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PUBLIC HEALTH (MEDICAL STATISTICS)

Study Guide

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Public health (medical statistics)

Study Guide

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Abstract. This textbook enables students to assimilate social and hygienic methods of population health research, planning, data collection, calculations and scientific analysis of statistical research in medical institutions. An additional advantage of the guide is that for each topic, it includes: a structured lesson plan for practical exercises, interactive methods using new pedagogical technologies, educational programs and situational tasks-solving exercises. The topics are organized in a systematic order to help teachers conduct lessons effectively while maintaining a positive approach to teaching.

INTRODUCTION

Healthcare workers, under the leadership of the Ministry of Health of our Republic, are tirelessly working to further improve the health of the population, reduce the incidence of diseases and mortality, promote a healthy lifestyle, and raise the sanitary culture and medical awareness of the people. In this regard, every future doctor and healthcare professional currently working in practice must be able to study and analyze the health status of the population and apply the obtained results in real life. Studying public health is the main task of medical statistics. At present, there is no field of medicine where medical-statistical research methods are not applied. In order to carry out health-improving activities among the population, reduce diseases and mortality, and further strengthen public health, doctors and healthcare organizers study the health of the population in connection with the environmental, socio-economic, socio-hygienic, labor, and living conditions that directly or indirectly affect it.

In clinical and experimental scientific research, sanitary statistics reveal the essence and internal patterns of the studied phenomena. Therefore, not only scientific researchers working in clinics, experimental laboratories, and research centers, but also all doctors should be able to apply sanitary-statistical research methods and, with their help, draw the necessary conclusions.

Evidence-Based Medicine and Statistics

In the past century, great achievements have been made in medicine and public health: overall mortality and child mortality rates have decreased, life expectancy has increased, many diseases now have effective treatment methods, and preventive medicine is increasingly becoming the main focus. According to the calculations of some scientists, the enormous sums of money spent on performing angioplasty lead to an increase in life expectancy of only about 1%. This raises a fair question within society: “How is our money being spent?”, “How effective is it?”, and “What will be the most reasonable focus for funding in the future?” To justify further spending on healthcare, it is necessary to answer these questions. At a time when newspapers, magazines, the internet, and television companies are paying great attention to healthcare, such questions should not be answered superficially, but supported by scientific evidence.

Today, the healthcare system is responsible for producing medicines and delivering them to consumers. Pharmaceutical companies are investing huge sums in manufacturing medicines and introducing new ones into practice. They strive to gain the maximum benefit from drugs intended for health, as well as from other medications they produce. Marketing specialists present medicines as the most effective and beneficial products in the world, using various new technologies and psychological influence techniques. In such circumstances, doctors and patients have become targets of advertising campaigns. Therefore, they must choose the most effective and affordable medicines among the many available (with similar

active ingredients), and to do so, they must rely solely on scientific evidence.

Any practicing physician who approaches their work with responsibility constantly asks themselves: “Did I make the correct diagnosis? Did I recommend the proper treatment? Did I do everything possible to treat the patient?” Similar questions also trouble the patient, but it is not always easy to give a clear answer. Of course, in straightforward cases, the result is immediately obvious: for example, bleeding is stopped by applying a bandage. However, not everything is always solved so easily.

Often, even if the effectiveness of the treatment satisfies both the doctor and the patient, doubts still remain: “What consequences might the treatment results lead to? Will there be any complications? How long will the achieved result last?” Where and how can one find answers to such questions?

Every physician has a certain level of knowledge, personal opinions, and experience regarding specific situations, but at the same time, they may remain under the influence of someone else’s opinion or a particular “school of thought,” even though they possess independent reasoning. All of this shapes the doctor’s clinical thinking, and diagnosis becomes a subjective process that depends on the physician’s personality. However, relying solely on one’s own experience can limit the quality of patient care. Thus, in practice, the diagnostic process is not always accurate.

There are many clinical situations in which no single doctor has sufficient experience. It is well known that the knowledge acquired during training gradually declines over time, and postgraduate education systems are often ineffective. Even expert opinions are not always correct. For example, when four cardiologists were shown a high-quality angiogram and asked to evaluate it, the opinions of three of them…Their opinions differed from one another. This means that for a doctor to make an accurate diagnosis and treat a patient effectively, they must have access to objective information. In the current era of scientific and technological revolution, the amount of available information is enormous. Today, more than 4 million scientific articles and over 40,000 biology- and medicine-related journals are published annually. If a doctor were to devote their time to reading all of these, there would be no time left for actual patient care.

Therefore, it is not reasonable to expect a doctor to independently search for, compile, and evaluate all this information. This problem could be addressed by bibliographic databases, which allow quick access to necessary data through the internet. However, first, not all doctors in Uzbekistan have computers, and not all of them know how to use computer technology, especially the internet. Those who do often do not know foreign languages. Most of the information available online is in foreign (primarily English) languages. Second, information provided on the internet does not undergo expert review, which means no one can guarantee the

reliability of the published content.

The information in printed manuals and bulletins is also not always reliable or up to date, as it is typically published only after being implemented in practice and its effectiveness confirmed by specialists—a process that may take 5–10 years. As a result, by the time textbooks, manuals, and bulletins are published, their content may already be outdated. All of the above factors hinder doctors from making timely and accurate diagnoses and conducting effective treatment.

In the present day, mass media pays great attention to health issues, treatment, and disease prevention. Consequently, patients now often come to a doctor with some knowledge about diagnosis and treatment, having formed their own opinion on diseases and treatment strategies. In addition, by respecting patients' rights, the doctor must obtain the patient's consent for treatment. In other words, the doctor is obliged to provide the patient with information about their disease, allow the patient to critically evaluate the proposed treatment strategy, and receive their consent before proceeding.

Is every doctor always ready for this? Do they have information about all the new treatment methods and medicines that the patient may have learned about from the literature? There may be situations where a patient, being more interested in their illness and having read the latest publications, knows more about the condition than the doctor. In the past, doctors and healthcare workers were the main source of information for patients and their families.Today, however, it is different — now practicing physicians and healthcare administrators need timely, complete, modern, and critically evaluated.

There is now a great need for timely, complete, modern, and critically evaluated information among practicing physicians and healthcare administrators. For this reason, by the end of the last century, many advanced doctors realized that, in order to achieve successful diagnosis and treatment, they needed concise, clear, and objective information on the results of the best clinical studies—those that demonstrated the effectiveness of various treatments and medicines being used worldwide—based on reliable data.

Practicing physicians and healthcare administrators must be able to answer the following questions: "Which research findings can be trusted? Which results can be applied in practice?" All of this laid the foundation for the emergence of the science of evidence-based medicine.

For the first time, in 1990, McMaster University proposed the idea of using the best available scientific research results, clinical experience, and consideration of the patient's individual characteristics together. They suggested calling this scientific-practical approach Evidence-Based Medicine (abbreviated EBM). This term quickly entered the English language and gained popularity. We suggest using the term "Далилларга асосланган тиббиёт" ("Evidence-Based Medicine") in

Uzbek.

Today, scientists define “Evidence-Based Medicine” in different ways, for example:

Conscientious, logical, and reasonable use of the most reliable clinical research results, combined with personal experience, while taking into account the patient’s wishes, to solve their medical problem.

Conscientious, accurate, and thoughtful use of the most reliable clinical research results to choose the best diagnostic and treatment methods for a specific patient.

Guaranteeing the most effective, safe, and cost-efficient diagnostic and treatment methods based on the most reliable clinical research data.

A technology for searching, analyzing, and synthesizing medical information to aid in making optimal clinical decisions.

A set of evolutionary principles for strategies and tactics in diagnosis and treatment.

A systematic and consistent method of research to apply the best existing treatment and prevention methods while taking into account the individual characteristics of the patient.

An information technology for selecting the optimal options in medical practice.

Conducting scientific research using the most advanced statistical methods to obtain reliable data for developing effective public health improvement measures.

Although the above definitions differ from each other, their essence is the same: to complement the physician’s skills, reputable experts, and textbooks with the most effective, safe, economical, reliable, and modern diagnostic and treatment methods, while enabling the doctor to make an optimal decision independently.

Naturally, another question arises: is evidence-based medicine something new, or is it simply “giving an old cap a new shine”? It is well known that in any scientific research, the results must always be implemented in practice, proving that the new method is more effective than the old one. This question cannot be answered in a single, definitive way. According to some scientists, the answer could be both yes and no, because applying evidence-based research results to practice requires a different approach.

Its proponents ask: On what facts do we base the claim that this medicine is better than another? Why should we use exactly this drug and not a different one? In general, it advises doctors to analyze the proposed medicines, treatments, and interventions critically, based on data, before applying the results of scientific research in practice.

As proof, let us consider one example. In Russia, two diagnoses are frequently given to newborns: perinatal encephalopathy and intracranial hypertension. In contrast, in the United States, these diagnoses are made only in rare cases—such as when there is severe brain injury or a brain tumor. The criteria for making these diagnoses in the U.S. and Russia are not the same, nor are the instrumental

examinations used.

According to U.S. researchers, most newborns in Russia diagnosed with perinatal encephalopathy or intracranial hypertension are actually perfectly healthy. Nevertheless, they are subjected to long-term treatment courses over many years with various medications, which negatively affect their health. The researchers who published this study noted that patients with such diagnoses often feel perfectly well even if they do not take the prescribed medications.

So, are these medicines helping children, or are they harmful? Where do we find the answer to this question? Evidence-based medicine is also needed to answer this.

This now leads to the following question: by using the methods of evidence-based medicine, can a doctor independently reach the correct conclusion? The answer is, of course, no.

Therefore, there must be some organization capable of solving this difficult task. Such an organization already exists today.

In 1972, British epidemiologist Archie Cochrane drew attention to the fact that society was unable to determine the true effectiveness of treatment interventions. Unfortunately, at that time, no system had been created to compile all available high-quality randomized clinical trial results across all sciences and specialties and to update them regularly

Randomization refers to the process in clinical trials of assigning patients to treatment groups by chance, with the aim of reducing uncertainty and errors and increasing reliability. Thus, randomized trials are studies in which patients are assigned to treatment groups on the basis of randomization.

Archie Cochrane proposed the establishment of a medical review center based on the systematic collection of materials, analysis of results, and their regular updating. For this purpose, in 1992, such a center was established in Oxford and named after Cochrane. In the same year, J. Chalmers founded the Cochrane Collaboration (Association), which today has more than 3,000 members. The association operates through networks linking centers in different countries. The aim of the association is to prepare systematic reviews based on a comprehensive register of all randomized clinical trials.

A systematic review (a Cochrane systematic review, or simply a Cochrane Review) is a study conducted according to pre-planned methods, in which the object of study is the results of a series of original studies. Using methods that reduce systematic errors, these reviews synthesize the results obtained from the studies. Such methods allow researchers to select articles based on criteria that increase the accuracy of analysis and review of publications addressing a specific research question.

If the results of original scientific studies are examined and analyzed but not

statistically combined, such a review is called a systematic qualitative review. When the results of original scientific studies are processed using statistical methods and combined, the review is called a systematic quantitative review.

Systematic reviews resemble reviews found in medical journals or dissertations. While traditional reviews cover various issues, systematic reviews focus not on the structure of topics as presented in textbook chapters, but on answering a narrow clinical question concerning the effectiveness of clinical interventions. Nevertheless, both types of reviews are important: a literature review helps to explore a topic relevant to a given problem, whereas a systematic review provides a clear, concise answer to a specific, well-defined question.

In addition to statistical reviews, the Cochrane Collaboration worldwide compiles an abstract database based on the results of published randomized controlled clinical trials that have been conducted in accordance with modern quality standards, are proven, reliable, and evidence-based.

In this way, a secondary information product is created from "filtered" studies, freeing the physician from the need to search for numerous articles and critically evaluate each one individually.

How systematic reviews are structured

*Like any scientific research, compiling a review is carried out in several stages:

*Defining the main purpose of the review;

*Determining the methods for evaluating the results;

*Systematically searching for information;

*Collecting quantitative data;

*Summarizing proven data using alternative statistical methods;

*Analyzing (interpreting) and explaining the results, while writing specific reports for each stage in accordance with certain rules and methods.

The purpose of a systematic review must be clear and concise. It organizes a problem faced by a physician into a specific framework. In general, the purpose can be classified into four categories: diagnosis, treatment, etiology, and outcome.

Determining the methods for evaluating results is considered the most challenging stage of the review. Before searching for relevant articles, the researcher must decide which methods will be used for evaluation and which evaluation method is considered optimal, since it is necessary to develop standard criteria that will allow for a methodological assessment of the quality of the study and the creation of an objective review.

The methods for evaluating results depend on the aim of the study. For example, in determining the effectiveness of treatment for chronic and recurrent diseases, the quality-of-life assessment method for patients may be used, while for acute diseases — objective symptoms (e.g., ulcer size), subjective symptoms (e.g., itching, pain, etc.), the patient's general condition, and other indicators are

considered.

Usually, the obtained results can be compared against the “gold standard.” The “gold standard” is represented by the results of representative, sufficiently large-scale studies conducted with a good design.

If the results of several studies conducted according to the “gold standard” are analyzed and a meta-analysis is performed, its results will be reliable and allow for accurate assessment. However, even when a study is conducted using the “gold standard,” its evaluation requires a very thorough approach, since there is no universal “gold standard” — it may apply only to a specific phenomenon.

The stage of systematic information retrieval begins with searching for “gold standards.” Collecting information requires experience, and without skills in a systematic search approach, many important studies may be overlooked. If a computer database is poorly indexed, no matter how carefully searches are conducted on the computer, it is not always possible to find the necessary information. Therefore, in addition to data obtained from computers, it is necessary to regularly monitor published studies and include those found manually (for which there is no electronic database).

Filtering published studies – the methods used in published articles and the results of conducted research do not always allow for qualitative comparative assessment. For example, when studying the effectiveness of Cavinton (vinpocetine) in children with intracranial hypertension, 900 articles were found, of which only 2 met the methodological requirements, and even in those, it was noted that Cavinton did not provide the expected effect in newborns with intracranial hypertension.

Abstracting information. “Filtered” information should be presented in the form of a systematic abstract (i.e., standardized): the purpose of the study, the type of research, the classification of the clinical base, patient recruitment, types of treatment, criteria for evaluating results, main findings (preferably in tabular form), and conclusions. At this stage, standardization is widely used to adhere to the well-known principle that everything

should be studied through comparison under similar conditions.

At this stage, from the abstracts, a systematic review is prepared — the main product of evidence-based medicine centers on the given topic.

Synthesizing proven data. The synthesis stage begins with a critical evaluation of the compared studies. Since some published articles cannot be compared, the reliability of their information may be questionable. For this reason, they may not pass this stage.

To demonstrate reliability, a method of quantitative synthesis — meta-analysis — is used, where results are presented in numerical or graphical form using special statistical techniques.

Meta-analysis is a methodology for synthesizing studies on the same topic,

performed by different authors in different ways, to increase the qualitative reliability of the assessment of their various results. The essence of meta-analysis is simple: as the number of observations in studies increases, the confidence interval narrows, the reliability of the results increases, and the possibility of making the right decision improves. In doing so, it is important to ensure that the compared numbers are statistically homogeneous; meta-analysis has specific evaluation criteria for this. There are several types of meta-analysis: simple, cumulative, prospective, etc.

However, in many cases, it is difficult to assess the external and internal validity of studies. In such cases, only the most reliable available materials are used. The methods for statistical grouping and synthesis of data are diverse, and the choice of method depends on the nature of the information available to the researcher.

Analyzing and interpreting results. The systematically reviewed and proven data are generalized, simplified for reading, and distributed to physicians. This is not always an easy process. To apply the results of the collected materials, rather complex statistical methods are used — for example, OR (Odds Ratio – the ratio of outcomes between different patient groups under study), NTT (Number Needed to Treat – the number of patients in the experimental group needed to achieve a positive outcome), etc. Calculating these requires special techniques. Therefore, to present the obtained results clearly and illustratively, graphical representations are used, with explanations and annotations provided underneath.

In recent years, in the practical work of physicians, clinical protocols for patient management have been developed using the achievements of evidence-based medicine. These protocols serve as specific clinical algorithms for physicians in the prevention, diagnosis, treatment, and rehabilitation of patients with various diseases. Thus, the main purpose of patient management protocols is to apply scientifically grounded, proven, safe,and effective diagnostic and therapeutic methods to patients.

It should also be emphasized that every physician is considered a researcher in their workplace. Many of them complete master’s programs and engage in scientific work, applying the results of their research in practice. To do this, a physician as a scientific investigator must ensure the reliability of the results of their work. To obtain reliably proven data and to organize research work properly in general, every researcher must conduct studies in accordance with the principles of evidence-based medicine and apply modern statistical methods. Therefore, the foundation of evidence-based medicine is medical (biological) statistics. One of the key aspects of applying evidence-based medicine in practice is the ability to use modern statistical techniques.

Today, the negative trends in public health are directly related to the deterioration of living conditions and lifestyle. By “living conditions” is meant the objective aspect

of human life activity, while “lifestyle” refers to the subjective aspect of life activity. The sum of the objects, phenomena, and environmental factors (both natural and artificial) that determine living conditions is called the human living environment. In strengthening public health, these very concepts must be the main focus of efforts.

According to the WHO concept, health promotion is the process of creating conditions to improve health and to increase the ability of individuals and society to exercise control over the factors affecting it.

Thus, health promotion is a process that enables people to improve and control their own health.

The main principles of health promotion include: the commitment of decision-makers, intersectoral cooperation, and ensuring the participation of the population in local associations based on the principle of “not only for people, but together with people.” Therefore, in strengthening public health, it is essential for the population to maintain a positive attitude toward their own health.

A positive attitude toward health is a relatively stable position that implies a person’s readiness to eliminate harmful habits and to take a serious view of their lifestyle and health. The motivation for the need to shape health refers to an individual’s interest in actions aimed at restoring, maintaining, and strengthening their health.

Health protection is understood as a system of measures aimed at safeguarding and preserving public health and preventing diseases. Disease prevention is a system of medical and non-medical measures aimed at preventing the development of diseases, reducing adverse consequences, and avoiding illness. Preventive measures carried out by healthcare institutions are referred to as medical prevention. Medical prevention can be individual, group, or general.

*Individual prevention – preventive measures carried out with a single person individually.

*Group prevention – preventive measures carried out with people who share the same risk factors or are predisposed to certain diseases.

*General prevention – preventive measures covering large groups of the population or the entire society.

In addition, there are primary, secondary, and tertiary prevention (rehabilitation – restoration of health).

Primary prevention is a set of general medical and non-medical measures aimed at preventing diseases, carried out for the entire population, social groups, specific territories, age categories, professions, and similar groups.

Primary prevention includes several components:

*Measures to reduce harmful factors affecting the human body (improving air quality, drinking water, nutrition, work conditions, rest, etc.);

*Formation of a healthy lifestyle;
*Measures to reduce and prevent mental illnesses, injuries, accidents, traffic incidents, disability, and mortality;
*Early detection and reduction of harmful health factors during preventive medical examinations;
*Immunoprophylaxis among various population groups;
Rehabilitation and provision of medical and non-medical assistance to populations exposed to harmful environmental factors.

Thus, one of the key components of primary prevention is the formation of a healthy lifestyle.

A healthy lifestyle encompasses a set of behaviors aimed at achieving life goals, strengthening health, and preventing its deterioration. Therefore, a healthy lifestyle is the activity of people aimed at maintaining and improving their health.

The formation of a healthy lifestyle involves:
*Creating a permanent system of health promotion and education aimed at regularly increasing public awareness about harmful environmental factors and ways to reduce their impact;
*Public health education from a sanitary-hygienic perspective;
*Reducing the prevalence of tobacco use and smoking, decreasing alcohol consumption, and preventing the use of narcotic substances;
*Encouraging public involvement in physical exercise, sports, and tourism, and increasing the popularity of health-promoting activities;
To form a healthy lifestyle, it is necessary to increase public knowledge and understanding of hygiene, sanitary, and hygienic standards and rules. To achieve these goals, the following activities should be carried out:
*Providing medical and hygienic information on healthy lifestyle formation to all social groups of the population;
*Encouraging the activities of state and public organizations engaged in healthy lifestyle promotion;
*Involving all healthcare workers in sanitary education and awareness activities.
The main directions of healthy lifestyle promotion include the points listed above.

1.Factors for promoting health preservation:
-Occupational hygiene
-Safe sexual relations
-Rational nutrition
-Personal hygiene
-Rest hygiene
-Optimal physical activity regimen
-Physical education and sports

-Proper management of stress and overexertion
-Body hardening
-Hygiene of marital relations and family planning
-Psychohygiene
-Medical and social activity
-Environmental hygiene
-Harmful factors affecting health

Hygienic education and training of the population should be carried out and taught in preschool and other educational institutions. During the training, retraining, and professional development of workers, hygienic knowledge should be included in their educational curriculum.

