the process of statistical data analysis. 2. In what form should the data be presented for processing by the Statistica package? 3. What are the columns and rows in the Statistica table called? 4. How to add new variables and new observations? 5. What is the separator separator between fractional and integer parts of numeric data? 6. How is data imported from previously created Excel files carried out? 7. What parameters must be specified for correct data import from Excel tables? 8. What typical errors can be found in the data array? 9. How does Statistica recognize individual text values in an array of numeric values? 10. What function in the Statistica package is used to check the correctness of data entry?
GPC-6 PC-20	**Additional questions for the lesson** **"Descriptive statistics"** 1. What types of signs are recorded and analyzed based on the results of biomedical research? 2. Give examples of different types of quantitative traits 3. What signs are called nominal? Give examples. 4. What is the difference between nominal and ordinal quality features? 5. How is it customary to describe the sample by qualitative characteristics? 6. What should be indicated when describing the sample by quantity? 7. What parameters refer to measures of the central trend? 8. Give a definition to the concepts of "fashion", "median" and "average" 9. Give a definition to the concepts of "variance" and "standard deviation" 10. What is the essence of the selection of the 1st, 2nd and 3rd quartiles in the sample? 11. What parameter can be specified to describe the distribution of qualitative nominal features? 12. What parameters can be specified to describe the distribution of qualitative ordinal signs? 13. What are the main properties of the normal distribution 14. What methods are used to study the type of trait distribution? 15. What statistical criteria are used to assess the type of distribution of a characteristic? 16. Formulate the null hypothesis for the problem of estimating the type

	of distribution 17. What is the meaning of the p value according to the results of applying the Kolmogorov-Smirnov (K-S) and Liliefors criteria? 18. What is the value of the ***p*** value allows us to draw conclusion about the differences between the studied distribution differs from the normal one? 19. What should be indicated for a competent description of a quantitative trait in the case of its normal distribution? 20. What must be indicated for a competent description of a quantitative trait in the case of its distribution other than normal?
PC-4	**Questions for writing control for the lesson "Analysis of quantitative data"** ***First questions in test-paper:*** 1. What are the main tasks of statistical analysis of biomedical data 2. What does the phrase "double blind" clinical trial mean? 3. What tasks in medicine is transverse scientific medical research usually used? 4. What tasks in medicine is longitudinal scientific medical research usually used? 5. What types of structures for scientific and medical research are usually distinguished? 6. What types of quantitative traits are usually identified? Give examples? 7. What types of signs are recorded and analyzed according to the results of biomedical research? 8. Give examples of different types of quantitative traits 9. What signs are called nominal? Give examples. 10. What is the difference between nominal and ordinal quality features? ***Second questions in test-paper:*** 1. List the measures of the central trend in statistics. 2. What is the median and what is the principle of finding it? 3. Give a definition to the concepts "dispersion" and "standard deviation". 4. What characteristics of the sample are measures of data dispersion. 5. What is the essence of the Coy and 3rd quartiles instructions? 6. What parameter can be specified to describe the distribution of qualitative nominal features? 7. What parameters can be specified to describe the distribution of qualitative ordinal features? 8. What should be indicated when describing a sample by quantity? 9. What must be indicated for a competent description of a quantitative trait in the case of its normal distribution? 10. What must be indicated for a competent description of a quantitative trait in the case of its distribution other than normal? ***Third questions in test-paper:*** 1. What is a Statistical Hypothesis? 2. What formulations characterize the null hypothesis in statistics?

	3. What formulations characterize the alternative hypothesis in statistics? 4. What is a statistical criterion? 5. What is the level of statistical significance? 6. What is the type 1 error in statistical data processing? 7. What are the main properties of the normal distribution 8. What methods are used to study the type of trait distribution? 9. Under what conditions is it possible to use parametric statistical criteria? 10. What statistical criteria are used to analyze related samples?
GPC-1	**Additional questions for the lesson "Analysis of Qualitative Features"** 1. What types of signs are recorded and analyzed based on the results of biomedical research? 2. What is a binary feature? Give an example. 3. How are the studied samples described in terms of qualitative characteristics? 4. What are the absolute and relative frequencies of the trait? 5. What statistical criterion is used for the two binary groups? 6. What statistical criterion is used for the two nominal groups? 7. What does the contingency table reflect? 8. Why is it necessary to build a table of expected frequencies when using the chi-square test? 9. How is the null hypothesis formulated when working with the chi-square test? 10. What needs to be considered when interpreting the results of the analysis of qualitative characteristics?

Criteria for assessing current control monitoring (interview):

«**Unsatisfactorily**»:

✓ ***Knowledge***: the student is not able to independently highlight the main provisions in the studied material of the discipline. Does not know and does not understand a significant or main part of the program material within the limits of the questions posed.

✓ ***Skills***: the student does not know how to apply incomplete knowledge to solving specific questions and situational tasks according to the model.

✓ ***Abilities***: the student has no practical skills.

«**Satisfactorily**»:

✓ ***Knowledge***: the student has mastered the main content of the discipline's material, but has gaps in the assimilation of the material, which do not impede the further mastering of the educational material in the discipline "Medical Informatics". The material is presented fragmentarily, not consistently.

✓ ***Skills***: The student has difficulty in presenting the material. The student is able to use incomplete knowledge of the material inconsistently and not systematized. The student finds it difficult to apply the knowledge necessary to solve problems of various situational types, when explaining specific concepts.

✓ ***Abilities***: the student has basic skills, but makes mistakes and inaccuracies. The student is basically able to independently main positions in the material studied.

«**Good**»:

✓ ***Knowledge***: The student is able to independently highlight the main points in the material studied. Shows knowledge of all studied program material. Gives a complete and correct answer based on the studied theoretical and practical materials; minor mistakes and shortcomings when reproducing the studied material, definitions of concepts were given incomplete, minor inaccuracies when using scientific terms.

✓ ***Skills***: The student is able to independently highlight the main points in the studied material; based on facts and examples, generalize, draw conclusions, establish intra-subject connections. The student is able to use the acquired knowledge in practice in a modified situation, observe the basic rules of the culture of oral speech, use scientific terms.

✓ ***Abilities***: The student has knowledge of all the studied program material, presents the material consistently, makes minor mistakes and shortcomings when reproducing the studied material. The student does not have sufficient skill in working with reference books, textbooks, primary sources.

«**Excellent**»:

✓ ***Knowledge***: The student independently identifies the main points in the studied material and characterizes the main ideas of the worked out material of the discipline "Medical Informatics". Fluent in terminology, shows deep knowledge and understanding of all program material.

✓ ***Skills***: The student is able to compose a complete and correct answer based on the studied material, highlight the main points, independently confirm the answer with various situational tasks, independently and reasonably make analysis, generalizations, conclusions. Establish interdisciplinary (based on previously acquired knowledge) and intra-subject connections, creatively apply the acquired knowledge to solve obstetric problems. Consistently, clearly, connected, reasonably and accurately present educational material; give an answer in a logical sequence using the accepted terminology; draw your own conclusions; formulate a precise definition and interpretation of basic concepts and rules; when answering, do not repeat the text of the textbook verbatim; present material in literary language; correctly and thoroughly answer additional questions from the teacher. Independently and rationally use visual aids, reference materials, textbook, additional literature, primary sources.