Among the complex indicators of an individual's lifestyle are: nature of life, standard of living, style of life, and quality of life.

Lifestyle – the way of life of a community, traditions, national culture, and living habits.

Lifestyle is a set of human behaviors and activities formed in the process of historical development. Traditions formed on the basis of specific historical processes are repeated over time. In turn, these create habitual actions that become needs.

Standard of living refers to nutrition, education, employment, working conditions, housing conditions, social security, rest, clothing, leisure activities, and legal rights. These quantitative indicators are not the final goal but rather an instrument for creating good living conditions.

Style of life – the psychological and individual characteristics of behavior and manners.

2.Secondary prevention

Secondary prevention is a set of medical, social, psychological, and other measures aimed at preventing complications of diseases, their progression to chronic conditions, and the decline of work capacity.

Secondary prevention includes:

-Educating patients and their family members about specific diagnosed diseases or disease groups, improving their knowledge and skills, and providing sanitary-hygienic education;
-Assessing health status in dynamics, conducting various rehabilitation, treatment activities, and preventive medical examinations to prevent disease progression;
-Carrying out treatment, prevention, and targeted rehabilitation measures, including dietary therapy, therapeutic physical training, medical massage, and rehabilitation in sanatorium-resort settings;
-Adapting to health changes, developing appropriate medical-psychological adjustment, and forming a proper attitude toward the needs and capabilities of the body;

Implementing state medical, social, and economic measures aimed at reducing the impact of harmful factors, creating conditions for optimal life activities for patients and persons with disabilities, and adapting them to the social environment (e.g., production of dietary food products, architectural and planning adaptations, creating conditions for people with limited functional abilities).

3.Tertiary prevention (rehabilitation)

Tertiary prevention, or rehabilitation, includes a complex of medical, psychological, pedagogical, and social measures aimed at restoring social and professional status, and preventing disability and premature mortality.

At the group and community levels, medical prevention usually includes not only medical measures but also comprehensive programs aimed at strengthening health. If you want, I can now merge this translation with your previous three English sections into a single continuous, well-structured academic document so it reads as one coherent text for your dissertation or educational materials. This will ensure all terminology is consistent and flow is logical.

Preventive programs are a system of activities carried out in this field – a form of complex and goal-oriented measures. These programs generally consist of four main components:

1. Analytical – the initial component of the program cycle, which includes the study of the population's health status, the factors and conditions influencing it, the possibilities for strengthening health, and preventing diseases.
2. Planning – the component that includes selecting priorities, goals, objectives, methods, and means.
3. Implementation – includes hygienic, epidemiological, technical, legal, and political measures when carrying out the preventive program.
4. Evaluation – a dynamic process aimed at determining the effectiveness of the planned measures and results obtained through the above programs.

Evaluation of the program cycle is considered an integral part of managing preventive programs. The components of the program cycle can be applied not only in various areas of healthcare but also in other fields of human activity.

Thus, the implementation of any preventive program concludes with an assessment of its quality and effectiveness.

Quality of medical preventive care

The quality of medical preventive care is a set of characteristics confirming that preventive healthcare meets the level of modern medical science and technology, and satisfies the needs of society and patients.

The quality of medical preventive care is characterized by:

-Adequacy of resources, technologies, and measures used for disease prevention and

health promotion;
-Safety of applied preventive measures;
-Accuracy in implementing medical preventive measures;
-Availability and accessibility of required preventive healthcare services;
-Continuous improvement and convenience of provided preventive care;
-Continuity and consistency in the process of patient rehabilitation and education within the healthcare system;
-Timeliness and effectiveness of preventive measures;
-Meeting the needs of individual patients, specific groups, and the population as a whole;
-Stability of obtained results and processes;
-Efficiency of medical preventive care in achieving a positive medical, social, and economic balance (the ratio of expenses for preventive care to the results obtained).

Current epidemiological trends

At present, in Europe and North America, three-quarters of deaths are caused by cardiovascular diseases, cancers, respiratory diseases, and liver cirrhosis. Considering the aging trend of the population, it is possible to predict an increase in the proportion of these diseases in future mortality statistics. Risk factors related to living environment and lifestyle play a key role in the development of these diseases.

The direct dependence of health on lifestyle has been recognized since ancient times. Before medicine became a professional activity, people observed the influence of living conditions and lifestyle on health. Later, physicians began advising their patients not only on medications but also on how to behave, eat, and rest during illness.

Social and hygienic research necessity

Due to the diversity and complexity of variable social conditions and factors affecting and determining public health, as well as the influence of traditions, behavior, and lifestyle on health indicators – particularly when considering the combined effect of multiple factors – it is necessary to conduct social-hygienic research.

In addition, public health should not be assessed solely by individual indicators or indices, but rather as a complex set of interrelated systems. This requires the use of clinical, psychological, sociological, sanitary-hygienic, mathematical-statistical – in short, complex socio-hygienic and clinico-social research methods.

Such research methods not only make it possible to conduct a comprehensive

analysis of social factors affecting the health of the population and its certain groups, but also allow for the study of the medical and social aspects of an entire lifestyle, the activities of the population and certain social groups, and the wide scope of their engagement. Such studies determine the direct impact of lifestyle on the health of the population.

At present, complex studies in social hygiene—especially those that directly involve observing patients (clinical-social studies)—are revealing correlations between social conditions and the health of the population. However, it should also be noted that, to date, comprehensive social-hygienic studies on lifestyle have been carried out very rarely.

Risk factors are understood as hazardous elements of production, and biological, genetic, environmental, hygienic, and social factors of the environment that are dangerous to health and lead to the occurrence, development, aggravation of diseases, and serious consequences.

According to many public health specialists, risk factors can be divided into four groups (Table 12):

1.Factors related to lifestyle and living conditions (impact on health – 55%);
2.Genetic factors (15%);
3 Environmental factors (20%);
4.Healthcare system factors (10%).

Now, let us consider the risk factors for non-epidemic diseases.

According to data analysis, among the population groups aged 25 to 65 in Europe and North America, the following risk factors are widespread: regular smoking (29–56% of the population); high blood pressure (15–60%); hypercholesterolemia (45–80%); excess body weight (11–38%).

Smoking is considered a risk factor not only for cancer but also for cardiovascular diseases. At present, eliminating smoking is one of the most effective measures for improving public health in both developed and developing countries. In many countries (Finland, Iceland, Southern Ireland, Canada, Uzbekistan, etc.), anti-smoking campaigns have been organized. These contribute to improving public health and reducing the number of smokers.

In 1980, the World Health Organization launched a campaign to combat smoking under the slogan “Smoking or Health…”. Scientific evidence confirms that smoking is harmful to health. Here are some examples. One study conducted in the United States found that among individuals aged 45–54, the average incidence of cardiovascular diseases was 1.4 times higher in those who smoked 20 cigarettes a day compared to non-smokers, and 2 times higher in those who smoked more than 20 cigarettes a day.

There is a clear link between sudden death and smoking. In recent years, the number of women and girls who smoke has been increasing. According to data, 68.4% of girls aged 14–18 in St. Petersburg smoke (either regularly or occasionally). Compared to men, smoking among women not only increases the risk of cardiovascular diseases, cancer, and other illnesses, but also leads to a number of additional problems:

-Smoking adversely affects pregnancy;

-In pregnant women who smoke, fetal growth slows, and newborns weigh on average 200 g less than those born to non-smoking mothers; there is an inverse correlation between birth weight and the number of cigarettes smoked;

-Smoking during pregnancy increases the risk of congenital disorders in newborns;

-Smoking during pregnancy raises perinatal mortality rates;

-Maternal smoking negatively affects the fetus by slowing respiration and accelerating heart rate;

-Smoking mothers are at higher risk of premature birth and spontaneous abortion.

Thus, combating smoking should be given an important place in the prevention of non-communicable diseases. Scientific analyses show that reducing the number of smokers in the population can lead to a 50% success rate in the fight against cardiovascular diseases. If smoking is stopped, after 10 years the risk of developing cardiovascular pathologies becomes equal to that of non-smokers.

According to the WHO, anti-smoking programs should be based on the following:

1. A non-smoker should be considered well-mannered in society and should always be supported;

2. Tobacco advertising should be banned, and its production, export, and import should be restricted.

Nutrition

Proper, rational nutrition and maintaining an energy balance are the foundation for preventing many non-communicable diseases.

What does “rational nutrition” mean?

Rational nutrition refers to a physiologically complete diet, taking into account a person’s sex, age, type of work, and other factors, that promotes an active long life, high physical and mental work capacity, increases resistance to harmful environmental factors, and helps preserve health.

The main principles of rational nutrition are:

-The energy value of the diet;

-The balance of essential components in the diet (proteins, fats, vitamins, carbohydrates, microelements);

-The regimen and conditions of food consumption.

There are distinctions between healthy nutrition, overnutrition, and undernutrition.

Healthy nutrition – in the context of traditions and customs, is scientifically

grounded nutrition for various population groups that meets needs, aids in disease prevention and health promotion, and is based on the consumption of a variety of food products. For an individual, healthy nutrition is considered synonymous with rational nutrition

Overnutrition – systematic excessive consumption of certain foods (e.g., salt, fats, sugars, etc.) or an energy intake in the diet that exceeds physical requirements.

Undernutrition – insufficient or poor-quality intake of nutrients or specific components; the caloric value of the diet does not meet physiological needs.

Excessive nutrition poses a significant risk in the spread of socially important chronic non-communicable diseases. It can lead to cardiovascular, gastrointestinal, respiratory, metabolic, musculoskeletal, and malignant diseases. Data show that consuming more vegetables and fiber and reducing fat intake can help prevent some cancers. Overnutrition contributes to risk factors such as elevated cholesterol levels in the blood, excess body weight, and high salt intake.

High blood cholesterol levels (hypercholesterolemia)

High cholesterol levels in the blood are mainly related to diet, but the genetic characteristics of the body that synthesize cholesterol also play a role. Often, there is a close relationship between blood cholesterol levels and the amount of saturated fats consumed in food. Changes in diet can alter blood cholesterol levels. In economically developed countries, more than 15% of the population has high blood lipid levels, and in some countries, this figure is twice as high.

Cholesterol belongs to the group of fats and is important for the normal functioning of the body; however, an increase in its level in the blood leads to the development of atherosclerosis. It has now been proven that there is a correlation between increased blood cholesterol levels and the risk of developing cardiovascular diseases:

-Experiments on animals have shown that feeding them a diet high in cholesterol leads to the development of atherosclerosis;

-Epidemiological studies of population groups with varying blood cholesterol levels have shown differences in the prevalence of ischemic heart disease (IHD);

-High cholesterol levels are often detected in the blood of patients with IHD;

-In individuals with genetically high blood cholesterol (familial hypercholesterolemia), early development of IHD is observed.

Excess body weight

According to research, in economically developed countries, obesity is observed in 11–38% of the population aged 25–64. Excess fat accumulation (often in the abdominal area) increases the risk factors for cardiovascular diseases, such as elevated blood pressure, lipid metabolism disorders, and insulin-dependent diabetes, among others. It is also established that obesity affects kidney function, respiratory function, menstrual cycles, and may cause osteoarthritis of the limbs,

as well as increase the risk of gout and gallstone disease. Today, obesity has reached epidemic proportions in both developing and developed countries. Almost 50% of the adult population has a body mass index above normal.

Reducing excess body weight and maintaining it within normal limits is difficult but achievable. Weight control requires monitoring the amount and composition of food intake and maintaining physical activity. Maintaining normal body weight depends on balancing calories consumed with calories expended. Physical activity helps burn calories. Weight loss should be gradual and without strict diets, as diet-based weight loss is temporary. Food should be balanced, low in calories, varied, familiar, and enjoyable to eat.

The WHO recommends the following measures for obesity prevention:

-Raising public awareness about the role of low physical activity in weight gain;

-Assessing one's weight accurately;

-Incorporating physical exercises at the workplace, and so on.

Excess salt intake

The link between excessive salt consumption and arterial hypertension was established at the beginning of the last century. Among people who consume up to 3 g of salt per day, no increase in blood pressure with age is observed. If these individuals move to areas where 7–8 g of salt is consumed daily, their blood pressure rises. Currently, in most countries, people consume more salt than physiologically needed. Reducing daily salt intake by 5 g lowers blood pressure. Therefore, for primary prevention of hypertension, the daily salt intake should not exceed 5 g, while the consumption of potassium-rich foods (tomatoes, bananas, grapefruits, oranges, potatoes, etc.) should be increased, since potassium counteracts the blood pressure–raising effects of sodium.

Many countries are paying special attention to these recommendations because they yield significant results. For example, since 1994, most bakeries in Finland have reduced the amount of salt in bread by half (from 1.2 g to 0.7 g per 1 kg of bread). These measures have reduced annual deaths from stroke by 2,000 and from myocardial infarction by 1,600. Healthcare costs have decreased by $100 million per year, and spending on medications by $40 million.

Low physical activity

By the second half of the 20th century, a sedentary lifestyle had become widespread. Today, in economically developed countries, there are fewer jobs requiring physical labor. Urbanization and the development of automation have made people's lifestyles more sedentary, whereas millions of years ago, human survival depended on hunting and gathering. Such activity shaped physiological adaptations and metabolic processes in the body.

In modern society, many people are forced to lead a sedentary lifestyle. Currently, in economically developed countries, every second person leads a sedentary, desk-

bound life, and this proportion is increasing among older adults. A sedentary lifestyle, obesity, and metabolic disorders contribute to the spread of socially significant diseases. Scientific studies have proven that physical activity reduces the incidence of cardiovascular diseases and prevents the development of atherosclerosis.

Taking into account the above, according to the WHO, regular physical activity should be an integral part of lifestyle. The WHO includes components to increase physical activity among children and adolescents in many prevention programs. Some governments, together with national organizations and sports clubs, have developed social marketing programs to promote an active lifestyle. These programs are aimed at changing lifestyles and recommend combining rational nutrition with physical exercise, as this may be effective for the primary prevention of disorders associated with improper nutrition, such as obesity, increased blood pressure, and hypercholesterolemia.

Alcohol and drugs. In many countries, one of the most serious health problems is alcoholism and drug addiction. The acute and chronic diseases that result from excessive alcohol consumption are widely covered. In many countries, over the past 10 years, mortality from liver cirrhosis has increased, and it has been proven that consumption of alcoholic beverages leads to increased blood pressure, even when not consumed in large quantities, and also leads to the development of other social diseases.

The spread of drug addiction is also a major problem for public health. The WHO Regional Office for Europe, in its “Health for All by the Year 2000” project, considers the use of illegal drugs as one of the most important public health issues.

High blood pressure. In economically developed countries, approximately one in five people has high blood pressure, but most hypertensive patients do not control their condition. Doctors of the “American Heart Association” call hypertension the “silent and mysterious killer.” The danger of arterial hypertension lies in the fact that in most people the disease progresses without symptoms, and patients feel like healthy individuals. Doctors even have an expression — “the rule of halves.” This means that only half of hypertensive patients know about their disease, half of them are treated, and only half of those treated receive effective treatment. If blood pressure remains high for a long time, it has a damaging effect on the body’s systems and organs, most notably the heart, brain, kidneys, and eyes. Arterial hypertension is a major factor in the development of ischemic heart disease and increases the risk of death in patients with atherosclerosis. It is generally accepted that the treatment of hypertension should be the main focus in combating the risk factors of cardiovascular diseases (along with fighting smoking, excessive body weight, and controlling blood lipid levels).

Diabetes mellitus. Diabetes mellitus is a risk factor for cardiovascular and other

serious diseases that can lead to disability. Genetic predisposition plays an important role in the development of diabetes.

Therefore, a person with a family history of diabetes should regularly have their blood sugar level checked. People with diabetes should eliminate risk factors for noncommunicable diseases such as obesity and physical inactivity, as this can help make the course of diabetes milder. Quitting smoking, maintaining normal blood pressure, and eating a balanced diet are also important. Proper and timely treatment prevents the progression of the main disease as well as the development of other related conditions. In many countries, special programs have been developed to combat this serious illness.

Psychological factors. In recent years, the role of psychological factors in the development of cardiovascular and other diseases has been increasing. Although these factors are considered significant in the development of major social diseases, the impossibility of accurately quantifying them makes it difficult to prove their specific role in the epidemiology of a particular disease. However, the role of stress, feelings of fear, and fatigue at work in the development of cardiovascular diseases has been proven. An unhealthy work environment, excessive daily workloads, and psycho-emotional strain at work contribute to this problem. Poverty and lack of social protection can also be sources of stress.

Based on research, in the development of cardiovascular diseases, certain behavior types influenced by human conduct have been identified, which are often observed alongside cardiovascular diseases. Without giving a psychological description of their personalities, it can be said that these are generally highly active, hard-working people who bring significant benefit to society. Therefore, in the prevention of cardiovascular diseases, it is not necessary to completely change their lifestyle; instead, they should be encouraged to adopt habits that counteract negative health impacts (regular physical activity, healthy eating, not smoking, controlling blood pressure, etc.). Each of the factors listed above has a significant influence on disease development, but even a slight increase in the number of risk factors considerably raises the likelihood of pathological processes in the body. For this reason, programs covering large segments of the population are currently considered particularly promising preventive strategies.

Medical activity and the formation of a healthy lifestyle.

Medical activity refers to the most typical and characteristic aspects of human activity manifested under specific socio-economic, political conditions, social relations, modes of production in society, and in relation to the health of the individual and the community.

It encompasses the activities of individuals, groups, the general population, and healthcare institutions in providing treatment to the population and carrying out preventive work among the public.

One of its main elements is people's attitude toward their own health and the health of others, and their timely compliance with treatments and recommendations prescribed by doctors and healthcare workers, as well as seeking medical care from treatment and prevention institutions. Such forms of medical activity largely depend on the general cultural level, education, psychological state, living conditions, and other factors of the population.

Medical activity is a new concept (Yu.P. Lisin) and is not limited only to the work of healthcare organizations and institutions. Properly and systematically organized medical examinations, dispensary monitoring, and healthcare visits reflect not only the work of medical institutions but also people's personal involvement and the effectiveness of their own medical activity.

SANITARY–STATISTICAL RESEARCH METHODS

Medical statistics views human health as a product of their social life and studies all phenomena in human activity in connection with their social environment. No process in the human body occurs without the influence of the social environment. This applies not only to indicators directly related to biological and social conditions—such as morbidity, mortality, injuries, disability, and physical development—but also to all bodily reactions that occur under the positive or negative influence of the external environment.

Thus, statistics is a social science, and its main subject is social phenomena. One of the primary tasks of healthcare institutions and medical personnel is to study public health in relation to the external environment, socio-economic conditions, work, and living conditions, with the aim of improving health, increasing working capacity, and extending average life expectancy. Therefore, when a physician studies public health, considering the external environment and socio-hygienic factors that shape and affect it, they must be able to collect accurate data on morbidity, mortality, and other health indicators in various population groups, assess the reliability of the obtained results, and reveal the patterns governing these phenomena.

In addition, in clinical settings, the physician must study processes in the patient's body in relation to the external environment, considering the leading influencing factors, in order to make an accurate diagnosis. In an experimental laboratory setting, they must be able to organize statistical research, correctly analyze the obtained results, and evaluate the effectiveness of new treatment and prevention methods, taking into account their impact not only on the biological organism but also on society as a whole.

Ultimately, the effectiveness of any innovation in medicine is measured by the most significant indicators of public health—morbidity, disability, mortality, and average life expectancy. To solve the above issues, statistical methods widely used

in socio-hygienic research are employed to identify the main factors affecting public health and to reveal the patterns behind them.

To conduct sanitary-statistical research, the researcher must have sufficient knowledge of the theoretical foundations, including materialist dialectics, historical materialism, economics, and the medical sciences relevant to the research area. In addition, knowledge of the general theory of statistical research, the organization of statistical observations, the rules for grouping, compiling, and calculating statistical materials, as well as statistical analysis methods, also form part of the theoretical basis of sanitary statistics.

At present, it is impossible to organize socio-hygienic research and many observations in the healthcare system without applying highly accurate and extremely complex mathematical-statistical methods. Conducting statistical research requires the wide use of mathematical analysis methods that can be performed with modern computer technology.

Using the law of large numbers—one of the foundations of statistics—statistical indicators are freed from random fluctuations, and the essence and causal patterns of the studied phenomena are revealed. In some cases, the number of observations in statistical research may be 10,000 or 100,000, while in others, 1,000 or even 100 observations may be sufficient. The number of observations sufficient for statistical research and the reliability of the results obtained are determined using mathematical analysis methods and their corresponding formulas.

In medical and sanitary statistics, mathematical analysis methods are applied in the following cases:

1. In all studies where a selected sample is used.
2. When it is necessary to express observation results in relative and average values and perform statistical analysis.
3. In all clinical and laboratory studies (when the number of observations is relatively small).