✓ ***Abilities***: The student independently identifies the main points in the studied material and is able to give a brief description of the main ideas of the studied material. The student shows deep and complete knowledge of the entire volume of the studied discipline.

Situational tasks for current and intermediate control

Controlled competence codes: GPC-1, GPC-6, PC-4, PC-20.

1. **Create** an algorithm for calculating the speed of the pulse wave of blood in the arteries

$$V = \sqrt{K\frac{E}{QD}}\ ,$$

if the values of the Young's modulus of the vessel material ***E***, the density of the vessel substance ***Q***, the diameter of the vessel ***D*** and the thickness of the vessel wall ***K*** are given. (GPC-1)

2. **Create** an algorithm for calculating the work of the heart ***A***, which is composed of the kinetic energy $Wk = \rho\upsilon^2/2$ and potential energy $Wp = P*V$, if the values of blood density ρ, blood velocity υ, the difference between systolic and diastolic pressure ***P***, stroke blood volume ***V*** are known.(GPC-1)
3. **Create** an algorithm for calculating the set of values of the function $Y = Ax^3 + B$, provided that ***X*** undergoes changes in the interval from - 20 to 10. The step size is 4. Values A = 5, B = 11. (GPC-1)
4. **Create** an algorithm for calculating the sum of the members of the sequence $a_1, a_2, ..., a_{50}$ with

even indices. (GPC-1)

5. Random variable ***X*** is given as a distribution table

X	x_1	x_2	....	x_n
P	p_1	p_2	....	p_n

Create an algorithm for determining the values of the dispersion ***D (X)*** and the standart deviation of the random variable ***σ(X)***. The dispersion and standard deviation of a random variable are found by the formulas:

$$P_1(x_1 - M(X))^2 + P_2(x_2 - M(X))^2 + ... + P_n(x_n - M(X))^2 = \sum P_i(x_i - M(X))^2 \qquad \sigma(X) = \sqrt{D(X)}\,.$$

Here ***n*** is the number of terms of the series $x_1, x_2, ..., x_n$, ***M(X)*** is the mathematical expectation of a random variable ***X***. (PC-4)

6. Create the programs of issuance 20 times on the display screen of the expression "DSMU - Forever": in one case, based on the operators IF / THEN, and in the other, based on the operators FOR / NEXT. (GPC-1)

7. Create and implement on a computer separate programs for calculating the values of functions $Y=X^2-3*X-7$ for a set of values of the argument ***X*** in the range 0 to 30 with a step of 2 based on the same operators as in task 6. (GPC-1)

8. Create a program for calculating the average values of random variables, the average square deviation. (PC-4)

9. In the group ***K*** is the number of students. Determine their average height $\bar{X}$ and standard deviation S_X using a sample of student height values. Solve the problem on a computer in program mode. (PC-4)

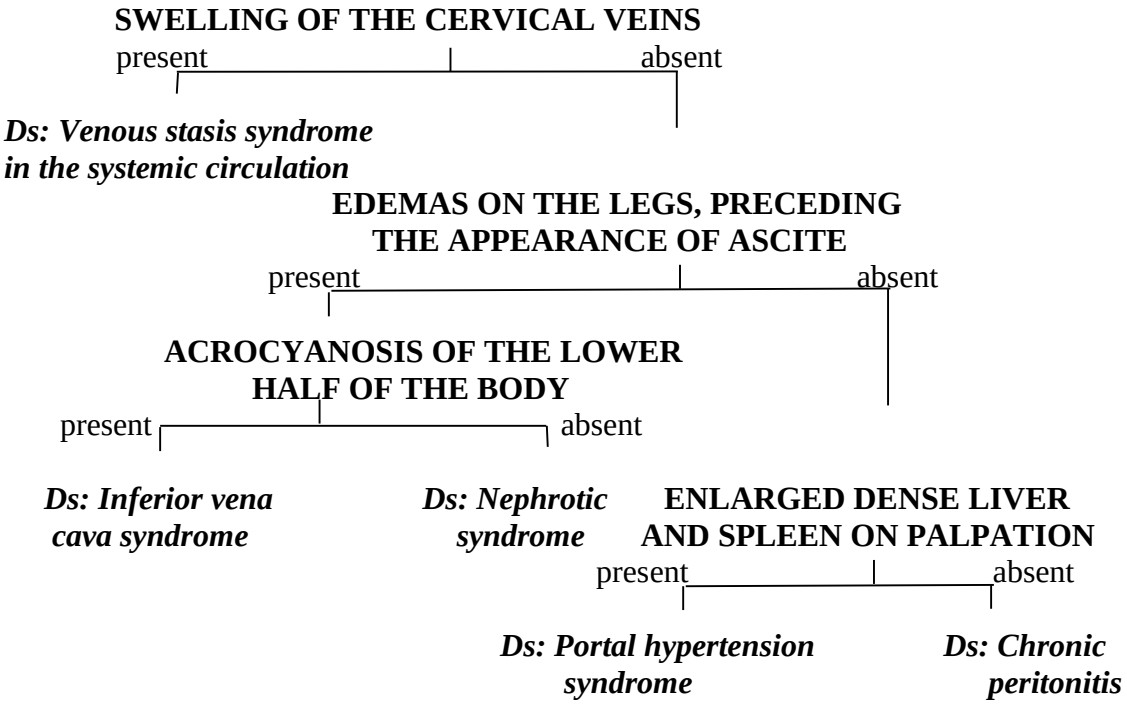
10. Create and implement on a computer a program for constructing a graph of functions ***Y = 2 * X*** for the value of ***X***, undergoing changes in the interval $-1 \le X \le 1$ with a step of 0.1. (GPC-1)

11. An array ***X*** is given: 6.5;0.03;1.5;6;0.31;0.9;-5. Form a new array ***Y***, each element of which is ***Y = 2*EXP*** (***X-n***) (***n*** = 1,2, ..., ***n***). Print out: a) a table of ***X*** and ***Y*** values; b) the values of the elements of the array ***Y*** by zones. (GPC-1)

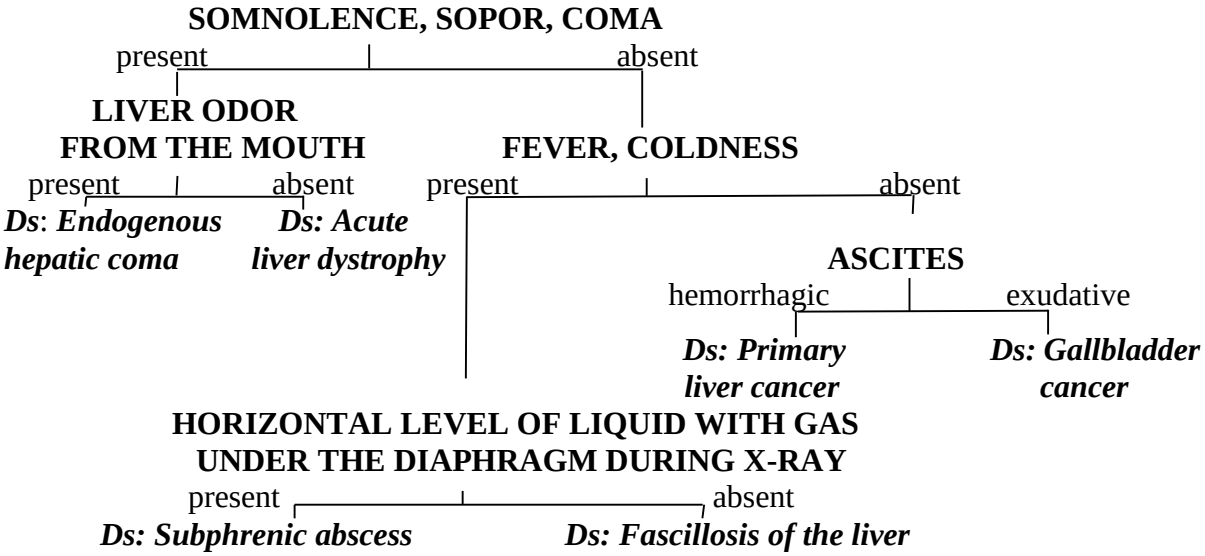
12. Create a program for calculating the sum ***S*** of elements of the sequence 6, -7, 10, 15, -30, 2.5, 4, 15, 8.5, 4.05, -10.05 with odd indices. (GPC-7)