In the above-mentioned and certain other situations, without applying mathematical analysis methods, it is impossible to properly plan and organize statistical research or to evaluate the reliability of the obtained results. In short, in their practical and scientific activities, a physician’s use of mathematically and statistically grounded selection and calculation methods makes it possible to successfully conduct socio-hygienic research, to reveal patterns in changes in public health, to determine the influence of the external environment, and to develop specific measures to further improve the health of the population or certain groups within it (workers, mothers, children, adolescents, veterans, etc.) based on the conducted studies.

The choice of answer to a clinical question depends on the physician’s practical experience and the specific task at hand. The work of a physician is the resolution

of a particular patient's problem. Physicians recognize all patients by sight, collect information from them about their illnesses, conduct studies on each patient, and take personal responsibility for them. As a result, physicians strive first and foremost to assess each patient's individual characteristics, grouping patients according to the severity of the disease, diagnosis, and treatment methods, and, in the terminology of probability theory, evaluating the likelihood of the patient belonging to a certain group.

Traditional clinical education is aimed at understanding the mechanisms of disease development based on information obtained from fundamental sciences such as biochemistry, anatomy, and physiology. These sciences shape the scientific worldview of medical students and lay the foundations for future clinical research. Such training fosters confidence and forms the essence of medicine by enabling the explanation of pathological processes in specific patients, predicting the course of disease, and determining appropriate treatment based on knowledge of its mechanisms.

However, personal experience and understanding of disease mechanisms are undoubtedly important in the following respects:

In most cases, treatment outcomes and prognosis for a specific patient are uncertain and must therefore be expressed in terms of probabilities.

These probabilities are best assessed for an individual patient based on previous experience accumulated with patients suffering from similar illnesses.

Although clinical observations of patients in their natural behavior are carried out, these are conducted by physicians of varying qualifications and viewpoints, which may lead to systematic errors and incorrect conclusions.

Any observation, including clinical observation, may be subject to random influences. To avoid incorrect conclusions, physicians must take into account and minimize both random and systematic errors, conducting research strictly on the basis of scientific principles.

In modern society, the influence of various forces accelerates the recognition of the potential of clinical epidemiological research. The cost of medical care has reached such a level that even the wealthiest segments of the population are unable to pay for every type of desired service. This shows that the adoption of new clinical methods is often observed in response to changes in clinical practice rather than being universally mandatory; thus, a commonly accepted or expensive treatment may indeed be beneficial for a patient.

Currently, methods for the careful evaluation of clinical data are being developed for use by healthcare administrators. There is a unified opinion that medical care should be based on the results of the most rigorous scientific research and evaluated in light of the financial expenditures that society can afford. Furthermore, specific

patients are viewed as part of a large group of similar patients. This approach not only helps in determining a precise individual prognosis but also in choosing the most effective way to use limited medical resources to provide optimal care to a large portion of the population.

The most appropriate examples of applying research principles are as follows:

-studying the history of public health to determine prospects;

-diagnosing community health (prevalence, morbidity, mortality, lifestyle changes);

-improving medical services (diagnostics, treatment, prevention);

-assessing individual risk factors;

-studying the relationship between distribution and a specific clinical phenomenon in order to identify syndromes;

-complementing the clinical presentation of a disease;

-establishing cause–effect relationships.

Evidence-based medicine is the conscientious and rational use of the best available evidence in making decisions about the individual care of each patient. The application of evidence-based medicine means integrating the best clinical evidence from systematic research with individual clinical expertise.

Individual clinical expertise is acquired through examining patients and practicing on them. Experience can be gained in several ways, but first and foremost it involves the accuracy and effectiveness of diagnoses made, responsiveness to each patient’s needs and requirements, applying treatment and research methods with respect for their will, autonomy, and rights.

The best and most relevant clinical evidence comes from existing clinical research, including patient-targeted studies, accuracy and consistency of diagnostic tests, the strength of prognostic markers, and the precision and effectiveness of therapeutic, rehabilitative, and preventive regimens.

Clinical evidence enables the replacement of outdated treatments and previously used diagnostic tests and methods with newer, more accurate, effective, and safer ones. Good doctors combine individual clinical expertise with the best available evidence—neither alone is sufficient. Without clinical expertise, a doctor’s practice may be entirely based on clinical evidence, yet even the best evidence may not be suitable for a particular patient. Without the necessary scientific evidence, a doctor’s practice becomes outdated and may even endanger the patient’s life.

Currently, doctors find it difficult to keep up with the latest achievements in medicine published in journals, as they lack sufficient time (to stay informed about all developments, they would need to read an average of 15 articles per day, 365 days a year). In this regard, British doctors allocate 1 hour a week for reading.

A doctor can practice evidence-based medicine even while sitting in their office chair. Modern works in evidence-based medicine are often rejected by auditors. They indicate that for the treatment of most patients, evidence-based methods are

used at least in surgery, psychiatry, and therapy departments. This shows that doctors can dedicate their time effectively to reading, searching for, evaluating, and implementing the best evidence for the patient, and practicing evidence-based medicine.

Medical Statistics and Its Main Tasks

Statistics is one of the social sciences that studies the quantitative changes of phenomena occurring in society in connection with their qualitative changes.

The main goal of statistics is to study the magnitude and quantitative changes of events occurring within a specific period and in certain regions of society, in connection with the laws governing their occurrence.

The main tasks of medical statistics include:

Studying public health: the population size, composition, natural movement (birth rate, mortality, natural increase), physical development, prevalence and course of various diseases among the population, average life expectancy, and others.

Studying general morbidity and mortality rates, or specific diseases and causes of death among certain population groups, in relation to lifestyle, environment, socio-economic, and historical conditions; and, based on the results of the conducted research, developing specific scientifically-based measures to further improve public health and introducing them into practice.

For the proper planning of healthcare, correct organization of the work of sanitary-epidemiological and treatment-prevention institutions, studying their activities, the quality and efficiency of medical services provided to the population, collecting and deeply analyzing data on the type and number of medical institutions, the number of employees, and the number of hospital beds in permanent hospitals.

Evaluating the treatment and prevention measures currently in use and studying their effectiveness.

In clinical and laboratory settings, planning, organizing, and conducting scientific research, assessing the accuracy of the results obtained, identifying the patterns of various phenomena and processes in the bodies of healthy and sick individuals, and evaluating the effectiveness of new treatment and prevention methods.

Sanitary statistics is considered a key part of the science of social hygiene and healthcare organization. It is divided into two parts: population health statistics and healthcare statistics. The first and second groups of tasks mentioned above belong to population statistics. Healthcare statistics cover the third and fourth groups of tasks. The fifth group of tasks, which is separated from all the objectives studied by sanitary statistics, is referred to as “medical statistics.”

To determine the sufficient number of observations for conducting statistical

research and to assess the reliability of the results obtained, mathematical analysis methods and related formulas are used.

In medical and sanitary statistics, mathematical analysis methods are applied in the following cases:

1.In all studies where a selected sample is used.

2.When it is necessary to express observation results in relative and average values and conduct statistical analysis.

3.In all clinical and laboratory studies conducted with a relatively small number of observations.

In the above-mentioned and certain other cases, without applying mathematical analysis methods, it is impossible to properly plan and organize statistical research and to assess the reliability of the results obtained.

STATISTICAL COMPILATION. STAGES OF STATISTICAL RESEARCH

One of the characteristic features of statistics is its application in studying a large number of phenomena. In primary observations, it is difficult to determine the general typical features of the phenomenon being studied.

In medical statistics, three main sections are distinguished:

*Theoretical and methodological foundations of medical statistics

*Statistics of population health

*Statistics of healthcare

The main directions of medical statistics:

*Studying the health of the population and identifying factors affecting health

*Studying the activities of treatment-and-prevention institutions and developing specific scientifically-based measures to further improve population health and implementing them in practice

*Statistical methods in medicine are used in the following situations:

1. Standardizing production factors from a clinical-hygienic perspective
2. Calculating the dosage of medicines
3. Determining standards of physical development
4. Evaluating the effectiveness of applied preventive measures

Statistical analysis helps determine tactics for treating or preventing diseases.

Thus, every physician must have a good knowledge of the theoretical foundations of statistics and be able to correctly apply statistical methods.

STATISTICAL POPULATION

A statistical population is a group consisting of relatively homogeneous elements obtained in a specific territory and within a specific period of time. A statistical population consists of individual primary observations and is formed by a special method. The number of observation units in the statistical population determines the volume of the study and is denoted by the letter “n.” Depending on the final goal and objectives of the research, a decision is made regarding the primary element of the statistical population.

Examples of a statistical population include: the group of people born or deceased in a given year, or the population of a particular district or city.

Each observation unit has multiple characteristics, but only those relevant to the research purpose and objectives are taken into account. Since these characteristics are recorded, they are called recorded characteristics. Moreover, each characteristic has its own gradations. For example, age may have the following gradations: under 20 years, 20–24 years, 25–29 years. In an analysis of treatment outcomes, the following categories may be distinguished: recovered patients, unchanged condition, deterioration of the condition, and death.

Recorded characteristics such as gender, age, place of residence, duration of illness and hospitalization, results of clinical examinations, and treatment outcomes not only allow for a detailed study of each element (observation unit) of the population but also make it possible to comprehensively study the entire population.

The primary elements under study are the observation units. Observation units are divided into similar and different characteristics. Similar characteristics form the basis of the population. Different or recorded characteristics, depending on their nature, are divided into:

1.Attributive (expressed in words)
2.Quantitative (expressed in numbers)

Attributive characteristics include all those expressed in words (for example: place of residence, disease diagnosis, gender of the population, and others).

Quantitative Characteristics

Quantitative characteristics include all characteristics expressed in numbers (height, body weight, number of days of treatment, blood cholesterol level, amount of protein in urine, etc.). Each value of a quantitative characteristic is called a variant

and is denoted by the letter "V." Regardless of the research being conducted, attributive and quantitative characteristics remain unchanged.

Based on their influence on the phenomenon under study, characteristics are divided into factor and resultant characteristics.

Factor characteristics – these are recorded characteristics whose influence causes changes in other dependent characteristics. When a factor characteristic changes, an increase or decrease in the resultant characteristic is observed. For example, as a child's age increases, their height also increases (age – factor characteristic, height – resultant characteristic).

Resultant characteristics – these are characteristics that change as a consequence of factor characteristics.

Since the division of characteristics into factor and resultant depends on the research being carried out, a characteristic under study can be both factor and resultant at the same time.

Every statistical population is divided into general and sample populations.

General population – consists of all observation units. For example, if all patients in the world suffering from rheumatism are studied, this group of patients will constitute the general population. In studying public health, the general population is examined taking into account clearly defined observation units. Thus, depending on the objectives and tasks of the study, the boundaries of the general population may change.

If analyzing all observation units of the general population presents difficulties, a sample population is used in the study.

Sample population – is a part of the general population, selected by a special method, and corresponding to the characteristics of the general population. Based on the analysis of the sample population, it is possible to obtain complete information about the patterns applicable to the general population.

The sample population must be representative, meaning that in the selected part, all elements should be presented in the same proportion as in the general population. In other words, the characteristics of the sample population must accurately reflect those of the general population.

To ensure representativeness, the sample population must meet the following basic requirements:

Qualitative representativeness – it must reflect the main characteristics of the general population, i.e., be as similar to it as possible.

Quantitative representativeness – it must have a sufficient volume (number of observations) to clearly represent the characteristics of the general population.

To determine the required number of observations in a sample population, statistics uses special formulas or ready-made tables.

Unlike individual observation units (individuals), the statistical population has

distinctive features:

*a characteristic by which the phenomenon under study is distributed

variability of observation units – these features are determined using special statistical methods.

Distribution of Characteristics in a Statistical Population

The nature of a distribution becomes clearly visible only in large sets of observations. By studying it, important information about the phenomenon under investigation can be obtained.

In medical and socio-hygienic research, distributions can take different forms:

*Alternative

*Normal (binomial, symmetric)

*Asymmetric (right-skewed, left-skewed)

*Bimodal (two-peaked)

In socio-hygienic research, the alternative type of distribution is often used. In such a distribution, the characteristic has two opposite properties (yes or no).

In normal (binomial, symmetric) distribution, the number of observations with different characteristics is arranged symmetrically in relation to the middle of the series. In this case, the greatest number of observations falls in the middle of the series.

In asymmetric distribution, the number of observations is not concentrated in the middle of the series, but rather shifts toward either the side with fewer characteristics (right-skewed asymmetry) or toward the side with more characteristics (left-skewed asymmetry).

Left-skewed asymmetry is typical for the distribution of characteristics such as the number of children in a family (e.g., families with 1–2 children). As the number of children increases, the number of such families decreases.

Right-skewed asymmetry can be observed when examining cases of temporary disability due to illness over the course of a year, as most workers have the minimal number of disability cases.

Bimodal (two-peaked) distribution has two maxima. Such a distribution requires additional analysis. For example, if both boys and girls are included in the population and their height is measured, the resulting distribution will be bimodal, as the average height differs between boys and girls.

STAGES OF STATISTICAL RESEARCH

In organizing any research, four stages are distinguished. These stages are carried out in strict sequence:

1. Developing the research plan and program
2. Data collection
3. Data processing
4. Analysis, conclusions, recommendations, and implementation in practice

First stage – Program and plan

The program and plan are subordinated to the unified purpose of the study: the program specifies the objectives and tasks of the research, while the plan addresses the organizational aspects of the study.

The program of a statistical study includes the data to be collected for the research. It consists of three components:

*Program for data collection
*Program for data processing (tabular report)
*Program for data analysis

Program for data collection – presented in the form of a card (form) containing a number of questions that must be studied during the observation process. Additionally, official medical documents (report forms) approved by the state can also serve as data collection programs; these are used to study population health and evaluate the performance of healthcare institutions.

However, in medical science and healthcare practice, for in-depth study of problems, researchers and practicing physicians develop their own programs – special questionnaires. When creating such a questionnaire, several rules should be followed:

*All characteristics in the questionnaire must correspond to the goals and objectives of the study
*The questions must be clear
*Each question–answer group must have a conditional number–code (identifier) and predefined answer options

Example of questions, answers, and codes

Question (recorded characteristic)	Answer	Code
1.Age	20years 20-39 years 40 years and older	1 2 3
2.Gender	Male Female	1 2
3.profession	Слесарь Токарь	1 2

According to their nature, recorded characteristics can be grouped into two types:

*Typological grouping

*Variational grouping

Typological grouping – grouping based on attributive characteristics, expressed in words or written form (for example: gender, types of diseases, occupation).

Variational grouping – grouping based on characteristics expressed in numbers (for example: body weight, height, blood pressure).

These types of groupings can appear in various combinations.

The data processing program refers to table layouts. Table layouts are designed

according to a specific principle. Tables should have a clear and concise title, and within the table, the “subject” and the “breakdown” are distinguished.

Statistical subject – the main characteristic of the studied phenomenon, placed in the vertical column of the table.

Statistical breakdown – the characteristics describing the subject, placed in the horizontal row of the table.

All columns and rows in the table must end with totals.

Types of tables:

*Simple

*Grouped

*Combined (complex)

Simple table – consists of a main characteristic and one additional characteristic.

Example: distribution of patients by stages of hypertension.

Stages of hypertension	Number of patients
1 2 3	
Total	

In a grouped table – the main characteristic and two or more additional characteristics that are not directly related to each other are included.

Distribution of hypertension patients by gender, age, and stages of the disease.

Stages of	Gender	Age	Total

hypertension								t
	Male	Female	20	2 0 -29	30-39	40-49	50 Years and older	
123								
Total								

In the subject part of a grouped table, multiple characteristics can be presented, such as duration of hospitalization or duration of surgery, but in the breakdown they should only appear in pairs; for example: disease and hospitalization duration, disease and surgery duration, disease and age, disease and gender.

A combination table consists of the main characteristic and two or more interrelated characteristics.

Distribution of hypertension patients by gender, age, and stage of the disease

Stages of hypertension	Age								Total	
	30		30-39		40-49		50 and older			
	M	F	M					F		F
1 2 3										
Total										

The research plan includes the organizational elements of a scientific study.

The plan must first indicate the research object, that is, the set of phenomena or subjects for which statistical data has been collected.

In social hygiene, research objects may include the population of a region (city), districts, specific population groups, patients, healthcare institution staff, and others.

The research object (population) should be defined in terms of environment (territory), time (period), volume (quantity), and observation (n).

The plan should specify how the research object (statistical population) will be formed.

Depending on the coverage of the population volume, it can be:

*Complete observation

*Sample observation

Depending on the observation period, it may be:

*Momentary

*Current (ongoing)

According to the method of obtaining information, it may involve:
*Direct
*Anamnestic (interview, questionnaire)
In complete observation, all units of the studied population are examined.

In complete observations, all primary events that make up the general population must be registered.
Using the complete observation method, data are collected on births, deaths, outpatient clinic visits, as well as the number of hospitals and doctors.

Organizing sample observation
The main components of the sampling method are:
*Calculating the sample size (n)
*Special methods for selecting the necessary parts from the general population (random, mechanical, typological, targeted, cluster method)
*Assessing the representativeness of the selected parameters

The sampling method is used when it is necessary to save resources, time, and materials while conducting in-depth research.
The required number of observations (n) for the sample is determined using a formula or special tables.
The plan must indicate the method of data collection for sampling: random, mechanical, typological, or cluster.

Random sampling method – According to this method, selection is done randomly or by "lottery method." Each observation unit has a card with a number corresponding to a list. The cards are placed in sealed boxes, and then drawn randomly. The larger the sample size, the greater the accuracy.

Mechanical sampling method – Selection is based on a certain characteristic (e.g., first letter of surname, case history number). The units of the population are arranged sequentially (alphabetically or by case history number), then an interval (every 5th or every 10th record) is chosen and the observation units are selected mechanically.
For this, the total number of population units is divided by the required sample size. For example, if 300 records must be chosen from 3,000, the sampling interval will be 10 (3000 ÷ 300 = 10), meaning every 10th record is selected. Because this method requires a lot of labor, its use is sometimes limited.

Typological sampling method – The studied population is divided into various

qualitative groups, after which observation units are selected from each group randomly or mechanically. The number of observation units in each typical group is taken proportionally to that group's share in the general population.

Cluster (nest) method – The general population is divided into certain typological groups ("nests"), and a few nests most similar to the general population are selected. Then, all observation units in those nests are studied, or units are chosen from each nest randomly or mechanically.

Targeted sampling method – Used to eliminate the influence of a known factor and determine the effect of a less-studied factor.

One type of targeted sampling is the cohort method, which is based on selecting a set of observation units according to the same time of occurrence of events, for example: number of children born in a family during a certain period (or pregnancies, deliveries, abortions).

Statistical research is divided into two types according to the observation period: momentary and current observation.

Current observation method – Events are recorded continuously as they occur (births, deaths, diseases).

Momentary observation method – Events and phenomena are studied as they exist at a specific moment in time. Examples: medical examinations of the population, sanitary inspections of facilities.

Second stage of research – Methods of data collection:

*Direct observation

*Data transfer

*Questionnaire-survey

*Direct observation method – Information is recorded from direct examination of a healthy person or patient. Examples include recording results of laboratory analyses and tests.

*Data transfer method – Widely used in social hygiene research. For example, extracting certain data from medical records or from official reporting forms of healthcare facilities.

*Anamnestic method – Information is recorded from a patient or their close relatives.

The anamnestic method can be implemented in two ways:

1. Questionnaire method – Information about each individual is obtained by having them fill out a specially designed form with questions. One disadvantage is that it is not always possible to get complete answers to all questions. For sensitive personal information (e.g., family relations, abortion history), the questionnaire should be anonymous, without indicating the person's name.
2. Interview method – Information is obtained through direct conversation between the doctor and the respondent.

The second stage of statistical research is data collection.

At this stage, statistical observation and data gathering are carried out.

By statistical observation, we mean the completion of questionnaires (data collection forms) and registration.

When the research plan and the preliminary program section are drawn up, data (statistical observation) are collected accordingly.

The third stage of statistical research is processing the collected data.

Once the data are collected, the processing begins, which consists of several steps:

1. Control
2. Coding
3. Grouping the records for tabulation
4. Counting the grouped documents
5. Calculating statistical indicators
6. Graphical presentation of the indicators

Coding – is carried out by assigning conditional symbols to the features in the documents to make grouping easier. Large, exact numbers or letters should be used for coding.

The fourth stage is analysis, conclusions, recommendations, and application in practice.

Here, the obtained results and indicators are thoroughly reviewed. At the end of the study, conclusions are drawn, and specific recommendations are given for applying the research results to healthcare practice.

The application of research results in practice can be done by publishing articles, implementing methodological guidelines, or introducing new methods of treatment or diagnosis into healthcare practice.

RELATIVE VALUES

It is known that statistical (aggregate) datasets are characterized by qualitative and

quantitative attributes.

To analyze the whole or part of a dataset, individual variants must be combined into groups, and this grouping should be presented in the form of a table or series.

The simplest method is considered to be qualitative variation (alternative distribution).

For example, distributing the number of diseases by individual nosological forms of diagnosis.

Diseases	Quantity
Hypertension	120
Infarc	10
Angina	450
Flu	150
Other diseases	1000
Total:	1630

Or, to classify 7-year-old children according to their level of physical development.

Level of physical devolopment	Number of children
High level	15
Average	85
Low	20
Total:	120

As can be seen from the table, the quantitative units of the given observations are presented in absolute numbers. Absolute numbers have limited significance; nevertheless, the size of a certain phenomenon, in some cases, provides important information (number of patients, deaths, births). They can be used to describe rarely occurring events (1 case of plague, 5 cases of diphtheria).

The only disadvantage of absolute numbers is that they cannot be used to compare the value of phenomena. For this purpose, relative values are used in statistics.

There are 4 types of relative values:

*Intensity index

*Extensive index

*Relation index

*Clarity index

Intensity index – also called the prevalence or frequency index – characterizes the frequency of a phenomenon occurring in a given environment, i.e., it shows the degree of distribution of the phenomenon within an environment that produces it.

For example: patients – environment; number of deaths – phenomenon; students – environment; number of students infected with influenza – phenomenon.

The intensity index is calculated using the following formula:

X = phenomenon × base / environment producing the given phenomenon

Where:

Environment – the total population or a specific part of it (men, women, patients, workers, etc.).

Base – a unit consisting of zeros (100, 1000, 10000, etc.). The base is used to clarify the indicator: the rarer the phenomenon, the larger the base. If the index is calculated per 100 people, it is expressed in percentages; per 1000 – in permille (‰); per 10000 – in prodecimille (‱).

Phenomenon – a process occurring within the population (number of deaths, births, patients, etc.).

Intensity indices are divided into:
*General
*Special

General – characterizes the phenomenon in a general form.
Special – provides a more detailed and differentiated result.

Example: In a district, the male population is 30,000, of which 300 died in one year.

The mortality rate in this case:
30,000 – 300
1000 – x

From this:

x = 300 × 1000 / 30,000 = 10‰ (permille)

Thus, there are 10 deaths per 1000 men.

Extensive index – is a distribution index, showing the ratio of a part to the whole, or the distribution of the whole into parts. It is expressed in percentages % (rarely in permille).

Extensive index = part of phenomenon × 100 / total phenomenon

Extensive indices are used to determine statistical relationships and their parts (e.g., leukocyte formula, disease structure, mortality by gender, by age, etc.).
The sum of extensive indices must always equal 100%.

For example, during a medical examination of children in a kindergarten, 30 cases of diseases were detected. Among them: ARI – 15, hepatitis – 2, chickenpox – 5, and other diseases – 8.

In this case, the extensive index is calculated as follows:

For Ari
30 –100%
15–x
x=15x100/30=50%.

For chickenpox
30 – 100 %
5–X
x= 5x100/30=16,7%

For hepatites 30 – 100 %
2–x
x=2x100/30=6,7%

For other diseasrs
30 – 100 %
8–X
x= 8x100/30=26,6%

Total:50+6,7+16,7+26,6=100%.

Correlation index – shows the degree of distribution of a phenomenon in an environment that is not directly related to it. Although it differs in meaning, in terms of calculation method, the correlation index is similar to the intensive index.

Correlation index = phenomenon × base / environment not producing the phenomenon

Example: the provision of the population with doctors, hospital beds, and healthcare institutions.

Example calculation: In a city with a population of 400,000 people, there are 100 doctors. The provision of the population with doctors will be:

400,000 – 100

10,000 – X

X = 100 × 10,000 / 400,000 = 25.0‰ (per mille)

Or in other words, there are 25 doctors per 10,000 population.

Visibility index – is used to determine the changes, trends, increase or decrease of a studied process over time. The visibility index shows the ratio of homogeneous indicators in different territories or time periods. One of the indicators is taken as 100, and the rest are calculated relative to it. The values being compared can be given in absolute numbers, relative values, or averages.

Example: incidence of gastritis among students in higher educational institutions.

Learning course	Morbidity in %	Accuracy indicator
1	6,0	100%or 1
2	12,0	200%or 2times
3	15,0	2 o 2 5 ı , 0 5 % t

		imes
4	10,0	166% or 1,6 times
5	18,0	300%or 3times
6	20,0	333% or 3,3 times

Calculation method

For 2nd-year students: 6 – 100

12 – x

x = 12 × 100 / 6 = 200%

The morbidity rate of 2nd-year students is 100% higher compared to 1st-year students (200 – 100 = 100).

For 3rd-year students: 6 – 100

15 – x

x = 15 × 100 / 6 = 250%

Thus, the morbidity rate of 3rd-year students is 150% higher compared to 1st-year students.

For 4th-year students: 6 – 100

10 – x

x = 10 × 100 / 6 = 166%

The morbidity rate of 4th-year students is 66% higher compared to 1st-year students (166 – 100 = 66).

For 5th-year students:

6 – 100

18 – x

x = 18 × 100 / 6 = 300%

Thus, the morbidity rate of 5th-year students is 200% higher (300 – 100 = 200), and so on.

GRAPHICAL REPRESENTATIONS

The data obtained as a result of statistical research are usually presented in tabular form. However, in many cases, it is not possible to present the analyzed phenomenon clearly and visibly through the values given in the table. To make the obtained results more illustrative, easier to understand, and to facilitate scientific analysis, graphical representations in the form of various diagrams are used.

The following main types of graphical representations are distinguished:

*Diagrams (flat, volumetric)

*Cartograms

*Cartodiagrams

When constructing graphical representations, the following rules must be observed:

*Each graphical representation must have a title that reflects its content, time, and place (usually placed below the figure);

*It must be drawn according to a certain scale;

*All colors and symbols used in the graphical representation must be explained;

*The image must strictly correspond to the meaning of the indicators.

*Diagrams

All diagrams are either volumetric or flat. Any diagram can be represented in both flat or volumetric form. Thus, volumetric diagrams differ from flat ones only in appearance.
In addition, according to their characteristics:

Here's the English translation of the list:

1. Line (diagram)

2. Column (diagram)

3. Bar (diagram)

4. Radial (diagram)

5. Sector (pie chart)

6. Internal column (diagram)

7. Internal bar (diagram)

8. Figure (diagram) / Shaped (diagram)

Line Diagrams

Line diagrams show changes in phenomena over time.
When constructing them, the axes of abscissa and ordinate serve as the basis. On the X-axis (abscissa) the time interval is represented, while on the Y-axis (ordinate) the indicator of the phenomenon is shown (such as morbidity, population size).

If several phenomena are displayed in one diagram, the lines are drawn in different colors.
For example, changes in temperature, as well as birth and death rates, can be represented using line diagrams.

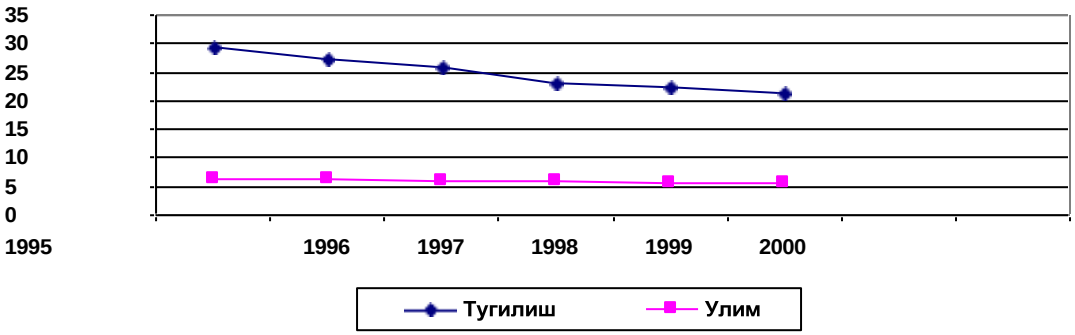
According to their characteristics, line diagrams are divided into:

*Straight-line
*Increasing

*Decreasing

*Curved-line

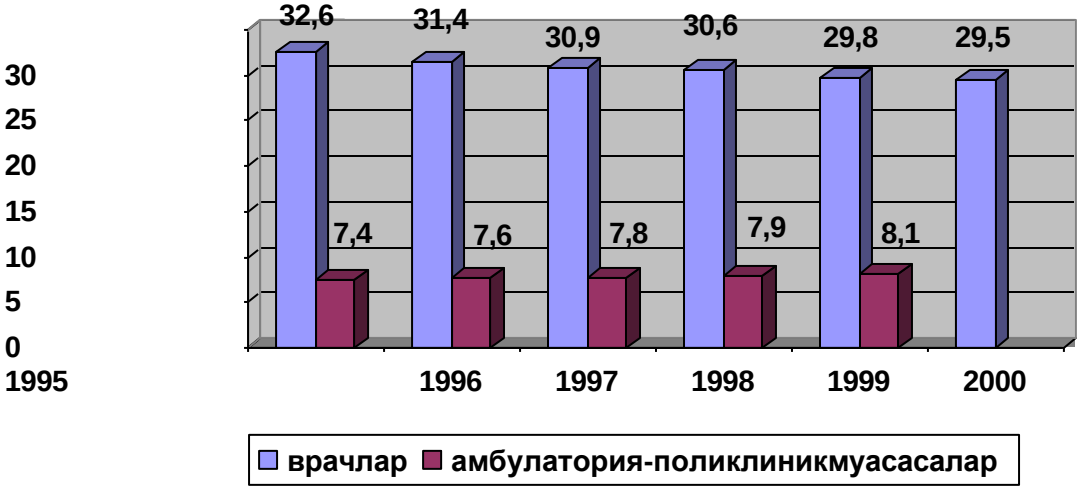
Example: Changes in birth and death rates.



Column Diagrams

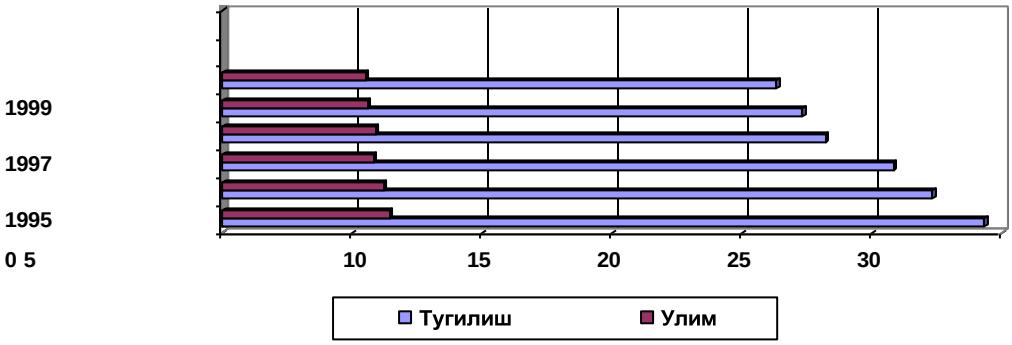
Column diagrams are used to represent indicators of the same type that are not directly related to each other. In most cases, they are applied to compare the values of the same indicator across different groups.

Example: Provision of 1,000 people with doctors and outpatient–polyclinic



Bar Diagrams

Alongside column diagrams, bar diagrams are also used. Their difference lies only in orientation: unlike column diagrams, they are arranged horizontally. They are applied in the same way as column diagrams.



Radial Diagrams

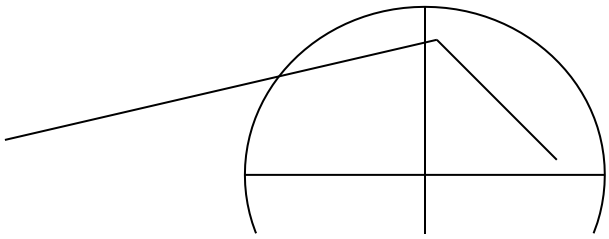
Radial diagrams are used to represent the frequency of a phenomenon within a limited time interval.

When constructing a radial diagram, a circle divided into equal numerical parts is used as the abscissa axis. The ordinate axis may be represented by the radius of the circle or its extension. Usually, the radius of the circle is taken as the average value of the analyzed phenomenon.

The number of radii corresponds to the time interval of the studied cycle (12 radii – one year, 7 – one week, 24 – one day).

Example: The seasonal frequency of acute intestinal diseases in children can be illustrated as follows:

Autumn



Winter ёз

Spring

Sector (Pie) Diagrams

Sector (pie) diagrams are used to represent the composition of a phenomenon. In this case, each part of the phenomenon is constructed as a sector of a circle. For this purpose, the radius of the circle is equated to 100%, and each percentage of the phenomenon corresponds to 3.6 degrees.

Example: The composition of sexually transmitted diseases in the year 2000:

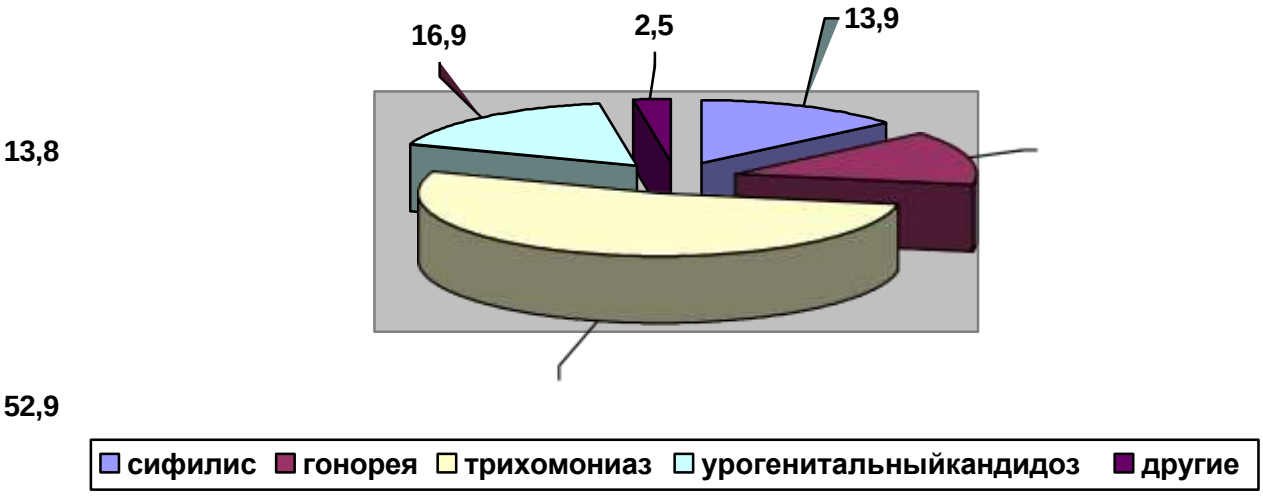
Syphilis – 13.9%

Gonorrhea – 13.8%

Trichomoniasis – 52.9%

Urogenital candidiasis – 16.9%

Others – 2.5%



Internal Bar and Internal Column Diagrams

Internal bar and internal column diagrams are also used to represent the composition of a phenomenon. In this case, the surface of the column or bar is taken as 100%, and each percentage of the phenomenon is equated to 1 cm.

Example: The composition of sexually transmitted diseases in the year 2000:

Syphilis – 13.9%

Gonorrhea – 13.8%

Trichomoniasis – 52.9%

Urogenital candidiasis – 16.9%

Others – 2.5%

Or in the form of an internal bar

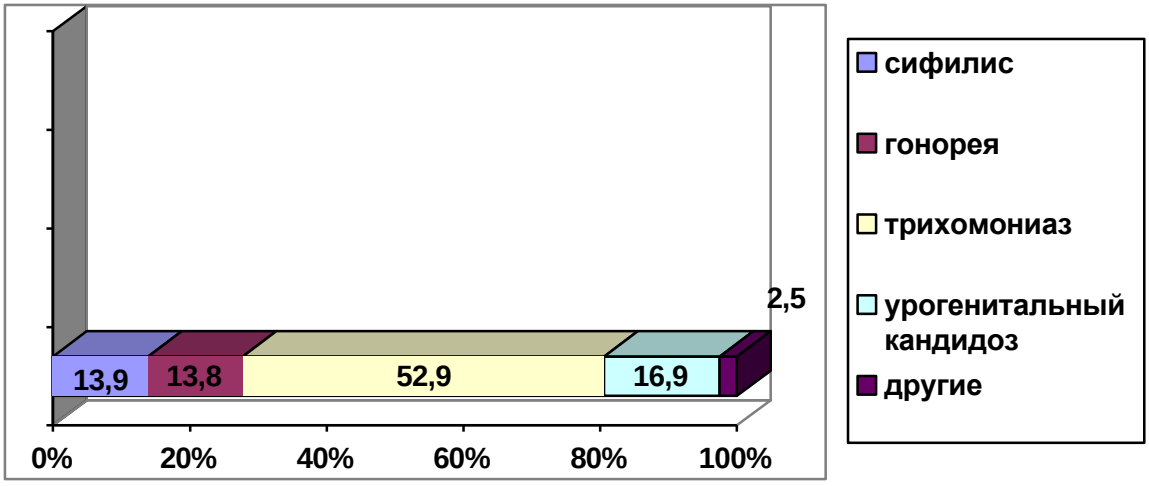


Figure (Pictorial) Diagrams

Figure diagrams are used to represent changes in studied phenomena across different groups or over time in the form of symbolic figures.

Example: Depicting changes in population size using human figures.

Cartogram

A cartogram is used to represent the distribution of a particular phenomenon across territories on geographic or schematic maps. For this purpose, the magnitude of the studied phenomenon is shown by different intensities of colors or shadings on the map.

Cartodiagram

A cartodiagram is the addition of diagrams to a cartogram. It is used to illustrate the distribution of several phenomena across territories on a geographic map.

Example: A synoptic map showing weather changes, a map of mineral resources, etc.

To compare and illustrate intensive, correlation, and clarity indicators, line, radial, column, bar, figure diagrams, cartograms, and cartodiagrams are used.

Extensive indicators are represented in the form of sector (pie), internal column, and internal bar diagrams.

DYNAMIC SERIES AND THEIR ANALYSIS IN HEALTHCARE

In medicine and healthcare, studying the health of the population is an important task. It also shows the nature and volume of the activities of medical–preventive institutions over time. To analyze the dynamics of a certain process, it is necessary to know how to construct different types of dynamic series, align them, and carry out their analysis.

A dynamic series is a sequence of comparable numbers of the same type that reflect the changes of a certain phenomenon over a given time interval.

The numbers in a dynamic series are called levels. The levels of a series may be expressed as absolute numbers, relative indicators, or averages.

In many cases, the levels in a dynamic series can differ significantly from each other. In such cases, the levels of the series are smoothed.

Dynamic series are divided into two types:

*Simple – if the levels of the series are expressed in absolute numbers;

*Complex – if the levels of the series are expressed in relative indicators or averages.

Two types of dynamic series are distinguished:

*Moment (instantaneous) series – if the phenomenon is studied at specific dates.

Example: Population size on January 1, 2004.

*Interval series – if the phenomenon is studied over regularly repeated periods of time.

Example: The number of those born in 1978 was 1,120. In the district, the number of births each quarter was less than four times, i.e. 1,120 ÷ 4 = 280 children.

For an interval series: the choice of the interval period (year, month, week, day, hour, etc.) determines the degree of change of the phenomenon. The slower the phenomenon changes over time, the longer the observation periods should be.

Analysis of a Dynamic Series

The following indicators are used to analyze a dynamic series:

*Absolute increase (or decrease) rate

*Growth (or decline) rate

*Rate of increase (or decrease)

*Visualization indicators

*The value of 1% of the absolute increase (or decrease)

*Absolute increase – the difference between the level of the current year and that of the previous year.

*Growth rate – the ratio of the current year's level to the previous year's level, expressed as a percentage.

*Rate of increase – the ratio of the absolute increase to the previous year's level, expressed as a percentage.

*Visualization indicator – the ratio of each level in the series to the level taken as 100%.

The value of 1% of the absolute increase (or decrease) – the ratio of the absolute growth to the growth rate.