13. Draw up a block diagram of the algorithm for the differential diagnosis of the disease and a program according to the algorithms presented below. (GPC-7)

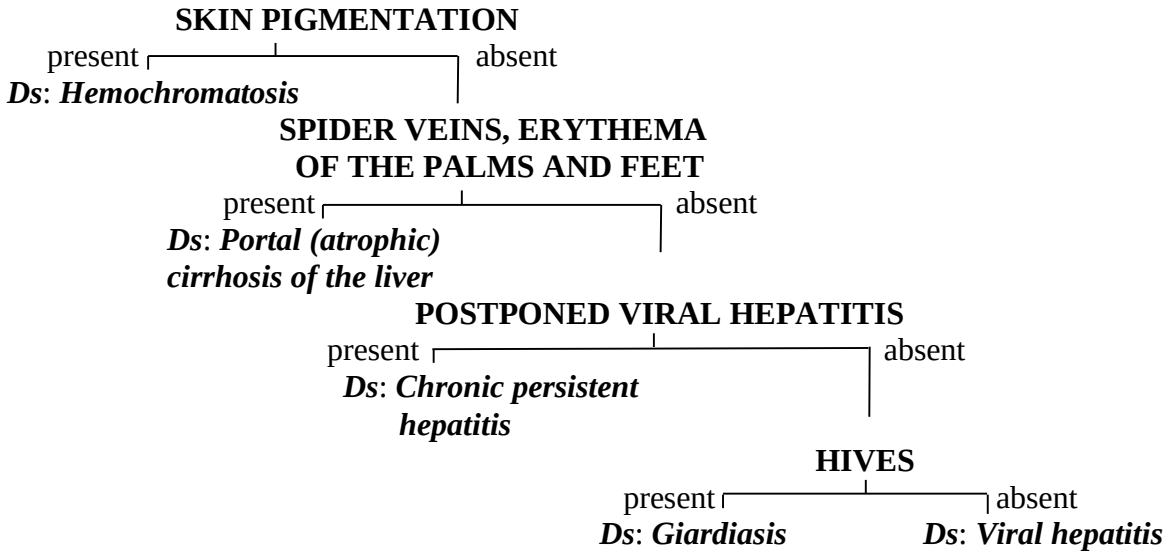
A. Algorithm for differential diagnosis of the most important pathology that caused ascites



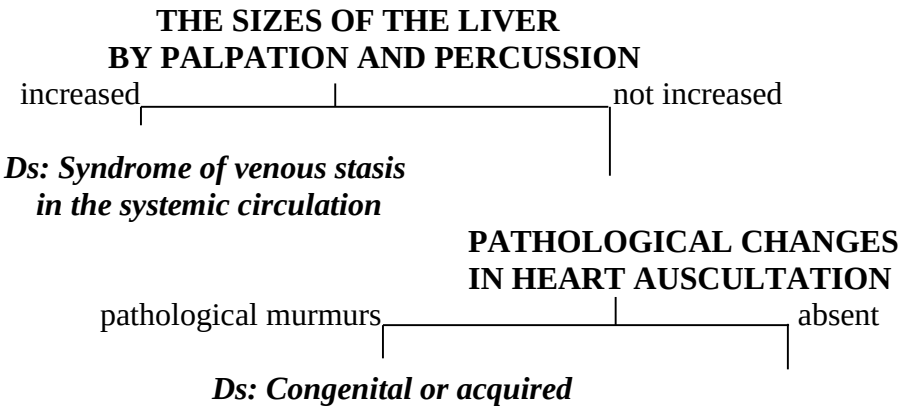
B. Algorithm for differential diagnosis of diseases that caused jaundice in combination with pain or heaviness in the right hypochondrium and fever

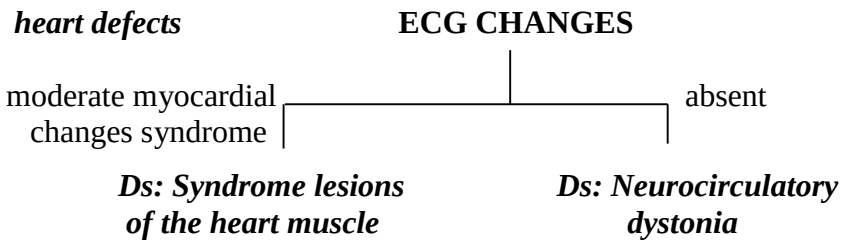


C. Algorithm for differential diagnosis of diseases that caused jaundice in combination with skin pigmentation



D. Algorithm for differential diagnosis of the most important pathology manifested by acrocyanosis





14. Create a table, add text information to it, and frame the table. (GPC-1)

1. Create your group's class schedule in the following format.

SCHEDULE
of classes of n-group students of the third year of the medical faculty

	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
1						
2						
3						
4						

The key to exercise.

A. **Insert** (**Вставка**) a table (**Таблица**)with the required number of cells.

B. To select a row (column) as a whole, you need to move the mouse pointer to the left (above) and click at the moment when the pointer has the form of an arrow pointing to the row (column).

C. Align the column with the numbering of the lessons to the left and use the mouse to set the required width. Align all other cells to the center.

D. Mark the days of the week and lesson numbers in bold. You can also format the font after typing.

E. Select the table and make a border **Format (Формат) → Border (Границы) → Fill**. On the **Borders** tab, select the Grid border type**.**

When selecting a table, make sure that the marker of the paragraph following the table is not included in the selection, otherwise the Grid framing type will not be offered.

2. Save this document in the **My Documents** folder on the C: drive under the name **Schedule**.

15. Automation of the development of a medical document template. (GPC-7)

1. Start the text editor Microsoft Word: **Start (Пуск) → Programs** (**Программы**)**→ Microsoft Word**.

2. Give the command to create a new document: **File** (**Файл**) **→ Create** (**Создать**)**→ Create document (Создать документ) → Document (Документ) → Normal**.

3. Enter the text of the lines according to the specified pattern:

DATE_____

Condition: satisfactory, moderate, severe. Well-being in dynamics:

Skin: clean, moist, dry, pale, pink, cyanotic, icteric. Pulse _____ per minute; rhythmic, non-rhythmic, thread-like, satisfactory filling, tension. Heart sounds: clear, muted, muffled, arrhythmic, rhythmic Heart Rate _____ per minute. BP _____ mm Hg. st.