Example: The population size of the city as of January 1 (per 1,000 people):

2000 – 6,956

2001 – 7,151

2002 – 7,409

2003 – 7,530

2004 – 7,745

Absolute increase:

For 2001: 7,151 – 6,956 = 195

For 2002: 7,409 – 7,151 = 258

For 2003: 7,530 – 7,409 = 121

For 2004: 7,745 – 7,530 = 215

Rate of Increase:

For 2001: (195 × 100) / 6,956 = 2.8%
For 2002: (258 × 100) / 7,151 = 3.6%

For 2003: (121 × 100) / 7,409 = 1.6%

For 2004: (215 × 100) / 7,530 = 2.9%

Growth Rate:

For 2001: (7,151 × 100) / 6,956 = 102.8%

For 2002: (7,409 × 100) / 7,151 = 103.6%

For 2003: (7,530 × 100) / 7,409 = 101.6%

For 2004: (7,745 × 100) / 7,530 = 102.9%

The Value of 1% of Absolute Increase:

For 2001: 195 / 102.8 = 1.89

For 2002: 258 / 103.6 = 2.49

For 2003: 121 / 101.6 = 1.19

For 2004: 215 / 102.9 = 2.08

A dynamic series is not always constructed from smooth levels. Some levels of a dynamic series may undergo significant fluctuations, making it difficult to observe the main regularities of the phenomenon during the studied period.

In such cases, in order to determine the overall dynamic trend, it is necessary to smooth the series.

The following methods are used to smooth dynamic series:

1.Increasing the interval

2.Calculating grouped averages

3.Calculating moving averages

Smoothing the levels of dynamic series should only be done after a thorough and comprehensive analysis of the causes that led to such fluctuations. Otherwise, mechanical smoothing may artificially distort the levels and disrupt causal relationships.

Increasing the interval: this method is carried out by combining (summing) the data of several consecutive periods.

Example: the number of angina (tonsillitis) cases may increase or decrease each month. After enlarging the intervals according to the quarters of the year, it becomes possible to observe certain regularities. The highest number of cases usually falls in the summer and autumn seasons.

To determine the grouped average value: several periods are combined, and the total sum is divided by the number of combined periods. With this method, the smoothing of the time series provides data that demonstrate the exact patterns of changes in phenomena over a specific time interval.

To determine the moving average: each level is replaced by the average value. This makes it possible to substitute each level with its average. The moving average is calculated by summing three consecutive levels and dividing the sum by three. By calculating the moving average, the smoothing of the time series reveals the regularities of changes in the phenomenon. In turn, this reduces the differences between the levels of the time series.

Example, the population of a city on January 1 (in thousands):

2000 – 7409

2001 – 7151

2002 – 6956

2003 – 7745

2004 – 7530

Interval enlargement can be carried out as follows:

For 2000–2002: 7409 + 7151 + 6956 = 21516

For 2003–2004: 7745 + 7530 = 15275

Grouped average value determination:

For 2000–2002: (7409 + 7151 + 6956)/3 = 7172

For 2003–2004: (7745 + 7530)/2 = 7637.5

Moving average determination:

For 2001: (7409 + 7151 + 6956)/3 = 7172
For 2002: (7151 + 6956 + 7745)/3 = 7284

For 2003: (6956 + 7745 + 7530)/3 = 7410.3

METHODS AND STAGES OF STANDARDIZATION IN HEALTHCARE

In most cases, in medical practice, it becomes necessary to compare statistical indicators in populations that are not homogeneous in composition (by sex, age, etc.). To study a particular phenomenon and compare its values across several groups, intensive indicators are usually used. However, the composition of the studied groups influences the intensive indicators.

For example: in order to draw a conclusion about the causes of the overall mortality rate (number of deaths per 100 patients) in two different hospitals, it is first necessary to determine the similarity in the types of diseases treated in each hospital. If one hospital admits more patients with severe, chronic illnesses, its mortality rate will naturally be higher. Another example: in populations with a larger proportion of young people, the birth rate is higher; in populations with more elderly people, the mortality rate is higher.

To compare indicators in groups that differ in composition, the standardization method is applied.

Standardization – is a method of calculating indicators that replace the general

intensive (or average) rates when it is difficult to directly compare the indicators of populations with different compositions.

Standardized indicators are conditional values: they are used only for comparison purposes and do not reflect the actual level of the phenomenon. Thus, standardized indicators are relative and serve for comparative analysis.

In statistics, three methods of standardization are distinguished:

1.Direct

2.Indirect

3.Reverse

The method of standardization is chosen depending on the availability of data.

The direct method is the most widely used, applied when all the necessary data about the phenomenon are available.

The indirect method is used when the composition of the population under comparison (sex, age, work experience, occupation, etc.) is known, but the composition of the phenomenon (number of births, deaths, cases of illness) is not.

The reverse method is applied when the composition of the phenomenon is known, but the composition of the population is unknown.

In socio-hygienic and clinical research, since we usually have access to all the necessary data, the direct method is most often used for calculating standardized indicators.

The direct method of standardization consists of five steps:

1. Step 1 – Calculate the general and specific intensive indicators in the populations being compared.

2. Step 2 – Select and calculate the standard.

3. Step 3 – Calculate the expected results relative to the standard.

4. Step 4 – Calculate the standardized indicators.

5. Step 5 – Compare the standardized indicators with the intensive indicators and draw conclusions.

Example: Based on the given data, make a conclusion about the influence of the patient composition on the mortality rates in two hospitals.

Distribution of patients and deaths in 2 hospital departments

Departments	Hospital A		Hospital Б	
	Number of admitted patients	Number of deaths	Number of admitted patients	Number od deaths
Therapy	600	30	200	12
Surgery	300	6	700	21
Infectious Diseases	100	4	100	5
Total	1000	40	1000	38

To draw a conclusion about the influence of the patient composition on mortality rates, it is necessary to calculate the standardized indicators. Since we know the number of patients (the size of the population) and the composition of events (the distribution of patients by departments), we can apply the direct standardization method.

Hospital "A" **Hospital "B"**

For the Therapy Department

600 – 30 **200 – 12**

100 – X **100 – X**

X = 30 × 100 / 600 = 5% **X = 12 × 100 / 200 = 6%**

For the Surgery Department

300 – 6 **700 – 21**

100 – X **100 – X**

X = 6 × 100 / 300 = 2% **X = 21 × 100 / 700 = 3%**

For the Infectious Diseases Department

100 – 4 **100 – 5**

X = 4% **X = 5%**

General Mortality Rate

1000 – 40 **1000 – 38**

100 – X **100 – X**

X = 4% **X = 3.8%**

Mortality rates by hospital department (%)

Departments	«A» hospital	«Б» hospital
Therapy	5,0	6,0
Surgery	2,0	3,0
Infectious diseases	4,0	5,0
Total	4,0	3,8

When comparing the mortality rates in each department of the two hospitals, it is evident that the mortality rate in Hospital "B" departments is higher than in the respective departments of Hospital "A." However, the overall mortality rate is higher in Hospital "A" than in Hospital "B."

How can this difference be explained?

In Hospital "B," the number of patients in the surgical department is greater, and mortality in this department is lower. In Hospital "A," more patients are in the therapeutic

department, where mortality is higher compared to the surgical department. Therefore, it is necessary to show what mortality would be if the number of discharged patients in the two hospitals' departments were the same. To do this, we must select a standard and calculate accordingly.

Step – Standardization and Calculation.

As a standard, we can use the sum of patients discharged from both hospitals, half of that sum, one of the hospitals' totals, or an arbitrary number. In our example, the standard will be the sum of discharged patients across both hospitals by department.

Calculating the standard:

The total number of discharged patients in both hospitals = 1000 each.

(1000 + 1000) / 2 = 1000

Therapeutic department: (600 + 200) / 2 = 400

Surgical department: (300 + 700) / 2 = 500

Infectious diseases department: (100 + 100) / 2 = 150

Total = 400 + 500 + 100 = 1000

Now, based on the intensive indicators, we calculate the expected number of deaths for the standard.

Step – Calculating standardized indicators, i.e., determining the expected mortality rate in departments relative to the standard.

Therapeutic department

Hospital "A" mortality = 5% (5 deaths per 100).

For 400 patients (standard), expected deaths:

100 – 5

400 – X

X = 400 × 5 / 100 = 20

Hospital “B” mortality = 6%.
100 – 6
400 – X
X = 400 × 6 / 100 = 24

Surgical department
Hospital “A” mortality = 2% (2 deaths per 100).
For 500 patients:
100 – 2
500 – X
X = 500 × 2 / 100 = 10

Hospital “B” mortality = 3%.
100 – 3
500 – X
X = 500 × 3 / 100 = 15

Infectious diseases department
Hospital “A” mortality = 4%.
100 – 4
150 – X
X = 150 × 4 / 100 = 6

Hospital “B” mortality = 5%.
100 – 5
150 – X
X = 150 × 5 / 100 = 7.5 ≈ 8
Expected number of deaths (absolute numbers) in Hospitals “A” and “B” after standardization:

Hospital “A”: 20 (Therapeutic) + 10 (Surgical) + 6 (Infectious) = 36

Hospital “B”: 24 (Therapeutic) + 15 (Surgical) + 8 (Infectious) = 47

Thus, after standardization, we can see that Hospital “B” has a higher expected mortality compared to Hospital “A”

Departments	Expected number of deaths in Hospital “A”	Expected number of deaths in Hospital “B”
Therapy	20	24
Surgery	10	15
Infectious diseases	4	5
Total	34=(20+10+4)	44=(24+15+15)

1Step – Calculation of standardized indicators

According to our calculation, in Hospital A, out of 1000 patients (standard), 34 patients would have died. How many would that be per 100 patients? The case fatality rate is calculated as follows:

1000 – 34

100 – X

X = 34 × 100 / 1000 = 3.4%

In Hospital B, out of 1000 patients, 44 patients would have died. How many would that be per 100 patients?

1000 – 44

100 – X

X = 44 × 100 / 1000 = 4.4%

2Step – Comparison of standardized indicators with crude rates and drawing conclusions

The obtained data should be presented in the form of a table.

Indicators	A Hospital	Б Hospital	Compare
Standardized rate	3,4%	4,4%	A<Б

Conclusion:

The comparison of standardized mortality rates in Hospitals “A” and “B” allows us to make the following conclusion: if the patient composition were the same in both hospitals, the mortality rate would be higher in Hospital “B” than in Hospital “A”. However, the comparison of crude (general) rates shows a higher mortality in Hospital “A”. The reason is that Hospital “A” admits more severe patients with therapeutic profiles, which usually result in higher mortality. In contrast, Hospital “B” shows a lower crude mortality rate, since it mainly admits surgical patients, who generally have lower mortality.

APPLICATION OF AVERAGE VALUES IN MEDICINE

When comparing different statistical groups, as well as when evaluating the general state of scientific experimental and clinical research, average values are widely used.

An average value is a number that expresses the studied characteristic in a sample as a single quantity. Average values represent magnitudes that are qualitatively homogeneous but quantitatively different.

When applying averages, two main conditions must be observed:

*Average values should be calculated within qualitatively homogeneous groups.

*In order to make meaningful comparisons of averages, they must be calculated when the number of observations is sufficient.

*To obtain averages, a variation series is constructed.

*A variation series is a numerical sequence of the studied characteristic, where values differ in magnitude and are arranged in a certain order (increasing or decreasing).

The characteristics of a variation series include:

*Variant (V): the numerical value of the studied characteristic;

*Frequency (P): the repetition rate of the variants;

*Number of observations (n): equal to the sum of the frequencies of the variants.

A variation series may be:

*Simple – when each variant occurs once and the number of observations is less than 30;

*Grouped – when the number of observations exceeds 30 and the frequencies of variants vary. Sometimes it can also be constructed with fewer than 30 observations;

*Interval – when the number of observations is very large (more than 100). Interval variation series are used to simplify calculations.

To construct an interval variation series, the following steps are taken:

*Determine the number of groups: the larger the number of observations, the more groups should be used. Variants are arranged in a logical sequence (increasing or decreasing). The number of groups is chosen by the researcher but should not exceed 10–12 for calculation accuracy.

Calculate the interval (i) between groups using the formula:

i = Vmax - Vmin-Number of groups

Determine the boundaries and midpoints of each group.

Distribute the studied population into the defined groups.

Example:

The heights of 56 first-year medical students (n) were measured:

160, 158, 160, 163, 162, 170, 166, 165, 164, 170, 170, 168, 169, 175, 178, etc.

We determine the number of groups. Suppose we choose 7 groups.

Then:

i = 178 - 158}{7} = 3

Thus, we construct the interval variation series for students' heights.

Height(sm)	Number of students	Variants
158-160	4	159
161-163	6	162
164-166	21	165
167-169	11	168
170-172	9	171
173-175	4	174
176-178	1	177

When constructing an interval series, it should be taken into account that the intervals in each group must be the same.

Thus, the aggregate is a combined characteristic of quantitative features and is calculated from variation series.

In sanitary statistics, the following types of average values are distinguished:

*Mode (Mo)

*Median (Me)

*Arithmetic mean (M)

Average values have several features:

*they occupy the average position;

*they have an abstract character;

*the sum of all deviations of the variants from the average variant is *equal to zero;

*averages hide the variability of the variation series.

Mode (Mo) – the variant that occurs most frequently in a variation series.

Median (Me) – the variant located in the middle of a variation series. This variant divides the variation series into two equal parts.

To determine the median, it is necessary to find the middle of the variation series. If the number of variants is odd, the median equals the variant located in the middle of the series. If the number of variants is even, the median equals half the sum of the two middle variants.

For a grouped variation series, a special formula is used to determine the median.

Arithmetic mean (M) values may be:

*simple,

*weighted,

*or calculated by the moment method.

Simple arithmetic mean – used when variants occur only once and the number of observations is n < 30, i.e., from a simple variation series.

The simple arithmetic mean is calculated using the formula:

$M = \Sigma V / n$

where

Σ – summation sign,

V – variants,

N– number of observations.

Example: The pulse rate was measured in 9 people:

65, 60, 61, 75, 70, 76, 62, 68, 63.

We construct a variation series:

V	P
60	1
61	1
62	1
63	1
65	1
68	1
70	1
75	1
76	1
Total	Σ= 9

Since each variant occurs only once, we calculate the simple arithmetic mean:

$M = \Sigma V / n$

$M = (60+61+62+63+65+68+70+75+76)/9 = 66.7$

The weighted arithmetic mean is calculated when variants occur several times and the number of observations is $n < 30$, i.e., from a variation series.

The weighted mean is calculated by the formula:

$M = \Sigma VP / n$

where:

Σ – summation sign

V– variants

P– frequency of occurrence of the variant

N – number of observations

Example: The weight of 120 nine-year-old boys was measured:

24, 21, 28, 30, 32, 32, 35, 35, 30, 30, 24, 25, 36, 37, 38, 31, 29, etc.

Since some variants occur several times, the weighted arithmetic mean should be calculated using a grouped variation series.

For this, first, we construct a variation series:

V	P	VP
21	1	21
22	1	22
23	2	46
24	3	72
25	4	100
26	8	208
27	14	378
28	26	728
29	28	696
30	15	450
31	9	279
32	4	128
33	2	66
34	1	34
35	2	70
36	1	36
37	2	74
38	1	38
Total	Σ= 124	Σ= 3446

To calculate the weighted arithmetic mean, we use the following formula: M = Σ V x P / n

M = 3446 / 124 = 27,7 kg That is, the average weight of 9-year-old boys amounts to 27.7 kg.

If the number of observations is expressed in large numbers (such as the weight of infants, the number of erythrocytes, leukocytes) or if the number of observations is expressed in hundreds or thousands, the weighted arithmetic mean is calculated using the moment method.

$M = M_o + \Sigma(dxP)/n$,

Here:

Mo – the assumed mean,

d – the deviation of each variant from the assumed mean,

P – the frequency of the variants,

n – the number of observations,

$\Sigma(d \times P)/n$ – this is the first-order moment, which shows the difference between the true mean and the assumed mean.

Example: The weights of 120 nine-year-old boys were measured: 24, 21, 28, 30, 32, 32, 35, 35, 30, 30, 24, 25, 36, 37, 38, 31, 29, etc.

We construct the variational series:

V	P	D	dP	d^2	d^2P
21	1	-8	- 8	64	64
22	1	-7	- 7	49	49
23	2	-6	- 12	36	72
24	3	-5	- 15	25	75
25	4	-4	- 16	16	64
26	8	-3	- 24	9	72
27	14	-2	- 28	4	56
28	26	-1	- 26	1	26
29	28	0	0	0	0
30	15	+1	+15	1	15
31	9	+2	+18	4	36
32	4	+3	+12	9	36
33	2	+4	+8	16	32
34	1	+5	+5	25	25
35	2	+6	+12	36	72

36	1	+7	+7	49	49
37	2	+8	+16	64	128
38	1	+9	+9	81	81
Total	Σ= 124		Σ= -34		Σ= 952

In order to calculate the arithmetic mean using the moment method, first the assumed mean is determined; in most cases this value is taken equal to the mode. In our example, this value is equal to '29,' that is, it occurs 28 times in the variational series.

Now, we find the deviation of each variant from the mode:

d = V – Mo

d = 21 – 29 = –8, 22 – 29 = –7, etc.

Next, we calculate d × P, d^2, and d^2 × P. The obtained numbers are then substituted into the formula.

$M = M_o + E (d \times P)/ n$,

M=29+(-34) /124=29–0,27=28,73

To evaluate the internal structure of the set, the standard deviation (sigma) of the mean values is determined. The value of σ depends on the method of calculating the arithmetic mean:

1. if the arithmetic mean is calculated by the simple method:

$G=\pm SQR\Sigma d^2/ n$

2.if the arithmetic mean is calculated by the weighted method:

$G=\pm SQR\Sigma d^2 x P/ n$

3.if the arithmetic mean is calculated by the moment method:

$G=\pm SQR\Sigma d^2 xP/n–(\Sigma dxP/ n)^2$

In statistics, G is also referred to as the second-order moment, and it is used in the following cases:

In sanitary statistics, to assess the norm and the degree of deviation from it.
For this purpose, the interval between the arithmetic mean and the standard deviation is determined.

Formula:

M ± 1G – average values (within the norm)

M + 1G to M + 2G – above average values

M – 2G to M – 1G – below average values

M + 2G to M + 3G – high values

M – 3G to M – 2G – low values

Values higher or lower than 3G indicate the presence of pathological processes.
To determine the density of a variational series.
For this purpose, the following rule is applied:

M ± 1G → 68.3%

M ± 2G → 95.5%

M ± 3G → 99.9%

Thus, if at least 68.3% of the observations fall within M ± 1G,
95.5% within M ± 2G, and 99.0% within M ± 3G,
then the variational series is considered dense, and the distribution of observed units in the population is regarded as symmetric.

The final task is to evaluate the density of the variational series.
For this, we first calculate the standard deviation G of the mean value.

$$G=\pm SQR\Sigma d^2xP/n-(\Sigma dxP/n)^2$$

In our example:

G=+SQRΣd2xP/n–(ΣdxP/ n)2= 2.8

The number of observations (n) = 124,
the mean (M) = 28.73 kg,
and G = 2.8.

We find the interval M ± 1G, that is:

28.73 +_ 2.8

In our case, the interval is from 25.93 (28.73 – 2.8) to 31.53 (28.73 + 2.8).

If we equate all observation units to 100%, then the number of observation units within this interval is taken as X, and we set up the proportion:

124 - 100%

104 - X

X = 104*100/124 = 83.9%

Conclusion: For the variational series to be considered dense, the number of observations within the interval M ± 1G must be greater than 68.3%.
In our case, it equals 83.9%.

Therefore, the variational series in our example is dense.

Main Errors Encountered in Statistical Analysis

Errors in statistical analysis are divided into three groups:

1. Methodological errors
2. Errors resulting from incorrect evaluation of indicators
3. Logical errors

1. Methodological Errors

These include:

*Arithmetic errors – mistakes arising from incorrect calculations. To eliminate them, calculations must be carefully rechecked multiple times.

*Insufficient number of observation units – the main cause is the violation of the quantitative representativeness of the selected sample. To prevent this, the researcher must determine the required sample size in advance.

*Incorrect determination of the observation unit – for example, in clinical research due to misdiagnosis, or in socio-hygienic research due to the researcher's inattention or lack of knowledge.

*Using overly complex tables – statistical tables should not contain more than 3–4 variables. Otherwise, excessive fragmentation of data leads to the loss of relationships and patterns.

*Insufficient analysis – occurs when collected data are not sufficiently processed (e.g., when only absolute numbers are used without calculating relative values, when dynamic series are not constructed, or when relationships between phenomena are not identified).

*Incorrect grouping of observation units by characteristics – i.e., violation of qualitative representativeness. For example, when analyzing morbidity and injuries, using the ICD-9 instead of the ICD-10 classification.

2. Errors from Incorrect Evaluation of Indicators

These can occur as follows:

*Confusing extensive and intensive indicators – for example, when studying the complications of medical procedures, their frequency should be expressed using intensive indicators. If analyzed only as parts of a whole, one may incorrectly conclude that all procedures leave complications.

*False conclusions from artificially constructed groups – e.g., making a conclusion only based on the group that showed no resistance to a new treatment.

*Failure to account for the initial level when assessing growth rates – the lower the baseline, the higher the apparent growth.

Example: If one district had 1 kindergarten and another was opened, this is reported as 100% growth. In another district with 2 kindergartens, one more was added, reported as 50% growth. The first district may then be mistakenly considered more successful.

*Superficial analysis of data – e.g., when assessing maternal mortality, it is not enough to study only the ratio of deaths to live births in one year; one must also analyze the course of pregnancy, quality of antenatal care, lifestyle, and overall health of women.

*Failure to use standardization methods in analysis – leading to biased results.

Logical Errors

These include:

*Failure to account for qualitative features of the phenomenon during analysis.

*Incorrect causal reasoning using "since this, therefore that" assumptions.

Example: Concluding that hypertensive patients experience crises only due to stress.

*Ignoring different types of relationships – such as cause-effect, time-sequence, and interval connections.

*This breakdown shows the main sources of errors in statistical analysis: methodological, evaluation-based, and logical.

ASSESSING THE RELIABILITY OF STATISTICAL RESEARCH RESULTS

Assessing the reliability of statistical research results means determining with what probability the findings obtained from a sample can be applied to the general population. In other words, based on the results of the selected sample, an evaluation is given of the general population. However, when studying a certain size selected from the general population, we must also know the extent of the error made. For this, the similarity error "m" is determined.

Unlike methodological, arithmetic, and measurement inaccuracies, the similarity error cannot be completely eliminated; the only way to remove it is to conduct the study on the entire general population. However, it can be reduced to a very small amount, which can be achieved by increasing the number of observation units (n) in the selected sample.

The representativeness (sampling) error is determined using the following formula:

1.Sampling error of the arithmetic mean:

$m_м$= G/SQRn
Here:
m – the standard error of the arithmetic mean;
G – the mean square deviation (variance or standard deviation);
n – the number of observation units.

2.The standard error of relative quantities (m_p) is calculated as follows:

m_p=SQRPxq/n

Here:

P – the relative quantity

n – the number of observation units

q – the complementary quantity, calculated as follows:

a) If the indicator (P) is expressed in percent (%), then q=100-P
b) If the indicator (P) is expressed in per mille (%‰), then q=1000-p
c) If the indicator (P) is expressed in per ten thousand (‱), then q=10000-P and so on.

If the number of observation units is less than 30, then the sampling error of the mean and relative qua80ntities is determined using the following formula:

$m_м$=G/SQRn–1ёкит$_p$=SQRPxq/n- 1

The means and relative quantities obtained from the selected sample are always expressed with their standard errors. Depending on the level of error, the confidence limits are determined.

Confidence limit – this is the calculated range for the mean (or relative) quantities, beyond which deviations are very unlikely due to random fluctuations.

They are expressed using the following formula:

$P_{ген}$=$P_{тан}$±txm$_p$ёкиM$_{ген}$=M$_{тан}$±txm$_м$

Here:

$M_{ген}$,$P_{ген}$-The values of the mean and relative quantities obtained from studying the general population

$P_{тан.}$,$M_{тан.}$-The values of the mean and relative quantities obtained from the selected sample

$m_м$,$m_р$–The sampling error of the results from the selected sample; t – the confidence criterion

In summary, determining the confidence limits means identifying the minimum and maximum values of the mean and relative quantities.

The confidence criterion or confidence level (t) is chosen by the researcher to obtain the result with the desired accuracy. Its value depends on the number of observations in the selected sample and is determined using special tables.

If t = 1, the probability of an error-free forecast is 68.3%;
if t = 2, the probability of an error-free forecast is 95.5%;
if t = 3, the probability of an error-free forecast is 99.0%.

The probability of an error-free forecast (P) is the likelihood that the levels of relative and mean quantities in the general population will fall within the same limits as observed in the sample.

The higher the probability, the wider the confidence limits become.

In medicine and biology, it is often necessary to compare or contrast the results of different groups. For example, one may need to compare the average heart rate, respiratory rate, blood pressure, duration of treatment, and other indicators between an experimental group and a control group. When evaluating these comparisons, not only their differences but also the reliability of these values is assessed.

The reliability of differences among quantities obtained from a selected sample is measured using the confidence criterion (t – accuracy criterion) and is determined using the following formulas.

For mean quantities:

$$\mathbf{t = M / m_м \geq 3}$$

For relative quantities:

$t = P / m_p \geq 3$

M, P – quantities obtained from the selected sample

m_M, m_p – Their sampling (representativeness) errors

t –A confidence level (accuracy) of 95.0% or higher is considered sufficient for medical and biological research.

In medical statistics, it is often necessary to compare the results of different populations.

In such cases, the confidence level of the indicators is assessed not for each population

separately, but for the difference between them.

For relative quantities: $t = P_1 - P_2 / SQR\ m_1^2 + m_2^2 \geq 2$

For mean quantuties: $t = M_1 - M_2 / SQR\ m_1^2 + m_2^2 \geq 2$

Here: M_1, M_2, P_1, P_2 – indicators obtained from the selected sample;
m_1 and m_2 – their sampling errors;
t – the confidence level.

If $t > 2$, the probability of an error-free forecast equals 95.0%, and the difference between the two indicators is considered reliable.
If $t < 2$, the probability of an error-free forecast is less than 95.0%, and it cannot be concluded with confidence that there is a difference between the compared indicators. To correct this, it is necessary to increase the sample size. If, after increasing the number of observation units, the difference remains the same, this indicates that there is in fact no difference between the compared indicators.

Example: The pulse rate per minute in students was measured before and after an exam, and the following data were obtained:
Before the exam: pulse rate $M_1 = 94.2$; $m_1 = \pm 3.9$
After the exam: pulse rate $M_2 = 82.0$; $m_2 = \pm 4.1$

According to the formula, the confidence level of the difference between the indicators is calculated.

$t = M_1 - M_2 / SQR m_1^2 + m_2^2 \geq 2$

$t=94,2–82/SQR3,9^2+4,1^2=12,2/SQR15,21+16,81=12,2/5,7=$
2,1

Are the obtained results not due to chance?

The difference between the two mean values is greater than 2, which means that with a 95.0% probability of an error-free forecast, we can say that the difference in pulse rate before and after the exam is significant. The exam acts as a factor affecting the students' psychological and emotional state, which is reflected in the increase in pulse rate.

MEDICAL CORRELATION AND REGRESSION METHODS

Correlation – a Latin term meaning connection or dependence. Relationships between phenomena and traits can be functional or correlational.

Functional relationship – a strict dependence between phenomena, where the change in one trait necessarily leads to a change of a specific magnitude in the related trait.

Example: If the radius of a circle changes, its area also changes.

Correlational relationship – a relationship where a specific magnitude of one studied trait corresponds to several possible magnitudes of a related second trait.

Example: The relationship between body weight and height can be a correlational relationship. If we measure the weight of children with the same height, the values vary within a certain range. This is because body weight depends not only on height but also on nutrition, health, and psychological state.

To assess the degree of connection between phenomena and traits, the correlation coefficient is calculated.

The connection between phenomena and traits can be direct or inverse.

Direct relationship – as one trait increases, the related trait also increases.

Example: As a child's height grows, their body weight also increases. A direct relationship is marked with a plus sign (+).

Inverse relationship – as one trait increases, the related trait decreases.

Example: As the effectiveness of preventive vaccinations increases, the number of infectious diseases decreases; or as the air temperature rises, the incidence of bronchitis decreases. An inverse relationship is marked with a minus sign (–).

The strength of the relationship can range from +1 to 0.

The magnitude of the correlation coefficient indicates the strength of the relationship between phenomena and traits. Based on strength, relationships can be classified as perfect, strong, moderate, weak, or absent.

Strength of the relationship	True(+)	False(-)
Perfect	+1	- 1
Strong	(+0,7) –(+1)	(-1) – (- 0,7)
Moderate	(+0,3) –(+0,69)	(-0,3) –(- 0,69)
Weak	(+0,29)–0	(- 0,29)–0
No relatiomship	0	0

Spearman (rank) correlation coefficient – a simple, though less precise, method for determining the strength of the relationship between phenomena. This method is applied in the following cases:

-When the number of paired observations is less than 30;
-When it is not necessary to know the exact strength of the relationship between traits;
-When the traits have both qualitative and quantitative characteristics.
In this method, the correlation coefficient is calculated using the following formula:

$$\rho=1-6\Sigma d^2/\ n(n^2-1)$$

Here:
ρ – correlation coefficient

1 and 6 – standard numbers

d – difference between ranks

n – number of paired observations

Σ – summation symbol

Example: To determine the strength and nature of the relationship between hearing ability and the work experience of workers.

Work experience(X)	Decrease in hearing ability, % (У)	Colors		Colors difference	
		X	У	d (X - y)	d^2
To 1age	1,0	1	1	0	0
1– 4 years	6,0	2	2	0	0

5– 9 Years	10,0	3	4	- 1	1
10–14 Years	8,0	4	3	+1	1
15–19 Years	15,0	5	6	- 1	1
20–24 Years	12,0	6	5	+1	1
25–29 Years	15,0	7	6	+1	1
30 years and older	20,0	8	7	0	0
Total					Σ = 5

Ranks are arranged in order of decrease or increase.
d = X – Y – difference between ranks.

The correlation coefficient is calculated using the following formula:

$\rho=1-6\Sigma d^2/ n(n^2-1)$

$\rho=1-6x5/8x(64-1)=1-30/504=1-0,06=+0,94$

Conclusion: The correlation coefficient (+0.94) indicates a direct and strong relationship. This means that as the work experience of the workers increases, their hearing ability decreases.

The Pearson or chi-square method is applied in the following cases:

-When the number of paired observations is less than 30;

-When it is necessary to know the exact strength of the relationship between traits;

-When the traits have only quantitative characteristics.

Using the Pearson method, the correlation coefficient is calculated with the following formula:

$r =\Sigma d_x x\ d_y/SQR\Sigma d_x^2 x\Sigma d_y^2$

Here:

dx and dy – deviations of the variants from the mean quantity

r – correlation coefficient

Example: Determine the strength and direction of the relationship between the minimum

and maximum arterial blood pressure in people aged 25–45.

Maximum blood pressure (X)	Minimum blood pressure (У)	d_x	d_y	d_x^2	d_y^2	$d_x \times d_y$
126	76	-5	-18	25	324	+90
126	81	-5	-13	25	169	+65
129	81	-2	-13	4	169	+26
126	94	-5	+0	25	0	0
136	96	+5	+2	25	4	+10
136	101	+5	+7	25	49	+35
136	101	+5	+7	25	49	+35
130	102	-1	+8	1	64	-8
131	102	0	+8	0	64	0
135	104	+4	+10	16	100	+40
Σ=1311	**Σ=938**			**Σ=171**	**Σ=992**	**Σ=+293**

n=10

Calculation procedure:

1. For the X and Y variation series, we first find the simple arithmetic mean, i.e., M_x and M_γ.

M_x = Sum of values in the X series / number of observations $M_x = \Sigma V_x / n$, M_x= 1311 / 10= 131,1; or 131

M_y=Sum of values in the Y series/number of observations;

$M_y = \Sigma V_y / n$, M_y=938/10=93,8; or 94

2.Using the formula, we determine the deviation: $d_x = V_x - M_x$; $d_y = V_y - M_y$

d=126–131,1=- 5,1

1. We take the square of the deviation

2.We find the sum of squares

We find the product of deviations

3.We find the correlation coefficient

r=+293/ SQR171x992=+0,71

2.Conclusion: There is a direct strong correlation between maximum and minimum arterial pressure, since the correlation coefficient is equal to +0.71.

To determine the difference between the results of the selected sample and the general population, we calculate the representational error of the correlation coefficient (mr).

$m_r = \pm$SQR1–r^2/n–2

For our example: $m_r = \pm$SQR1– $(0,71)^2$/10– 2=0,25

Thus, the correlation coefficient indicates the direction and strength of the relationship between events or variables.

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REGRESSION

The correlation coefficient shows the direction and strength of the relationship between two variables, but it does not provide information about how much one variable changes when the other changes by one unit. In this case, the regression coefficient is calculated.

Regression is a function that shows how much a related variable changes when one variable changes by one unit.

The regression coefficient is determined by the following formula:

$R = r \times G_y / G_x$;

G – the standard deviation of the variables

r – the correlation coefficient

Based on the previous example, we find G. Since a simple variation series is constructed in the table, to determine the standard deviation we use the following formula:

G = SQR E d^2/ n – 1, Since the number of observations is less than 30, a correction coefficient of 1 for a small sample has been introduced into the denominator.

G_x=SQR171/10–1=± 4,4 G_y=SQR992/10 –1=± 10,5

Then we determine the regression coefficient:
R =0,71x10,5 /4,4 =1,7

Thus, if the maximum blood pressure changes by 1 mmHg, the minimum blood pressure increases on average by 1.7 mmHg.

STUDY OF DEMOGRAPHIC PROCESSES AMONG THE POPULATION AND THEIR SIGNIFICANCE IN THE HEALTHCARE SYSTEM

Demography – (from the Greek demos – population, grapho – to study) is the science about the population and its development.

Demographic statistics study the main regularities concerning the number, composition, birth rate, mortality, growth, and movement of the population. Demographic data are of great importance for planning and meeting the population's need for medical care (such as the number of hospital beds, positions in polyclinics, staff, places in nurseries and sanatoriums, the number of doctors, nurses, pharmacies, and others). The population serves as the direct object for carrying out health improvement activities by healthcare institutions.

Medical-demographic indicators in Uzbekistan

Uzbekistan is an independent and sovereign state located in the very center of Central Asia, situated between the two major rivers Amu Darya and Syr Darya. The territory of Uzbekistan covers 448.9 thousand square kilometers.

According to the administrative-territorial structure, the country is divided into 12 administrative regions (viloyats) and the Republic of Karakalpakstan. The capital of Uzbekistan – the city of Tashkent – is considered an independent administrative-territorial unit.

As of January 1, 2018, the population of Uzbekistan amounted to 32,653,000 people, of which 50.6% were urban residents and 49.4% rural residents.

For many years, a steady increase in the population has been observed. The average population density of Uzbekistan was 65.8 people per 1 sq. km.

The distribution of the population across the territory of the Republic is uneven. This uneven distribution is associated with the medical-geographical features of the regions

of the Republic. The highest population density is characteristic of plains, valleys, and industrially developed regions. For example, Andijan region has more than 631.2 people per sq. km, Fergana region – 485.3 people, and Namangan region – 325.3 people per sq. km.

At the same time, in desert zones such as Navoi region and the Republic of Karakalpakstan, the population density is significantly lower – 7.9 and 10.2 people per sq. km, respectively (2018).

Table 1

Population size and density of the Republic (as of January 1, 2018)

	Population	**Population density per 1 sq. km**
Republic of Uzbekistan	32653000	65,8
Republic of Karakalpakistan	1692800	10,2
Andijan region	2714200	631,2
Bukhara region	1707400	42,1
Jizzakh region	1186600	55,9
Kashkadarya region	2777800	97,2
Navoi region	881200	7,9
Namangan region	2420600	325,3
Samarkand region	3326200	198,3
Surkhandarya region	2218900	110,4
Syrdarya region	739500	172,8
Tashkent region	2671000	175,1
Fergana region	3280800	485,3
Khorazm region	1629100	269,3
Tashkent city	2309300	6792,1

As a result of the measures taken to improve the demographic situation in the Republic of Uzbekistan, the birth rate decreased from 34.5 per 1,000 people in 1991 to 9.5 in 2011.

In recent years, a reduction of the general mortality rate by 3–5% has been observed. For example, in 2000 this indicator was 5.5 per 1,000 population, while according to preliminary data in 2010 it amounted to 4.9.

Uzbekistan belongs to the countries with a sufficiently high natural population growth rate. The average annual population growth is 1.0–1.5%,

and over the last three decades, the population of Uzbekistan has more than doubled, which in absolute numbers means an increase of more than 15 million people. According to demographic and statistical calculations, if the current natural growth rate is maintained, by 2040 the population of Uzbekistan will reach 50 million people.

Based on the above, the natural growth process of the population of Uzbekistan can be assessed as positive, since it occurs against the background of low mortality rates.

The methods of studying these indicators characterizing public health, as well as information about them, are given in separate chapters.
Just as it is difficult to evaluate and characterize the health of an individual, it is even more difficult to evaluate and characterize the health of society and the population.

Public health is not only a medical concept, but in many respects it is one of the social, political, and economic categories and serves as an object of social policy. Therefore, it should be evaluated not only from a medical standpoint, but more from its social significance.

In medical and social research in our country, when assessing the health of certain groups or regional communities, it is recommended to use the following indicators (Diagram 1):

Demographic indicators

Morbidity

Disability

Physical development

Demography consists of two main parts:

1. Population statistics – in other words, information about the number of the population at a certain point in time, its composition (sex, age, profession, occupation, marital status, nationality, language, education), place of residence, geographical distribution, and density.

2. Population dynamics (movement) – changes in the size of the population. In turn, it is divided into two types:

a) mechanical movement;

b) natural movement (as a result of births and deaths).

The main source of obtaining information on population statistics is the state census, conducted periodically by the government. During the Tsarist Russia period, the first population census was conducted in 1897. In the Soviet era, nationwide censuses were carried out in 1920, 1926, 1936, 1959, 1970, and 1989. The last census was conducted on January 12, 1989.

The census is based on the principle of simultaneity: it is carried out on a specific day and hour, at the time when population mobility is at its lowest — usually in December or January during the winter season. It covers the entire population and is implemented uniformly throughout all territories according to a common program and plan, through direct survey methods. Because conducting a census requires a huge amount of labor, effort, and financial resources, it is usually held once every 10 years.

According to the last nationwide census on January 12, 1989, the population of the Republic of Uzbekistan amounted to 19 million 905 thousand people. In 1979, the population was 15 million 391 thousand, and in 1970 – 11 million 799 thousand people. Over 20 years, the population of Uzbekistan increased by 8 million 106 thousand people.

As of January 1, 2018, the population of Uzbekistan reached 32,653,000 people. Among the Central Asian republics, Uzbekistan ranks first in terms of population size and density.

Population density is the number of people per 1 square kilometer. Currently, males make up 50.1% and females 49.9% of the population. The sex distribution of the population is influenced by many factors, the most important of which is the ratio of boys to girls at birth: usually, 104–105 boys are born for every 100 girls. In childhood and middle age, the number of men and women is approximately equal, while in older age, due to higher male mortality, the number of women becomes slightly greater than that of men.

The age distribution of the population is of even greater importance. Without knowing the age structure of the population, it is impossible to properly evaluate indicators such as birth rate, mortality, and morbidity among them.

In sanitary statistics, events and phenomena occurring among the population with an interval of 1 year are studied very rarely. In order to provide medical care adapted to age, the population up to 20 years old is divided into the following groups:

0–1 year – infants (breastfeeding age)

1–2 years – nursery age

3–6 years – preschool age

7–10 years – primary school age

11–13 years – middle school age

14–17 years – adolescents

18–19 years – pre-conscription (military age) youth

For assessing demographic changes among the population, it is total population. Based on this, three types of population age structures are distinguished.

Age	Population composition (as a percentage of the total)		
	Progressive type	Stationary type	Regressive type
0- 14 15- 49 50 and older	30 50 20	25 50 25	20 50 30

The First Type (children are more numerous compared to the elderly) – ensures population growth in terms of numbers. It accounts for 18.2%

The Second Type – ensures numerical stability of the population. It provides socio-economic strength to the country and accounts for 70.6% of the population.

The Third Type – is characterized by a decline in births compared to deaths, a relatively higher number of elderly compared to children, and leads to a general decrease in the population size. This accounts for 11.2%.

Population Dynamics (Movement)

Within the population, natural and mechanical (migration) movements are distinguished.

Natural movement of the population refers to the change in the number of inhabitants in a certain territory as a result of the main demographic processes – births and deaths.

Migration refers to the mechanical movement of the population either within a country or from one country to another.

Migration has different forms, primarily:

External migration – interstate movement,

Internal migration – movement within one country.

Internal migration can also be of two types:

1. Permanent movement – as a result of changing one's place of residence,

2. Seasonal migration – movement of the population during a certain time period (season), etc.

The social-hygienic and epidemiological significance of migration:

a) The mechanical movement of the population leads to an increase in population size in one territory and a decrease in another, as well as changes in its age, sex, and occupational composition. This, in turn, requires reconsideration of the functioning of healthcare institutions.
b) The mechanical movement of the population, especially interstate migration, may cause the emergence of infectious diseases in a given country.

Natural Movement of the Population

The population consists of people, while demographic phenomena are formed by characteristics related to individuals. Therefore, as with other social phenomena, the number of observed events depends on the total size of the population. Thus, when discussing the magnitude or intensity of an observed phenomenon, it is not enough to know its absolute numbers.

To obtain more accurate information about the processes occurring among the population, these phenomena must be compared to their environment – i.e., to the population size. This requires the use of demographic indicators.