Breathing: vesicular, weakened, harsh, hard, bronchial. Wheezing: absent, present, the area of hearing wheezing

Tongue: moist, dry, clean. Coated with bloom _____.

Abdomen: soft, painless, distended, enlarged, sunken, flattened, tense, painful _____

Liver: not palpable, palpable _____

Physiological functions: norm, Edema: present, absent.

INSPECTION:

_____

TREATMENT CORRECTION: present, absent.

_____

4. Such items of the diary as date, examination, correction of treatment, it is necessary to select with the mouse and change the saturation of the text. To do this, give the command: **Format (Формат) → Font (Шрифт)**. Then select the bold style in the **Style (Стиль)** dialog box. A special style of text formatting can be applied to any line of the diary text. To do this, select words, sentences and through the **Format (Формат) → Font (Шрифт)** command change the font or design style.
5. When the text of the diary is ready, then it must be saved as a template: **File** (**Файл**)→ **Save As (Сохранить как)**. Include the item **Document template (Шаблон документа)** in the **File type (Тип файла)** field. Set the file name **Observation Diary**. The created template remains unchanged and ready for further use. The doctor prints out the template for the diary in the required quantity, fills in the diaries and pastes them into the medical history.

16. **The creation of** experimental graph. (GPC-1)

1. Launch Excel (**Start (Пуск) → Programs** (**Программы**)→ **Microsoft Excel**) and open the workbook you created earlier.
2. Select an unused worksheet by clicking on the tab or create a new one (**Insert (Вставка)→Sheet (Лист)**). Double click on the sheet tab and rename it **Experiment Processing**.
3. In column **A**, starting from cell **A1**, enter an arbitrary set of values for the independent variable (1, 2, 3, 4, 5, 6, 7, 8, 9, 10).
4. In column **B**, starting from cell **B1**, enter an arbitrary set of values for the function $\mathbf{y = x^2}$ = (1, 4, 9, 16, 25, 36, 49, 64, 81, 100).
5. Using the sweeping method, select all the filled cells in columns **A** and **B** (range **A1**:**B11**).
6. Click the **Chart Wizard (Мастер диаграмм)** icon on the standard toolbar.
7. In the **Type** (**Тип**) list, select **Point (Точечная)** (to display the graph specified by value pairs). In the **View** (**Вид**) palette, select the middle point in the first column (handles connected by smooth curves). Click the **Next** (**Далее**) button.
8. Since the range of cells was pre-selected, the Chart Wizard automatically detects the location of the data series. Make sure the data in the chart is correct. On the **Series (Ряд)** tab, in the **Name field (Имя)**, specify: **Measurement Results (Результаты измерений)**. Click the **Next** (**Далее)** button.
9. Select the **Titles** tab (**Заголовки**). Make sure the given dataset title is automatically used as the title of the chart. Replace it by typing Experimental Points in the **Chart Title** field (**Название диаграммы**). Click the **Next** button (**Далее**).
10. Select the **Separate** (**Отдельно**) radio button. Optionally, give an arbitrary name for the added worksheet. Click the **Finish** button (**Готово**).
11. Make sure the chart is built and embedded in the new worksheet. Look at it and click on the plotted curve to select a series of data.
12. Give the command **Format** (**Формат**) → **Selected row** (**Выделенный ряд**). Click the **View** tab.
13. On the **Line** (**Линия**) panel, open the **Color** palette (**Цвет**) and select a **red** color. In the **Line type** list box (**Тип линии**), select **dotted** line.
14. On the **Marker** panel (**Маркер**), select a triangular marker from the **Marker type** list (**Тип маркера**). In the **Color** and **Background** palettes, choose **green**.
15. Click the **OK** button, deselect the data series and see how the graph has changed.
16. Save the workbook.

17. Determination of diagnostic sensitivity, specificity, effectiveness of immunological and microbiological serological tests, predictive (prognostic) significance of positive and negative results in patients with fever of unknown origin. (GPC-7)

1. Review the serological test results shown in Table 6.

Note. TN - true negative, FN - false negative, TP - truly positive, FP - falsely positive

2. Run Excel (**Start** (**Пуск**) → **Programs** (**Программы**) → **Microsoft Excel** (**Microsoft**

Excel)). Fill out the spreadsheet as shown in Fig. 1.

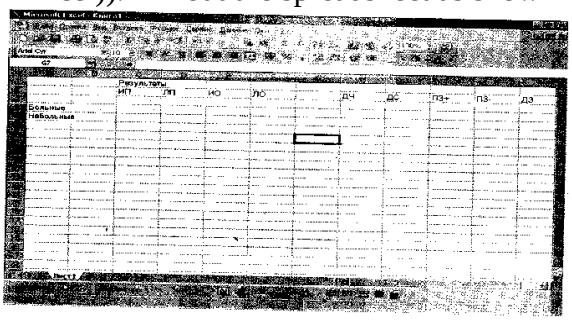


Figure: 1 Spreadsheet for calculating laboratory test scores.

3. Calculate the diagnostic sensitivity, specificity, efficiency of the presented immunological and microbiological serological tests, predictive (prognostic) significance of positive and negative results in patients with fever of unknown origin and draw conclusions. To do this, enter the values for the first study from the table 6 in cells C4, D5, E5, F4.

Table 6

Test results in patients with fever of unknown origin and in people with other diseases with one of the symptoms of fever.

Research	Surveyed	Research results	
		Positive	Negative
1. Anti-nuclear antibodies	Sick	7 (TP)	13 (FN)
	Non-sick	2 (FP)	15 (TN)
2. Antineutrophilic cytoplasmic antibody	Sick	10 (TP)	20 (FN)
	Non-sick	2 (FP)	7 (TN)
3. Antibody to double-stranded DNA	Sick	13 (TP)	0 (FN)
	Non-sick	0 (FP)	3 (TN)

Sequentially in cells H4, I4, J4, K4, L4 enter the formulas for calculating the diagnostic sensitivity, specificity, efficiency of the immunological and microbiological serological tests, predictive (prognostic) significance of positive and negative results:

= C4/SUM (СУММ)(C4:F4)*100

= E5/ SUM (СУММ)((D5:E5)*100

= C4/ SUM (СУММ)((C4:D5)*100

= E5/ SUM (СУММ)((F4:E5)*100

= SUM (СУММ)((C4:E5)/ SUM (СУММ)((C4:D5:E5:F4)*100.

Record your results in a notebook. Delete the previous values and enter the following values for study 2 and 3 from Table 6. Then compare the results.

18. Create a program to determine the concentration **N** of the drug in the organ with a single injection with the initial concentration $\mathbf{N_0}$ and at a certain value of the parameter **T**. Enter the program into the computer and find the concentrations of $\mathbf{N_1}$, $\mathbf{N_2}$, $\mathbf{N_3}$ of the drug in the organ in a day (t = 24 hours) after its introduction at $\mathbf{N_0}$ = 100 mg / kg mass and $\mathbf{T_1}$ = 4 hours, $\mathbf{T_2}$ = 8 hours, $\mathbf{T_3}$ = 48 hours. Display the graph of dependence $\mathbf{N = f(t)}$ at **T** = 4 hours and $\mathbf{N_0}$ = 100 mg / kg mass and draw the graph in a notebook. If you find it difficult to complete the task, run the gwbasic.exe file from the BASIC catalog. Then load one by one into the computer's RAM (by pressing the F3 key) and execute (by pressing the F2 key) the files farma 1.bas and farma1a.bas. Record the results of the execution in a notebook. Exit BASIC by typing the **SYSTEM** command and pressing the **ENTER** key. (GPC-7)

19. Make a program to determine the concentration **N** of the drug in the organ when it is administered in equal doses at time intervals $\mathbf{t_0}$. The concentration of the drug after the **n**-th administration is determined by the formula

$$\mathbf{N_n} = N_0 + N_0 * e^{-t_0/T} + N_0 * e^{-2t_0/T} + \ldots + N_0 * e^{-(n-1)t_0/T}$$

Enter the program into the computer and calculate the concentration **N** of the drug in the organ at the time of its 18-th administration at $\mathbf{N_0}$ = 10 mg / kg of weight, **T** = 8 hours and three values of $\mathbf{t_0}$ equal to 8 hours, 1 day and 2 days. Display the graphs of the dependence $\mathbf{N = f(t)}$ for the indicated three cases on the display screen and draw them in a notebook. The task can also be performed by running the FARMA2.BAS and FARMA2A.BAS files from the BASIC catalog.

(GPC-7)

20. Using the formula **N**=QT(1-e $^{-t/T}$) compose a program to determine the concentration **N** of the drug in the organ for any values of **Q** and **T**. Enter the program into the computer, calculate the values of the drug concentration **N** in the organ with the following parameter values: **t** = 6 h, **t** = 10 h, **t** = 24 h: **Q** = 100 mg / h, **T** = 4 h and display the graph of the dependence **N = *f* (t)**. Record the results and the graph in a notebook. The task can also be performed by executing the programs FARMA3.BAS and FARMA3A.BAS. (GPC-7)

21. Create a program model of pharmacokinetics to determine the concentration of the drug in the case of a combination of continuous administration with a single loading dose (**N**=QT-e $^{-t/T}$ (QT-N $_o$). Enter the program into the computer and calculate the values of the **N** concentration in the organ after **t** = 6 hours, **t** = 12 hours, **t** = 18 hours, **t** = 24 hours and at **Q** = 100 mg / h, $\mathbf{N_0}$ = 150 mg / kg, **T** = 8 h. Record the results in a notebook. This task can be done using the file farma4.bas. (GPC-7)

22. Enter the differ3.bas program into the computer's RAM to calculate the drug concentration in the organ and in the blood during intravenous or intra-arterial infusion. At the request of the computer, enter the necessary data (**Q** = 150 mg / h, $\mathbf{T_1}$ = 8 h, $\mathbf{T_2}$ = 12 h, $\mathbf{T_3}$ = 24 h) and get the values of $\mathbf{N_b}$ and $\mathbf{N_o}$ depending on time. (GPC-7)

23. Create a program for calculating the hydraulic resistance **Rc**, load this program into the computer and calculate **Rc** by entering the values of $\mathbf{P(t_i)}$, **Δt** and $\mathbf{V_y}$ from the keyboard. (GPC-7)

24. Determination of the working diameter of the aorta using a mathematical model. (GPC-7)

The functional (working or actual) diameter of the aorta is an important clinical and physiological indicator by which one can judge the contractility of the left ventricle and the heart as a whole, the maximum velocity aortic ejection, and the presence or absence of aortic defects, which is important to know when deciding on valve replacement aorta. There is a known method for determining the working diameter of the aorta using a mathematical model, where the values of the stroke volume of the heart (SVH) and pulse arterial pressure (PAP) are used as input parameters.

The theoretical premise of this model is the biophysics method of using blood pressure as the height to which the weight of the stroke volume of blood must be raised to determine the stroke work of the heart. That is, the magnitude of the pressure is equivalent to the distance, and in the case of the stroke volume of the heart, the height of the cylinder, the diameter of which is equal to the working diameter of the aorta. Considering that the expulsion of blood is carried out unevenly, as the height of the cylinder it is necessary to use the average value of the pressure pulsation, the isoline of which corresponds to the diastolic blood pressure. As you know, the resultant of all fluctuations in blood pressure (liters of expulsion) is 1/3 of the pulse pressure. Based on this, the cross-sectional area of the aorta ($\pi D^2/4$ in cm^2) can be expressed by the equation:

$\pi D^2/4$ =SVH/PAP·0,333·1,36 where 1,36— coefficient of conversion of millimeters of mercury into centimeters of water column. (GPC-7)

From here $D = \sqrt{4 \cdot \frac{SVH \cdot 0{,}333 \cdot 1{,}36 \cdot 3{,}14}{PAP}}$ or $D = \sqrt{2{,}81 \cdot \frac{SVH}{PAP}}$.

Thus, the proposed model works in strict accordance with the fundamental laws of physics, mathematics and medicine, and its accuracy depends only on the accuracy of determining the stroke volume of the heart and pulse blood pressure, the measurement of which does not require high qualifications..

Perform the sequence of actions:

1. Launch the Excel program **(Start → Programs → Microsoft Excel).**

Fill in the spreadsheet: in cells **A1** and **B1**, enter the abbreviations **SVH** and **PAP.** Next, in cells **A2** and **B2**, enter the corresponding values of the hemodynamic parameters of patient **A** from

the table 1.

Table 1

The values of the hemodynamic parameters of patients required to calculate the working diameter of the aorta (blood pressure measurement data according to Korotkov, the results of a tetrapolar chest rheographic study).

Surname, name, patronymic of the	SVH, ml	PAP, mm.Hg.	D, cm
A	85	41	
B	70	35	
C	110	50	

3. Enter the formula in cell **C2**. To do this, put a sign of equality. Then press the arrow button to select a function in the panel for entering and changing formulas. Select first "**Other functions**" (***Другие функции***), then the category of functions "**Math**" (***Математические***) and the function "**Root**" (***Корень***). The entry = **КОРЕНЬ** (**ROOT**) will appear in the formula bar (Fig. 3). Enter the radical expression **2.81** * **A2** / **B2** in parentheses. In this case, the arithmetic operator of multiplication is entered from the keyboard with the sign *, the arithmetic operator of division is denoted by a slash /. Press **Enter**. The aortic working diameter is automatically calculated using the entered formula. Enter the resulting aortic diameter in the table in the notebook.
4. Delete the previous readings from cells **A2** and **B2** and enter new values from Table 1 for patient **B**. End each digit by pressing the **Enter** key. In cell **C2**, a new automatically calculated value of the working diameter of the aorta in patient **B** will appear. Rewrite the indicator in a notebook and perform the same actions with the indicators of patient **C**.
5. Exit Excel.