However, it should be remembered that demographic processes are counted over a certain period of time. For example, the number of births may be calculated for one year or one month, while the population size is usually taken at the beginning or end of the year.

Therefore, to make demographic indicators comparable, it is necessary first to calculate the average population size. Most often, the average annual population is defined as half of the sum of the population at the beginning of the year (January 1) and at the end of the year (December 31).

After determining the average annual population, the main medical-demographic indicators of natural population movement are calculated for districts, regions, cities, and the republic as a whole.

Demographic Study of the Population

The demographic study of the population is determined by general and special indicators.

Birth Indicators

a) Crude Birth Rate (CBR)

CBR= Number of live birthsx 1000\Average annual population

b) General Fertility Rate (GFR)

GFR = Number of live birthsx1000\Number of women aged 15–49

c) Marital Fertility Rate

Marital Fertility=Number of live births to married womenx1000\Number of married women aged 15–49

d) Age-Specific Fertility Rate (ASFR) – studied in one-year or five-year intervals among women aged 15–49.
For example, the fertility rate among women aged 20–24 is calculated as:

ASFR 20-24 =Number of live births among women aged 20–24x1000\Number of women aged 20–24

Mortality Indicators

a) Crude Death Rate (CDR)

CDR=Number of deathsx 1000\Average annual population

b) Age-Specific Mortality Rate

ASMR 20-24=Number of deaths at ages 20–24x1000\Average annual population aged 20–24

c) Cause-Specific Mortality Rate

CSMR =Number of deaths from a specific diseasex1000\Average annual population

d) Proportional Mortality Ratio (PMR)

PMR =Number of deaths from a specific diseasex100\Total number of deaths

Natural Increase of the Population

Natural Increase = Crude Birth Rate\Crude Death Rate

Infant Mortality Indicators

The calculation of infant mortality rates (IMR) requires special methods.

1. Infant Mortality Rate (IMR):

IMR=Number of deaths under age 1 during the yearx1000\Number of live births during the year

This method is recommended when the number of live births remains approximately the same for two consecutive years. Since some infants who die within a year may have been born in the previous year, more accurate calculations often use the I. Ratz method.

Subcategories of Infant Mortality

Neonatal Mortality (0–27 days):

Neonatal Mortality =Number of deaths at 0–27 daysx1000\Number of live births

Early Neonatal Mortality (0–6 days):

ENMR = Number of deaths at 0–6 daysx 1000\Number of live births

Late Neonatal Mortality (7–27 days):

LNMR= Number of deaths at 7–27 daysx 1000\Number of live births

Postneonatal Mortality (1–12 months excluding 0–27 days):

PNMR =Number of deaths aged 1–12 monthsx 1000\Live births – neonatal deaths (0–27 days)

Perinatal Mortality

The Perinatal Mortality Rate (PMR) includes stillbirths and deaths within the first week of life, but it is not a simple sum; it is calculated as:

PMR = Number of stillbirths + deaths within 7 daysx1000\Number of live births + stillbirths

Perinatal period: from 28 completed weeks of gestation until 7 completed days after birth.

WHO Definitions

Live birth: The complete expulsion or extraction of a product of conception from its mother, regardless of gestational age, showing any signs of life (breathing, heartbeat, umbilical cord pulsation, or voluntary movement), whether the umbilical cord is cut or not, and whether the placenta is delivered or not.

Stillbirth: The death of a fetus before expulsion from the mother, regardless of gestational age, showing no signs of life (no breathing, no heartbeat, no pulsation of the umbilical cord, no voluntary movements).

Birth weight: The weight of the newborn taken immediately after birth, before postnatal weight loss occurs.

Categories of birth weight:

Low birth weight: < 2500 g

Very low birth weight: < 1500 g

Extremely low birth weight: < 1000 g

Gestational Age

Gestational age is calculated from the first day of the last normal menstrual period (LMP) and is expressed in completed days or weeks.

Preterm birth: before 37 completed weeks (<259 days)

Term birth: 37–42 completed weeks (259–293 days)

Post-term birth: ≥ 42 completed weeks (>294 days)

Neonatal Period

Neonatal period: from birth to 28 completed days.

Early neonatal: 0–6 days

Late neonatal: 7–27 days

Neonatal mortality: deaths of live-born infants within the first 28 days of life.

Deaths on the first day of life (day 0) should record exact duration (hours or minutes lived).

If a child dies on the second or third day (the 2nd or 3rd day of life) or during the remaining 27 full days, the child's age is recorded in days.

Criteria for data recording

The legal requirements for registering stillbirths and live births may vary between countries and even within a country. Cases of delivery of a fetus with a body weight of not less than 500 g, regardless of whether it is born alive or dead, should, whenever possible, be included in statistics. If the body weight at birth is unknown, then the relevant gestational age criteria should be applied (22 completed weeks of pregnancy) or, alternatively, the length of the body (crown to heel, at least 25 cm) can be used.

To answer the question of whether the event occurred during the perinatal period, the following criteria should be applied in order:

1. body weight at birth,

2. gestational age,

3. body length from crown to heel.

It is recommended that fetuses and infants born with a body weight of 500 g to 999 g be included in national statistics, since this information has independent value and, in addition, increases the completeness of data on fetuses and infants born with a body weight of 1000 g or more.

In statistical reporting on stillbirths, perinatal, neonatal, and infant mortality, as well as deaths due to congenital anomalies, it is advisable to present data separately for live births and stillbirths, and also separately for groups with body weight at birth of 500–999 g and ≥1000 g. Neonatal deaths due to congenital anomalies should be recorded separately for early and late neonatal periods. Such information makes it possible to provide more complete statistical data on perinatal and neonatal mortality, whether caused by congenital anomalies or not.

In published coefficients, the denominator of the indicators should always be specified, i.e., either the number of live births or the total number of births (live births + stillbirths). Countries are recommended to present the coefficients and indicators listed above, or, depending on the existing data collection system, report the available ones.

Stillbirth Rate (Per 1000 live births):

Stillbirth Rate= Number of stillbirthsx 1000\Number of live births

Stillbirth Coefficient (Per 1000 total births):

Stillbirth Coefficient = Number of stillbirthsx1000\Total number of births

Stillbirth Rate Considering Birth Weight:

Stillbirth Rate (by weight) = Number of stillbirths with birth weight ≥1000 x1000\Total number of births with weight ≥1000 g

Early Neonatal Mortality Rate (Per 1000 live births):

Early Neonatal Mortality Rate= Number of deaths in early neonatal periodx1000\Number of live births

Early Neonatal Mortality Rate Considering Birth Weight:

Early Neonatal Mortality (by weight)= Number of deaths in early neonatal period with birth weight ≥1000 g x 1000\Number of live births with weight ≥1000 g

Perinatal Mortality Rate (Per 1000 live births):

Perinatal Mortality Rate= Number of stillbirths + Number of early neonatal

deathsx1000\Number of live births

Perinatal Mortality Indicator (Per 1000 total births):

Perinatal Mortality Indicator= Number of stillbirths + Number of early neonatal deaths x 1000\Total number of births

Perinatal Mortality Rate Considering Birth Weight ≥500 g

(If birth weight is unknown, consider fetuses with gestational age ≥22 full weeks or crown-heel length ≥25 cm)

Perinatal Mortality Rate (by weight)= Number of stillbirths with birth weight ≥1000 g} + Number of early neonatal deaths with birth weight ≥1000 g x1000\Total number of births with birth weight ≥1000 g

> Note: This indicator does not have to equal the sum of stillbirth and early neonatal mortality rates, since they may have different denominators.

Neonatal Mortality Rate:

Neonatal Mortality Rate= Number of deaths in the neonatal period
x1000\Number of live births

Neonatal Mortality Rate Considering Birth Weight:

Neonatal Mortality Rate (by weight)= Number of deaths in the neonatal period with birth weight ≥1000 g x1000/Number of live births with birth weight ≥1000 g

Infant Mortality Rate Considering Birth Weight:

Infant Mortality Rate (by weight)= Number of deaths among live-born infants with birth weight ≥1000 gx 1000\Number of live births with birth weight ≥1000 g

Reporting Causes of Perinatal Deaths:

The recommended form for reporting perinatal mortality provides a full analysis of the majority of recorded cases. In places where such analysis is not possible, at a minimum, it is necessary to analyze either:

The main condition of the fetus or newborn (as indicated in the perinatal death certificate), or

The main condition of the mother that affected the fetus or newborn (“Section C”).

If a single case must be chosen (for example, to include neonatal deaths in the analysis table by a single cause across all age groups), the primary condition of the fetus or newborn should be selected.

Grouping for Perinatal Mortality Statistics by Birth Weight:

Intervals of 500 g, e.g., 1000–1499 g

Grouping for Perinatal Mortality Statistics by Gestational Age:

I.Up to 28 weeks (up to 196 days)

II.28–31 weeks (196–223 days)

III.32–36 weeks (224–258 days)

IV.37–41 weeks (259–293 days)

V.42 weeks and above (294 days and more)

Maternal Mortality

Maternal mortality is defined as the death of a woman that occurs during pregnancy (regardless of the duration and location of the pregnancy), or due to pregnancy-related causes, including complications during treatment, but not due to accidental or incidental causes, occurring during pregnancy or within 42 days after the termination of pregnancy.

Late Maternal Mortality

Late maternal mortality refers to the death of a woman that occurs more than 42 days after childbirth, but within one year of delivery, due to direct obstetric causes or indirectly related causes.

Pregnancy-Related Death

A pregnancy-related death is defined as the death of a woman from any cause related to pregnancy that occurs during pregnancy or within 42 days after delivery, regardless of the cause.

Classification of Maternal Mortality Cases

Maternal mortality cases can be divided into two groups:

1. Direct obstetric deaths: Deaths resulting from obstetric complications of pregnancy, delivery, or postpartum period, including interventions, inadequate care, incorrect treatment, or a chain of events arising from recorded causes.
2. Indirect obstetric deaths: Deaths not directly caused by obstetric issues, but aggravated by the physiological effects of pregnancy, or resulting from pre-existing conditions or diseases that occur during pregnancy.

Improving Data on Maternal Mortality

To improve the quality of maternal mortality data and to gather alternative data on deaths occurring during pregnancy or related conditions, including deaths occurring more than 42 days after delivery due to obstetric causes, the 43rd session of the World Health

Assembly in 1990 issued a recommendation. According to this recommendation, countries should consider including items related to current pregnancy and pregnancies during the year on death certificates.

For international reporting purposes, only maternal deaths occurring within 42 days after delivery should be included in the calculation of various maternal mortality indicators. Late maternal deaths are useful for national-level analytical purposes.

Reporting and Publishing Maternal Mortality Indicators

When publishing maternal mortality indicators, it is necessary to always indicate the rate in terms of the number of recorded maternal deaths, either as:

The number of maternal deaths directly due to obstetric causes, or

The number of deaths due to obstetric causes (both direct and indirect).

It should be noted that maternal deaths due to HIV disease (B20–B24) and obstetric tetanus (A34) are coded as Class 1 and should not be included in maternal mortality indicators.

Denominators for Calculating Maternal Mortality

For calculating maternal mortality, the denominator can be expressed either as:

The number of live births, or

The total number of births (live births + stillbirths).

Results can then be interpreted by multiplying the ratio by a chosen factor (e.g., 1,000; 10,000; 100,000), depending on the requirements or accepted practice.

Thus, maternal mortality coefficients and indicators can be expressed accordingly.

Maternal mortality rate =

Number of maternal deaths (from direct and indirect causes) × k

/ Number of live births

Direct obstetric causes and maternal mortality ratio after live births =

Number of maternal deaths occurring directly from obstetric causes only × k

/ Number of live births

Maternal mortality ratio due to causes related to pregnancy and childbirth =

Number of maternal deaths due to pregnancy-related causes × k

/ Number of live births

In order to correctly record the causes of death among the population in urban and rural areas of our republic, and to further improve the accuracy of monthly and annual mortality reports, statistical departments and health administrations of the regions coordinate their activities. For this purpose, a medical statistician or a mid-level health statistician at the regional statistical offices enters the data and submits reports.

Average life expectancy — average length of life

One of the main tasks of demographic research is to determine the level of life expectancy of the population.

The average length of life means the average number of years a newborn generation (assuming that the age-specific mortality rates calculated in the current year remain unchanged throughout their lives) is expected to live.

To determine the average life expectancy, it is necessary to compile a mortality table (sometimes also called a life table or survival table), which is one of the main methods of analyzing mortality in demography.

MORBIDITY AMONG THE POPULATION AND METHODS OF ITS STUDY

It is known that morbidity is one of the indicators that assess the level of public health. According to the definition of the World Health Organization – any objective or subjective deviation or disturbance from the normal physiological state of the organism is considered morbidity. Thus, the concept of "morbidity" is somewhat broader than the concept of "disease". Studying morbidity in certain places and over a specific period of time is of great importance for healthcare institutions.

Firstly: morbidity is one of the main indicators reflecting public health and sanitary conditions.

Secondly: morbidity is the main criterion for assessing the quality and effectiveness of healthcare institutions' performance.

Thirdly: the study and reduction of morbidity is one of the main tasks of healthcare, sanitary-epidemiological services, treatment and prevention institutions, and all medical specialists.

Studying morbidity in relation to environmental, living, and working conditions in specific territories serves as the main source for developing concrete measures to improve public health in that area.

Fourthly: by studying the dynamics of diseases, deep information can be obtained about the changes in pathological processes among the population, and on this basis, the medical and sanitary needs of the population can be comprehensively identified, leading to the reorganization of healthcare services.

In short, information about the magnitude and structure of morbidity rates among different age and sex groups in specific territories is of great importance in planning medical measures to further improve public health.

According to Yu.P. Lisitsyn's definition, diseases can be classified into four types:

Biological Definitions:

Disease – disruption or failure of the organism, its organs, and systems.

Disease – disruption of proportionality, harmony, and adaptation in relation to the external environment.

Disease – disturbance of the organism's integrity, its internal structure, and the constancy of the internal environment (homeostasis).

Disease – failure of adaptation mechanisms.

Disease – mismatch between the organism and natural biorhythms (dyschronosis).

Cybernetic / Control Definitions:

Disease – disruption of control and coordination mechanisms of bodily functions.

Disease – disturbance of the organism's functional structure, like a complex cybernetic network.

Disease – disruption of the organizational model and life activity algorithm.

Energetic Definitions:

Disease – deficiency, excess, or imbalance of the human body's energy.

Disease – disruption of the expenditure of the organism's energy resources.

Disease – influence of external and internal environments through inadequate energetic, tension, or magnetic "fields," etc.

Social and Psychological Definitions:

Disease – restriction of freedom in all aspects of human life, and impairment of human functions.

Disease – disruption of human interactions and social connections within society.

Disease – psychological trauma, maladaptation, and damage to personality.

Disease – disturbance of living conditions and lifestyle.

One of the initial and main sources for studying morbidity among the population is patients' seeking medical help at treatment and prevention institutions.

General information on morbidity is based on the current registration of all diseases. Each primary consultation for a disease within the year is considered a unit of observation. The population may visit treatment and prevention institutions (TPIs) not only because of illness, but also for other reasons, for example: undergoing medical check-ups (when applying for certain jobs, obtaining a driver's license, laboratory tests, preventive vaccinations, pregnancy monitoring, genetic consultation).

Therefore, in morbidity registration by consultations, the concept means those cases of diseases which were first recorded in the relevant medical documents during the current calendar year. Subsequent visits are considered follow-up visits, since once a disease has been registered at the patient's first visit to a healthcare facility, they may visit the physician multiple times for the same condition.

When summing up the newly identified cases of diseases during the year at TPIs — which had not been recorded previously — and calculating intensity indices, the result is called the primary morbidity rate.

For primary chronic diseases, regardless of how many times a patient visits healthcare facilities during the year, only the first visit is considered a unit of observation. Repeated consultations for the same chronic condition within the year are not included in morbidity statistics. However, in the case of acute diseases, since a patient may become ill several times during the year, each case is considered a new disease and registered accordingly.

In addition to primary morbidity, the overall morbidity (general morbidity) among the population is also studied. For this, along with newly diagnosed diseases, chronic conditions that were recorded in previous years but for which the patient seeks medical care again in the current year, are also included. The calculated intensive indices from this total are referred to as the general morbidity rate, or prevalence.

When primary morbidity cases are recorded over several years

(three to five years), they are referred to as cumulative morbidity.

When analyzing morbidity data obtained from patients' visits to TPIs, it is necessary to consider factors affecting data completeness, such as:

-Accessibility of medical care,

-Availability of physicians,

-Presence of specialized healthcare institutions in the locality,

-Population's level of sanitary culture,

-Attitude towards health (e.g., whether they seek care for mild illnesses), etc.

One of the main sources of studying general morbidity is preventive and targeted medical examinations and dispensary observation among the population. This method helps to detect latent, previously unknown, or chronic diseases that did not force the patient to actively seek medical care.

Medical examinations may be:

Preliminary,

Periodic,

Targeted,

depending on the objectives, tasks, and organizational technologies used.

Preliminary medical examinations are conducted when entering employment or study, as well as during study and work, to detect occupationally-related diseases that may recur, progress, or aggravate under harmful working conditions.

Periodic medical examinations aim to detect occupational diseases at an early stage, to monitor workers' health under harmful and hazardous conditions, and to identify general illnesses that may contraindicate working under such conditions.

Depending on the groups of people examined, preliminary and periodic medical examinations are divided into three types:

1. Examinations among employees working under harmful occupational conditions in institutions and organizations.
2. Examinations among individuals whose professional activities may spread

diseases to the population (food service workers, childcare and certain public utility workers)

3. Examinations among all age groups of children, adolescents, students of higher and secondary specialized educational institutions.

Targeted medical examinations are usually carried out to detect early forms of socially significant diseases (malignant tumors, tuberculosis, diabetes, etc.) among both organized and unorganized groups of the population.

The Ministry of Health of the Republic of Uzbekistan has established rules for conducting preliminary and periodic medical examinations in workplaces. The frequency of these examinations depends on the degree of risk of harmful factors. The Ministry also specifies:

1.The number of medical specialists involved,

2.The list of laboratory and functional examinations,

3.The medical contraindications for employment.

Information obtained on diseases identified during medical examinations is referred to as “pathological prevalence” or “morbidity detected during medical examination” (point prevalence).

In studying the spread of certain diseases, mortality statistics are also important, since sometimes autopsies reveal diseases not diagnosed during life, thereby supplementing morbidity data.

When morbidity is studied separately through medical visits, medical examinations, and mortality analysis, it is difficult to give a comprehensive assessment. Therefore, to provide a complete characterization, the so-called “true morbidity rate” is calculated. This indicator combines:

-Morbidity identified through consultations,

-Diseases first detected during medical examinations,

-Information on causes of death (for diseases not previously registered in health institutions).

The true morbidity rate can be compared to an iceberg: the cases detected through medical visits are the visible part above water, while those revealed through medical examinations and mortality analysis are the hidden part below the

surface.

Based on long-term and individual studies of morbidity, the following system of studying diseases in the population can be outlined:

Scheme of studying the prevalence of diseases among the population.

Main sources of collecting information about diseases	Types of morbidity
1. The population's visits to medical institutions	Primary morbidity General morbidity Morbidity from infectious diseases Morbidity from major non-epidemic diseases Diseases leading to temporary loss of working capacity Morbidity among hospitalized patients Disability
2. Medical examination data	Morbidity based on medical examination results
3. Data obtained from studying causes of death	Morbidity based on the study of causes of death

In large cities, it is somewhat difficult to collect comprehensive data on general morbidity, since the population may seek medical care not only at the polyclinic of their permanent residence, but also at other preventive and treatment facilities (such as private clinics and specialized medical centers).

Therefore, at present, in order to obtain complete and accurate information about the general morbidity of the population, special observations are carried out. Regardless of the methods of collecting and processing primary data, the study of general morbidity

provides information about the structure of diseases, their prevalence, and their dynamics within the population.

Based on the data on the general morbidity of the population, the following statistical indicators are calculated:

Primary morbidity

Number of newly registered diseases during the current yearx 1000 \Average annual population

General morbidity

Total number of diseases registered during the current yearx 1000 /

Average annual population

These indicators can be calculated separately by disease, sex, and age.

Structure of diseases

Number of specific diseasesx 100 /Total number of diseases

The structure of diseases within certain groups of the population (by age, sex) is also calculated.

Indicator of diseases detected during medical examinations

Number of diseases identified during medical examinationx 1000 /Total number of persons examined

Statistics of Infectious Diseases

Infectious diseases pose a threat to the population because, if not prevented in time, they can spread rapidly and turn into an epidemic. Therefore, in order to control them, every infectious disease must be reported promptly to the district and city state sanitary-epidemiological control centers. Immediate notification is mandatory when infectious diseases are detected or suspected.