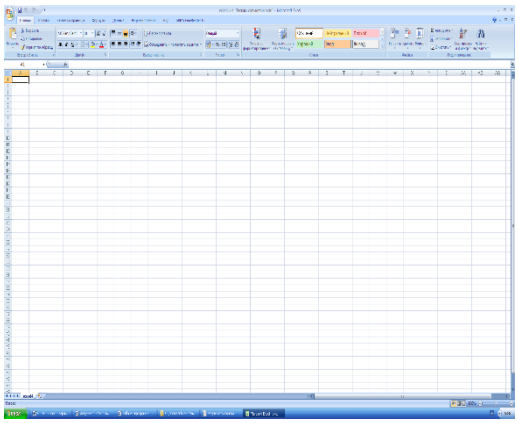


Fig. 3. Registration of the working formula in the formula bar with embedding of a mathematical function.

6. To prove the efficiency of the proposed model for determining the working diameter of the aorta, the found values can be compared with the calculated ones using the echocardiographic method and determining the working area of the aorta **S** according to Hormen:

$$S = V_{lv} \cdot S_{lv} / V_a$$

where V_{lv} is the average blood flow velocity in the outlet of the left ventricle, S_{lv} is the area of the outlet of the left ventricle, V_a is the average blood flow velocity in the aorta.

The calculated data using the model (on average 2.25 cm) and the values determined using the echocardiographic characteristics (2.36 cm) do not differ significantly from each other, which indicates the performance of the model. Considering that with the echocardiographic method for determining the aortic diameter, there is a difficulty in echolocation of the aortic valves and a high qualification of the researcher is required, the use of a mathematical model to determine the working diameter of the aorta greatly facilitates the doctor's task.

25. Determination of the residual volume of the left ventricle using a mathematical model (GPC-7).

The residual volume of the left ventricle determines the efficiency of the pumping function of the heart and the reserve functional capacity of the myocardium. Determination of left ventricular residual volume helps the physician evaluate diastolic myocardial function, which is often altered in a number of heart conditions.

There is a method for determining the residual volume of the left ventricle, according to which a three-dimensional ellipsoid is used as a geometric model of the left ventricle, having two identical minor and one major axes, the ratio of which in systole and diastole is taken constant - 1: 1: 2. The volume of the ellipsoid is described by the formula:

$$\mathbf{V = 4/3\pi A \cdot B \cdot C}$$

where **V** is the volume of the ellipsoid, **A**, **B**, **C** are the semi-axis of the ellipsoid.

Substituting instead of **A**, **B**, **C** the corresponding echocardiographic dimensions of the left ventricular cavity at the end of systole, the residual $\mathbf{V_R}$ volume is calculated.

The disadvantage of this method is the subjective nature of manual measurement of the size of the left ventricle on the echocardiogram, the conditional method for determining the end of systole at the end of the **T** wave of the **ECG**, as well as the deliberately inaccurate principle of modeling the volume of the left ventricle in the form of an ellipsoid, since the ratio of the major and minor axes of the left ventricle varies from 1, 3 to 3.0, depending on age, constitution and heart disease. Therefore, there are many modified formulas for determining $\mathbf{V_R}$. So, it is possible to determine the residual volume of the left ventricle using two-dimensional echocardiography, when two mutually perpendicular images of the left ventricle are obtained in two- and four-chamber positions, the contours of the left ventricular cavity are manually traced, after which each image is divided by computer technology into 20 lobes along the longitudinal axis **L** to obtain for each disk two radii **a** and **b** (respectively, one from each image). After that, the area of each disc is calculated (**a·b·π/4**), the areas of the discs are summed up, and the sum of the areas is multiplied by **L** / 20.

The disadvantages of this method are the subjective nature of determining the contours of the left ventricle in four- and two-chamber positions, the impossibility of obtaining strictly perpendicular and equal length (**L**) images of the left ventricle, since echocardiographic observation of heart structures is possible only through ultrasound-permeable intercostal spaces, the anatomy of which does not allow to be implemented the idea of the method with sufficient rigor. And finally, the determination of the moment of the end of systole is conditional, which also increases the method error, reaching 25%.

To determine the residual volume of the left ventricle, it is possible to use a mathematical model. The theoretical premise of the model is the known data that the residual volume of the left ventricle is directly dependent on the time of blood expulsion by the heart and diastolic pressure, and at the same time - inversely dependent on the stroke volume and pulse arterial pressure. In addition, it is generally accepted that $\mathbf{V_R}$ is normal in healthy people. makes up about 40% of the end-diastolic volume of the left ventricle, or, which is the same, 2/3 of the stroke volume. Summarizing the above, the mathematical model of the left ventricular residual volume is determined by the expression:

$$\mathbf{V_R = BPd \cdot t \cdot К / V_S \cdot BPp}$$

where $\mathbf{V_S}$ in ml is the stroke volume of the heart, **t** is the blood expulsion time in s, **BPd** is diastolic blood pressure, **BPp** is pulse blood pressure, **K** is a coefficient equal to 9284 for men, 5732 for women.

The coefficients were determined by the formula, knowing the average values of the parameters.

Of course, the left ventricular diastolic volume can be determined by summing the stroke and residual volumes.

Perform a sequence of actions:

1. Run Excel (**Start → Programs → Microsoft Excel**).
2. Fill in the spreadsheet: in cells **Al**, **A2** and **A3**, enter **gender**, **man**, **woman**, respectively. In cells **B1**, **C1**, **Dl**, **El**, **Fl**, **G1**, enter the abbreviations **BPd**, **t**, **K**, **Vs**, **BPp**, **V_R**. Next, in cells **B2**, **C2**, **D2**, **E2**, **F2**, enter the corresponding values of the hemodynamic parameters of patient **A** from Table 10.2.
3. Enter the formula = **B2** * **C2** * **D2** / (**E2** * **F2**) in cell **G2** using the multiplication and division arithmetic operators - * and /. For the correct sequence of actions in the denominator, the product **E2** * **F2** must be enclosed in brackets (Fig. 4). Press **Enter**. Write down the automatically calculated value of the residual heart volume in cell **G2** into a notebook.

Table 2.

Values of hemodynamic parameters of patients required for calculating the residual heart volume (data from measuring blood pressure according to Korotkov, the results of a tetrapolar chest rheographic study)

Full name	***Gender***	***V_R,** ml*	***BPd,** мм рт. ст.*	***BPp,** mm. Hg.*	***t,** с*	***K***	***V_R,** мм*
A	m	68,9	79,8	51	0,278	9284	
B	m	72,4	72,9	43,5	0,27	9284	
C	w.	93,3	70,3	44,2	0,306	5732	

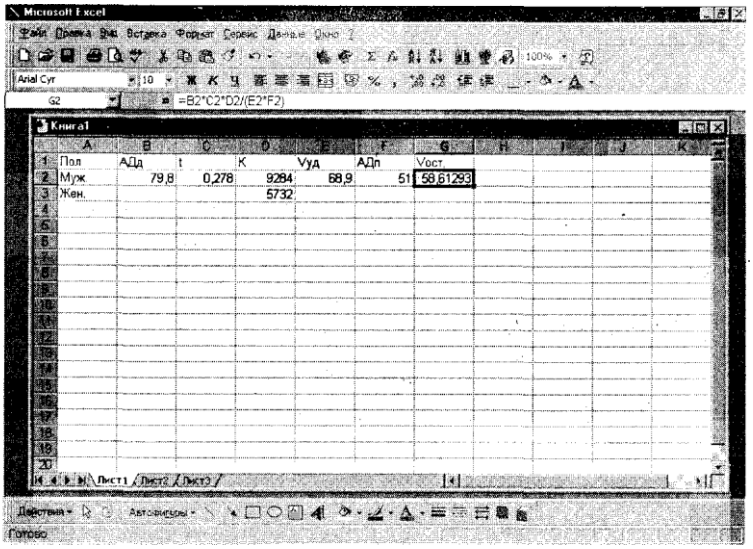


Fig. 4. Entering the formula for calculating the residual heart volume.

4. Delete the previous values from cells **B2**, **C2**, **D2**, **E2**, **F2** and enter the new values from Table 2 for Patient **B**. End each digit by pressing the **Enter** key. In cell **G2**, the new automatically calculated value of the residual heart volume in patient **B** will appear. Rewrite the indicator in a notebook and perform similar actions with the indicators of patient **C**. However, given that the gender of patient **C**. is female, enter the corresponding values in cells **B3**, **C3**, **D3**, **E3**, **F3**. Enter the appropriate formula in cell **G3** and press "**Enter**".
5. Next, calculate the end-diastolic volume of the heart and evaluate the diastolic function of the left ventricle. To do this, in cells **H1** and **I1**, enter the abbreviations **EDV** and **DF**. In cell **H2**, enter the formula = **E2** + **G2** (the sum of the stroke and residual heart volumes). Press Enter. In cell **G2** enter the formula = **G2** / **H2** * 100 (**V_R** / **EDV** (%)), press "**Enter**". Rewrite in a notebook the values of the end-diastolic volume of the heart and the indicator characterizing the diastolic function of the left ventricle (normally 40%). Assess left ventricular diastolic function in patients.

26. Investigation of systemic hemodynamic parameters in healthy people, patients with borderline arterial hypertension and patients with stage I hypertension. (PC-4)

To determine the most important parameter of systemic hemodynamics of mean dynamic arterial pressure, it is possible to use an improved model of V.A.Lishchuk. The final expression of the model of the indicated indicators of the circulatory system has the form:

$$\mathbf{APa} = SBV*TPR(Vv\beta + TPR*Va)^{-1}$$

where **APa** - average arterial pressure, **SBV** - strained blood volume, **1 / β** - pumping coefficient of the heart, **Vv** - elasticity of venous vessels, **Va** - elasticity of arterial vessels, **TPR** - total peripheral resistance.

The pumping coefficient of the heart is defined as the ratio of blood flow to central venous pressure. The elasticity of arterial vessels can be calculated as the ratio of the stroke volume of the heart to the value of the pulse pressure.

Perform the following sequence of actions:

1. Run Excel (**Start → Programs → Microsoft Excel**).

Fill in the spreadsheet: in cells **Al**, **B1**, **Cl**, **Dl**, **E1**, enter the abbreviations **SBV**, **Vvβ**, **TPR**, **Va**, **APa**. Next, in cells **A2**, **B2**, **C2**, **D2**, enter the corresponding values of the hemodynamic parameters of patients from Table 3.

3. In cell **E2**, enter the formula **= A2 * C2 * / (B2 + (C2 * D2))**, using the arithmetic operators of multiplication, division and addition - *, / and +. For the correct sequence of actions in the denominator, use parentheses. Press **Enter**. Enter the automatically calculated mean arterial pressure in a notebook.
4. Delete the previous indicators from cells A2, B2, C2, D2 and enter new values from table 3. Finish the entry of each digit by pressing the "**Enter**" key. A new automatically calculated blood pressure value will appear in cell E2. Rewrite the indicators in a notebook and compare the mean blood pressure values in sick and healthy people.

Table 3

Input parameters for calculating average *arterial pressure (APa) in healthy people, patients with borderline arterial hypertension (BAH) and patients with hypertensive disease (HD) stage I*

Groups	***SBV***, ml	***Vvβ***, unit	***TPR***, dyn·s·cm^{-5}/m^2	***Va***, ml/mmHg/m^2	***APa***
Healthy	79	8,7	1621	1,5	
	75	8,8	1670	1,6	
BAH	74	9,4	1867	1,1	
	70	10,6	2154	1,12	
	71	9,9	1989	1,15	
HD	81	9,73	2170	0,6	
	80	10,9	2487	0,7	
	65	8,66	1919	0,5	
	74	10,3	2223	0,7	

Section 2.

Codes of controlled competencies: GPC-1, GPC-6, PC-4, PC-20.

Option 1
1. Import the file Module_1 .xls
2. Describe the study group by gender and height
3. Compare the groups with and without anemia in terms of RBC and the presence of clinical manifestations, give an interpretation of the results.
4. Check the effect of lek. No. 1 by the value of Hb.

Option 2
1. Import the file of ModulD.xls.
2. Describe the study group by Hoi level and weight
3. Compare the groups of patients with clinical manifestations of anemia and without manifestations in terms of blood Fe and SBP grade, give an interpretation of the results.
4. Check the effect of therapy on the Renin value.

Option 3
1. Import the file of ModulD.xls.
2. Describe the group of subjects under study in terms of BMI and Glu.
3. Compare groups with different BMI by weight and cholesterol level (FactHOL), give interpretation of results.
4. Check the effect lek. No. 2 by the value of Hb.

Option 4
1. Import the file of ModulD.xls.
2. Describe the group of subjects under study according to the degree of SBP and the value of FM (mass of fat tissue).
3. Compare groups with different levels of the FactSilIND for weight and glucose (Fact GLU) and interpret the results.
4. Check the effect of therapy on the value of Angiotensin.

Option 5
1. Import the ModulD.xls file.
2. Describe the group of subjects under study in terms of height and Strength Index.
3. Compare groups with different degrees of blood Fe content in terms of RBC and the presence of clinical manifestations, give an interpretation of the results.
4. Check the effect of therapy on the value of Aldosterone.

Option 6
1. What are the main tasks of statistical analysis of biomedical data
2. What does the concept of "representativeness" of the sample mean?
3. What methods are used to check the type of distribution for normality?

Option 7
1. What is the "General population". Give an example.
2. What is "Statistical hypothesis".
3. How the interpretation of the correlation coefficient obtained in the calculations is carried out?

Option 8
1. What is "Distribution Histogram".

2. List the measures of the central trend in statistics.
3. What is the measure of the statistical connectivity of two normally distributed features?

Option 9

1. What types of quantitative traits are customarily identified? Give examples?
2. What is the sum of all the frequencies of occurrence of individual characters.
3. What is the median and what is the principle of finding it?

Option 10

1. For the solution of what problems in medicine transverse scientific medical research is usually used?
2. What characteristics of the sample are measures of data dispersion.
3. What is commonly called the null hypothesis in statistics?

Option 11

1. What problems in medicine are usually used for longitudinal scientific medical research?
2. What is the level of statistical significance?
3. What criterion should be used to compare two groups of patients, one of which was treated traditionally, and in the other, traditional treatment was supplemented by a new methodology proposed to improve treatment results (both samples obey a normal distribution)?

Option 12

1. What criterion should be used to assess the effect of treatment procedures on the physiological state of patients in the case when the distribution of signs is different from normal?
2. What parameters are used to describe the normal distribution?
3. What is the type 1 error in statistical data processing.

Option 13

1. What is a Statistical Test?
2. What is commonly called an alternative hypothesis in statistics?
3. What does the level of "significance $\alpha = 0.05$" mean?