All notifiable infectious diseases can be divided into the following groups:

Quarantine diseases (plague, cholera, smallpox, yellow fever, relapsing fever).

Diseases reported simultaneously to the state sanitary-epidemiological control centers and specialized medical-preventive institutions where data is collected (tuberculosis, syphilis, gonorrhea, trachoma, fungal diseases, leprosy).

Diseases reported collectively by medical-preventive institutions to the state sanitary-epidemiological control centers (influenza, upper respiratory tract infections).

Diseases requiring individual case notification (typhoid fever, paratyphoid, salmonellosis, dysentery, enteritis, measles, pertussis, meningitis, encephalitis, infectious hepatitis, scarlet fever, tetanus, poliomyelitis, rabies, rickettsioses, epidemic typhus, malaria, leptospirosis, neonatal sepsis, chickenpox, rubella, hemorrhagic fever, mumps, ornithosis, and others).

According to the law, for the above-mentioned groups of diseases, every physician or mid-level healthcare worker who first detects or suspects an infectious disease must immediately send a notification to the state sanitary-epidemiological control center (SSESC) using form 058-sh. Such reports are submitted by the staff of medical-preventive institutions to city and district SSESCs.

SSESC staff record urgent notifications in a special “Infectious Diseases Register” and submit a monthly report to higher-level SSESCs using form 85-sh “Report on Infectious Disease Incidence”.

Medical-preventive institutions also submit influenza and acute respiratory infection reports to sanitary-epidemiological stations using form 85-influenza.

In the analysis of infectious diseases, alongside the above-mentioned reporting forms,

data from the “Epidemiological Investigation Card of the Infectious Disease Focus” (form 357-sh), completed by epidemiologists during field investigations at outbreak sites, is also used.

As a result, district and city sanitary-epidemiological control centers calculate and analyze infectious disease indicators on a weekly, 10-day, monthly, quarterly, semi-annual, and annual basis.

Important Non-epidemic Diseases.

Non-epidemic diseases that are severe in progression and pose a threat to people around and to future generations are recorded separately. Such diseases include tuberculosis, sexually transmitted diseases, fungal infections, trachoma, and malignant tumors. When physicians of any treatment-preventive institution detect such diseases, they report the case to specialized dispensaries by filling out the relevant documentation (forms 089-u, 090-u).

Once the diagnosis is confirmed at local dispensaries, patients are registered and monitored. After confirmation at the dispensary, information about the patient is forwarded to regional dispensaries, where, depending on the type of disease, reports are prepared either once every 6 months or once a year using forms 61a, 61b, and 61j. Based on the information in these reporting forms, morbidity indicators for the region are calculated per 100,000 population.

Diseases Leading to Temporary Loss of Working Capacity.

Such morbidity is studied based on sick-leave certificates issued to patients by physicians, and it applies only to the working population. A sick-leave certificate serves simultaneously as a statistical and legal document confirming absence from work due to illness, and as a financial document for the payment of temporary disability benefits.

Based on sick-leave certificates, morbidity among workers is compiled according to Form 16 – Physician Supervision for enterprises and workshops. Later, information on morbidity is processed by the statistical departments of trade unions by industrial sectors. Relevant data is then summarized and analyzed within the industrial sectors.

The assessment of diseases leading to temporary loss of working capacity is made according to three main indicators:

Number of days of incapacity for work per 100 workers =Number of days of incapacity for workx 100\Average number of workers

Average duration of one case of incapacity for work =Number of days of incapacity for work\Number of cases of incapacity for work

In studying diseases that cause temporary loss of working capacity, in addition to calculating average indicators per 100 workers, it is also very important to take into account the contingent of patients. In practice, it is known that a certain proportion of

workers do not experience incapacity for work at all during the year; the majority experience it 1–2 times, while some workers become ill 4 or more times a year. However, most cases and days of incapacity for work occur among a small group of workers who are frequently and severely ill.

The main indicators used to study morbidity by patient contingents are:

Health Index – the proportion of workers in a given group who did not fall ill during the year =Number of workers in this group who did not fall ill during the yearx 100\Average number of workers

Indicator of sick persons =Number of workers who lost working capacity during the yearx100\Average number of workers

Morbidity among hospitalized patients

Morbidity data among hospitalized patients is of great importance for determining the number of hospital beds, the number of specialists, and for planning specialized hospitals. Along with the number of patients treated in hospitals, morbidity indicators also play a significant role.

At present, the registration and study of hospital morbidity is well organized. Each hospitalization case is considered a unit of observation. A statistical card of discharged patients (Form 066-u) is filled out for each patient discharged from the hospital.

Hospital morbidity indicators are calculated per 1000 population for districts, cities, regions, and the republic. In addition, based on data from stationary hospitals, the following additional indicators can be determined:

Frequency of diagnoses, their magnitude, nature, main and concomitant diseases, and their complications.

Quality of doctors' diagnoses, their consistency with polyclinic diagnoses, and in cases of death – with pathoanatomical diagnoses.

Length of hospital stay by type of disease.

Timeliness of hospitalization for certain diseases and their extent.

Structure of hospitalized patients by age, sex, occupation, and clinical departments.

Effectiveness of different treatment methods (surgical, therapeutic, pharmacological, physiotherapeutic, etc.).

Outcomes of hospital treatment – recovery, partial recovery, deterioration, death.

Number of repeated hospitalizations for a given disease during one year.

General hospital morbidity – the total number of first-time hospitalizations for certain diseases during the current year, regardless of whether they were registered in previous years, but not registered during outpatient or polyclinic visits.

Hospitalization rate – the total number of all hospitalizations due to morbidity and other reasons.

International Classification of Diseases (ICD)

The doctor who treats a patient and records the disease uses the classification system to identify the disease and make the correct diagnosis.

A special classification of diseases, injuries, and causes of death has been developed for the purpose of collecting primary medical data, accounting, and scientifically and statistically analyzing the distribution of morbidity among the population.

The physician treating and registering the disease relies on classification when identifying it and making a diagnosis. Medical workers studying morbidity should be able to correctly group statistical material using the currently applied classification of diseases.

On August 21, 1900, the first international conference was held in Paris with the participation of delegates from 26 countries to review the classification of diseases and causes of death, and it approved the first classification. According to the decision of the conference, the classification would be revised every 10 years. At present, experts in health statistics from the World Health Organization (WHO) are directly engaged in revising such classifications. Over time, the international classification and nomenclature of diseases and causes of death has been revised 10 times.

The World Health Organization has set itself the goal of creating a stable yet adaptable International Classification of Diseases (ICD) to be revised every 10 years.

The 10th revision of the ICD is officially titled “International Statistical Classification of Diseases and Related Health Problems.”

ICD-10 was revised in 1989 and adopted at the session of the World Health Assembly in 1993.

This classification not only meets the diagnostic information needs of its users but also incorporates other data characterizing human health.

According to the Order of the Minister of Health of the Republic of Uzbekistan (No. 31, dated January 22, 2003), procedures and measures for implementing ICD-10 in our country were established. The implementation of this order allowed the transition to a nomenclature that makes it possible to compare diseases and causes of death with those of all other countries.

This, in turn, improved the quality of statistical data, created opportunities for better health management, and integrated the development of medical science. Its Uzbek-language edition was first published in 2004.

In ICD-10, all similar pathological conditions are grouped for the analysis of collected data. Diseases in ICD-10 are divided into chapters, which are further divided into blocks, then into three-character categories, and finally into four-character subcategories.

ICD-10 consists of three volumes (in the Russian edition).

The first volume (in two books) contains the three-character and four-character subcategories, which represent the disease names. Based on these codes, all countries process morbidity and mortality data and submit them to WHO. This volume also includes rules for determining and recording maternal and child mortality.

The second volume provides the purpose of ICD-10, its scope of application, relevant recommendations for its use, coding rules for morbidity and mortality, and the history of its development.

The third volume contains tables of diseases, external causes of injuries, chemical substances, and medications (about 5,500 names).

In ICD-10, compared to ICD-9, the number of disease classes increased (from 17 to 21). The class of diseases of the nervous system and sensory organs was further subdivided into three classes:

Chapter VI – Diseases of the nervous system

Chapter VII – Diseases of the eye and its adnexa

Chapter VIII – Diseases of the ear and mastoid process

The auxiliary E-code is presented as an independent Chapter XX – “External causes of morbidity and mortality”, while the V-code is allocated to Chapter XXI – “Factors influencing health status and contact with health services.”

The total number of general blocks in ICD-10 is 258. To encode (classify) disease categories, a Latin letter (first character) and two digits are used. All letters of the English alphabet are utilized except for U. The letter U has been reserved for an additional class, intended for newly identified diseases as well as those with an uncertain etiology. This code can be applied in scientific research carried out on the basis of special programs.

The replacement of the first character in a category from a digit to a letter made it possible to increase the number of studied disease groups (categories) from 999 to 2600.

In some cases, one category represents a single specific disease, but in most cases, it includes groups of diseases that share common characteristics.

In ICD-10, the subcategories are arranged sequentially, taking into account the frequency, importance, and other features of diseases in healthcare.

Recording the causes of death still remains a problem for many countries. The proposed changes to the "Medical Certificate of Cause of Death" aim to clarify their causes more accurately, with particular attention given to the "Certificate of Perinatal Death."

Currently, in some regions of the world, injuries and poisonings rank 2nd–3rd among the causes of death. Therefore, in ICD-10, they are reclassified into separate blocks according to their localization. Special emphasis is placed on the causes of injuries and the circumstances under which they occur. The list of drugs and chemical substances leading to poisoning has been significantly expanded (to more than 5000 items).

The new classification, since some diseases affect several human organs and systems, allows coding them according to the degree of severity.

The principle of dual coding is retained in ICD-10, which makes it possible to conduct special studies on infectious and other diseases depending on which organs are more affected. A separate category is reserved for diseases that are not clearly diagnosed or cannot be identified. This, in turn, helps health administrators and researchers assess the quality of the diagnostic process.

The "unspecified conditions" class includes numerous possibilities, symptoms, and syndromes. This enables the identification and evaluation of healthcare-related problems in countries where medical services are not well developed.

In addition to outlining the basic principles of the modern structure of ICD-10, the following points should be highlighted:

A relatively small number of categories must cover the full spectrum of pathological conditions.

Diseases that are widespread and of major importance to public health must be presented

in separate categories.

"Other" and "unspecified" categories should be included, though their use should not be unrestricted.

ICD-10 was created for practical use in healthcare. Therefore, besides classification, diseases are also grouped into special categories:

-Epidemic diseases

-Constitutional or general diseases

-Local diseases (by anatomical site)

-Diseases associated with growth and development

-Injuries

Thus, ICD-10 became an important step toward improving the methodology for studying population health.

ICD-10 Classification of Diseases:

Class I – Certain infectious and parasitic diseases

Class II – Neoplasms

Class III – Diseases of the blood and blood-forming organs and certain disorders involving the immune mechanism

Class IV – Endocrine, nutritional, and metabolic diseases

Class V – Mental and behavioral disorders

Class VI – Diseases of the nervous system

Class VII – Diseases of the eye and its adnexa

Class VIII – Diseases of the ear and mastoid process

Class IX – Diseases of the circulatory system

Class X – Diseases of the respiratory system

Class XI – Diseases of the digestive system

Class XII – Diseases of the skin and subcutaneous tissue

Class XIII – Diseases of the musculoskeletal system and connective tissue

Class XIV – Diseases of the genitourinary system

Class XV – Pregnancy, childbirth, and the puerperium

Class XVI – Certain conditions originating in the perinatal period

Class XVII – Congenital malformations, deformations, and chromosomal abnormalities

Class XVIII – Symptoms, signs, and abnormal clinical and laboratory findings, not elsewhere classified

Class XIX – Injury, poisoning, and certain other consequences of external causes

Class XX – External causes of morbidity and mortality

Class XXI – Factors influencing health status and contact with health services

One of the main goals of studying public health is to improve the health of the population by reducing the prevalence of diseases and mortality. To achieve this, it is necessary to study the causes of diseases and death among the population in connection with environmental conditions, socio-economic and socio-biological factors, as well as lifestyle. This makes it possible to identify the magnitude of morbidity and mortality indicators and determine the leading causes behind them. Such knowledge helps medical professionals to forecast the health status of individuals or groups and to develop effective measures for its improvement.

At present, using socio-hygienic and mathematical methods, it is possible to

quantitatively determine the influence of environmental factors on human health, to assess the strength of these effects, and to forecast the trends of morbidity and mortality among the population.

Studies carried out in various regions, cities, and rural areas of our Republic have shown that mathematical methods allow for the creation of prognostic tables. With the help of these tables, it becomes possible not only to predict the health prospects of specific regions, districts, and populations (including children) but also to analyze the health of individual groups or persons in advance and develop targeted measures for its improvement.

This approach is especially important for safeguarding children's health, as they are highly sensitive to environmental factors. Identifying the future trends of morbidity and mortality in advance allows the development of scientifically grounded preventive measures aimed at further improving health outcomes. Therefore, in the following sections, we will explain the method of constructing a prognostic table of childhood morbidity and mortality rates, taking into account the main socio-hygienic and biomedical factors influencing them. This method is one of the simplest approaches to building prognostic tables and does not require the use of complex computational technologies.

1. One of the most important conditions for drawing up a prognostic table is to have precise indicators regarding childhood diseases.

For this purpose, information about diseases should be transferred from children's development histories (children's and adolescents' medical passports) to specially prepared questionnaires and studied through medical examinations. At the same time, living conditions, socio-hygienic, medical, biological, and genetic factors affecting children's morbidity should be examined.

To study children's diseases, a pre-determined program should be developed, and a special card-questionnaire should be created to record diseases and the leading factors influencing them. It is also necessary to collect sufficient observational and statistical materials. It is essential to identify the leading risk factors influencing morbidity and prognosis of diseases (such as the child's health status at birth, birth weight, number of pregnancies, type of infant feeding, the mother's age at childbirth, her education level, social status, housing conditions of the family, and others). The morbidity indicators should then be calculated for the entire studied group as well as for each gradation of every influencing factor. The general morbidity indicator (M) should be calculated per 1,000 children, including socio-hygienic factors, also per 1,000 children.

In Uzbekistan, protecting and strengthening the health of the population is one of the

state's most important medical and social tasks. This issue is reflected in the Constitution of the Republic of Uzbekistan and other legislative documents. All aspects of protecting public health are fully covered in the Law of the Republic of Uzbekistan "On the Protection of Citizens' Health," adopted on August 29, 1996.

Before describing different aspects of public health protection, it is necessary to clarify the concept of "health protection," since until the 1950s different countries gave various definitions of this term. In 1952, WHO experts on the organization of public health gave the following definition:

"Health protection" is the art and science of strengthening the organizational activities of society aimed at improving the environment, preventing diseases, prolonging life, ensuring mental and physical health, increasing human activity efficiency, combating infectious diseases, teaching people personal hygiene rules, organizing medical and health services for early diagnosis and prevention, as well as developing social mechanisms to improve and support every person's living standard and health. When such well-being is ensured, each citizen gains the opportunity to realize their inalienable right to longevity and a healthy life.

Today, it is clear to all of us that public health protection is not only the responsibility of health care organizations. It is a task of the state and society as a whole, but in managing this process, the healthcare system plays a crucial unifying and coordinating role. One of the main goals of public health is to organize comprehensive healthcare services based on the needs of the target population group. Therefore, it is necessary to have accurate information about the health status of the population and the available resources.

Thus, the essence of public health is to strengthen population health, prevent, diagnose, and treat diseases, as well as to provide physical, social, and occupational rehabilitation, ensuring availability of trained personnel and the necessary medical equipment and instruments for healthcare delivery.

In Uzbekistan, the protection of public health is carried out through a strong healthcare system that has been developed over many years.

The healthcare system refers to the set of state and social measures aimed at organizing medical care, preventing diseases, and improving the health status of the population, which also has a socio-economic character. Medical care means a set of treatment and preventive measures provided by persons with higher or secondary special medical education during childbirth, illness, injuries, or poisoning.

The Law of the Republic of Uzbekistan "On the Protection of Citizens' Health" guarantees citizens' rights regarding health protection by the state, promotes the formation of a healthy lifestyle among citizens, and legally regulates the activities of state authorities, enterprises, institutions, organizations, and public associations in the

field of health protection.

According to the definition of the World Health Organization (WHO), the healthcare system is a set of interrelated measures aimed at strengthening health, carried out at home, in educational institutions, workplaces, communities, and in physical, mental, and social spheres, as well as in healthcare and related institutions.

In Uzbekistan, the development of the healthcare system and the protection of citizens' health are carried out taking into account the country's unique socio-economic, social-geographic, demographic, morbidity, and sanitary-epidemiological characteristics.

The main principles of health protection in Uzbekistan include:

-Respect for human rights in the field of healthcare,

-Equal access to medical care for all segments of the population,

-Priority of preventive measures,

-Social protection of citizens' health,

-Unity of medical science and practice.

Protecting and improving public health is one of the key social tasks of our government. For this purpose, numerous medical institutions operate in the Republic: republican, regional, city, and district central hospitals, medical-sanitary units, maternity complexes, polyclinics, dispensaries, rural medical points, the Republican Scientific Center of Emergency Medical Aid with its regional, city, and district branches, specialized republican scientific-practical medical centers and their branches, clinical bases of medical educational institutions, and other healthcare facilities serving the population.

To improve medical services for all groups of the population, especially for rural residents, medical services have been brought closer to them, ensuring access to qualified healthcare. When establishing 793 rural family polyclinics, special attention was paid to demographic indicators and morbidity rates of the population.

Many scientists around the world believe that the goal should not be only treating diseases, but also preventing them and strengthening public health. This concept is becoming increasingly important because preventing a disease is cheaper than treating it. Therefore, the organization and planning of healthcare services are carried out with a focus on disease prevention and health protection. The development of the healthcare system is considered to be associated not only with disease treatment but also with health preservation, which leads to an increase in the role of preventive activities of healthcare

institutions.

It should be emphasized that the concept of "maintaining the health of the healthy" must become a reality, as this will lead to the efficient use of healthcare resources. There is a proverb: "It is better to prevent a disease than to cure it."

First, the cost of treating a patient's illness is much higher than the cost of preventive measures. Second, the psychological state of the sick person, the possibility of the disease becoming chronic, disability, or in some cases death, significantly damage public health, shorten life expectancy, and reduce the population's labor activity. Third, illness causes material and moral damage to the patient's family.

Therefore, in our Republic, preventive measures are a priority in protecting public health and developing the healthcare system.

The Ministry of Health, government bodies, regional and local health departments, city and district health associations, state sanitary-epidemiological control centers, neighborhood committees, and many other state and non-governmental organizations carry out measures to ensure the sanitary-epidemiological well-being of the population, improve environmental conditions, nutrition, working, living, recreational, educational conditions, fight epidemics, and protect nature.

The Ministry of Health determines the directions and scope of preventive care at the local level, sets the timing and methods of preventive vaccinations, and supervises the promotion of a healthy lifestyle among the population.

In healthcare practice, there are other types of medical examinations as well—for example, one-time comprehensive medical examinations for private car drivers.

With relatively little expense, it is possible to cover large segments of the population with preventive examinations using various test methods. Such organizational forms of medical examinations are called "screening." The word "screening," borrowed from English, means "filtering" or "selecting out."

Screening is a method of detecting individuals suspected of having a disease or those with early signs of illness through mass examinations of the population. The main purpose of screening is to identify high-risk groups for certain diseases, select individuals requiring further in-depth examination, and provide consultation with specialized experts. Compared to other types of medical examinations, this method is more cost-effective.

There are two types of screening:

1. Single-subject (targeted) screening – conducted to identify a specific disease.

2. Multi-subject (multi-purpose) screening – carried out to detect several diseases at once.

Both types of screening may consist of several stages (multi-stage screening).

One of the main sources of information for studying general morbidity is preventive and targeted medical examinations as well as dispensary observation among the population. This method allows for the detection of hidden, previously unknown, or chronic diseases that do not force people to actively seek medical care. The data obtained from examinations, combined with information from patients' direct visits to medical institutions, supplement and clarify morbidity statistics, providing a more complete picture of the general health situation of the population.

Screening is a mass examination of individuals to detect an undiagnosed disease or risk factor, for example, using a smoking-related questionnaire, the Michigan test for alcohol consumption, instrumental examinations (mammography, X-ray), or laboratory tests (blood glucose or hemoglobin levels). These methods can be carried out relatively quickly.

Screening is considered a secondary preventive measure and helps identify sick individuals among those who consider themselves healthy—for example, detecting early stages of cervical cancer through a Pap smear. Screening also helps identify risk factors such as high cholesterol levels in individuals at risk of developing atherosclerosis.

Without screening, diagnosis is usually made only after symptoms of the disease appear. However, in many cases, the disease begins before symptoms emerge, and this can only be detected by screening tests.

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