Option 14

1. What is the point of specifying the 1st and 3rd quartiles?
2. What signs in statistics are considered to be independent?
3. Indicate the basic properties of the normal distribution
4. To what level in the modern IIA classification is it accepted to refer.

Option 15

1. What types of structures of scientific and medical research are usually distinguished
2. How is an informed choice of a statistical method made?
3. What types of qualitative features are customarily identified? Give examples.

C. Evaluation tools for intermediate control

Competency code	Evaluation material
GPC-1	1. The concept of general informatics. Components of computer science. 2. What is medical informatics. What is the object and subject of its study. 3. The concept of information. Types of medical information. 4. Technical support of the information system. 5. What are "system" and "information system"? Structure of Information system. 6. What subsystems form the information system support. Give a brief description of them. 7. Medical information is an object of processing on a computer. Binary number system. Information code. 8. Probabilistic determination of information. Amount of information, information units.
GPC-1	9. Entering, editing, formatting data and calculations in MS Excel. Data entry automation. Using complex formulas and standard functions. 10. The main stages of solving problems on a computer 11. Algorithm. Types of algorithms. Methods for describing algorithms. The concept of a diagnostic algorithm. 12. Concepts about algorithms for linear, branching and cyclic structures. 13. Programming system. Programming languages. Translators and their varieties. 14. Operators of the BASIC language for organizing loops, conditional and unconditional jumps. 15. A numerical sequence a_1, a_2, a_3, ..., a_{35} is given. draw up an algorithm and a program for calculating: a) the sum of the elements of this numerical sequence; b) the product of the elements of this numerical sequence; c) sums or products at any step of the cycle. 16. Create an algorithm and a program for calculating the value of y: $y = x^2 + 5x + 6$ if $x > 0$; $y = x^2 - 5x + 6$ if $x < 0$; $y = 6$ if $x = 0$. 17. Model including intravenous or intra-arterial infusion. 18. Software (computer) modeling.
GPC-1	19. Basic configuration of a personal computer. 20. List the main devices of the basic configuration of a personal computer and indicate their purpose 21. Purpose of the processor. Characteristics of the main parameters of the processor. 22. Types of computer memory and their characteristics 23. Internal, external computer memory and means of their implementation. Cache memory. Characteristics of random access and permanent memory. 24. Storage devices. 25. Data exchange devices. 26. Peripheral devices and their purpose. 27. Data output devices. 28. Data input devices. 29. The concept of computer software. Types of software.

	30. System software. System programs. The composition of system programs and their purpose. 31. Operating system (general information). Operating system functions. 32. File system. Types and attributes of files. File structure. 33. Operating system MS Windows, its main objects and controls. 34. Requirements for Windows to computer hardware. 35. The main features of Windows. 36. List the applied software and indicate their purpose. 37. Objects and controls MS Windows. 38. Context menu and its features. 39. Operations with file structure. 40. Word processors and editors, their similarities and differences. 41. List the main elements of the Microsoft WORD screen and describe the menu bar options. 42. Spreadsheets, their features and basic concepts. Areas of use. 43. MS Excel program and its versions. 44. Types of ensuring the functioning of AWP. Workstation technical support. 45. Special software AWP.
PC-4	46. Features and general principles of statistical analysis of medical research data 47. The structure and main options for medical research. 48. The concept of transverse and longitudinal medical research. 49. Prospective and retrospective medical research.
GPC-1 GPC-7	50. Expert systems. Main areas of their application and main components. 51. Assessment of the diagnostic effectiveness of the test. 52. Medical information systems and their varieties. 53. Medical information systems of the basic level. 54. Diagnosis from the point of view of cybernetics. The main stages in the development of medical diagnostics. 55. General requirements for workstation of various specialties and doctors - hospital specialists. 56. Basic requirements for a computer history of the disease. 57. Describe the basic structure of a computerized medical history and the principles of information entry. 58. Information and reference and consultative diagnostic systems. 59. Special hardware. Electrodes and sensors. Analog-to-digital converters (ADC) and their characteristics. 60. Computer diagnostics and its features 61. The main types of medical logic in computer diagnostics of diseases. Phase interval logic. 62. Deterministic logic. 63. The method of probabilistic diagnostics. Conditional and prior probabilities. Bayes' formula. 64. Make a program according to the following algorithm for the differential diagnosis of diseases (the algorithm is attached).
PC-4	65. The concept of an automated workplace (AWP) of a doctor. Categories of AWPs in medicine and healthcare. 66. Database management system. Basic concepts of FoxPro DBMS. 67. Types and characteristics of FoxPro database fields. 68. Window for editing and editing the database.

	69. Possibilities of database management systems in the construction of information systems.
GPC-1	70. Medical instrument-computer systems and their classification. 71. Principles of construction of medical instrument-computer systems. 72. Hardware of the medical instrument-computer system. 73. Software for medical instrument-computer systems. 74. Types of medical images. Block diagram of obtaining a matrix image. 75. What is an image pixel and how it is formed in the memory of the display process. 76. Stages of computer image processing. 77. The concept of the Internet. Dedicated and switched communication lines. 78. The concept of a network operating system (SOS). Protocol. 79. Internet information services most important for AWP. 80. Local area networks (LAN). Peer-to-peer LANs. Network hardware. 81. Concepts about the network adapter, file server and modem. 82. Concepts about the bridge, router and gateway. 83. Communication channels, their types and characteristics. 84. Case history as an element of the management system.

10. MATERIAL AND TECHNICAL SUPPORT OF THE EDUCATIONAL DISCIPLINE

Lectures:

- multimedia projector;
- notebook;
- set of electronic presentations / slides.

Laboratory exercises:

- a set of demonstration tables and posters;
- computer classes with installed software for testing.

11. METHODOLOGICAL RECOMMENDATIONS FOR THE ORGANIZATION OF THE TRAINING DISCIPLINE

Training consists of classroom lessons (48 hours), and independent work (24 hours). In the discipline, it is advisable to use the following educational technologies.

Lecture course: giving lectures accompanied by video materials (posters, presentations, demo versions of medical information systems)

Practical lessons: designed for individual work of students with a computer, provides for solving situational problems using standard software, operating medical information systems (computer simulations of the medical and diagnostic process).

In accordance with the requirements of the Federal State Educational Standard of Higher Education 3+, active and interactive forms of conducting classes are widely used in the educational process. The proportion of classes conducted in interactive forms is at least 10% of classroom lessons.

Independent work of students implies preparation for practical training.

The educational activity of students, including independent work with literature and specialized software products, contributes to mastering the culture of thinking, the ability to logically correctly formulate its results in written and oral speech; readiness to form a systematic approach and analysis of medical information, the perception of innovations; forms the ability and readiness for self-improvement, self-realization, personal and objective reflection.

For each section of the discipline, guidelines for students and guidelines for teachers have been developed.

During the study of the academic discipline, students independently carry out work, make presentations and submit electronic reports.

The student's work in a group forms a sense of teamwork and sociability.

The initial level of students is determined by testing, the current control of the mastery of the subject is determined by oral or written questioning in the course of classes, when solving typical situational tasks and answering test tasks.

At the end of the study of the academic discipline, intermediate control of knowledge is carried out using computer test control, by practically checking.