Ministry of Healthcare **of** *Ukraine*
O. O. Bogomolets National Medical University

Department of hygiene and ecology №2

METHODICAL INSTRUCTIONS

For individual work of students
During preparing for practical lesson in the discipline "Occupational health and safety in the healthcare sector"
On the topic:

Professional harmful factors during the performance of the functional duties of healthcare workers

Kyiv – 2020

MINISTRY OF HEALTHCARE OF UKRAINE
O.O. BOGOMOLETS NATIONAL MEDICAL UNIVERSITY

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from _____ 20___.

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INSTRUCTIONS

FOR STUDENTS' INDEPENDENT STUDIES
IN PREPARING FOR PRACTICAL WORK

Discipline	Occupational (Labor) hygiene
Module № 1	Occupational health in the field
Module № 2	Occupational health issues in the medical field
Topic	**Professional harmful factors during the performance of the functional duties of healthcare workers**
Course	II, III
Faculties	Medical №1-4, FTDAFU, dentistry, medical-psychology

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1. Relevance of the topic:

Medical workers make a significant contribution to maintaining the health of the working population, and, therefore, to improve the efficiency of the state's labor potential and the welfare of its citizens.

In the process of performance of labor duties, medical workers have to contact with many occupational hazards and unlike workers of other categories, it is not always possible to take into account all the production factors that affect the body of medical workers and determine their intensity. It should be noted that the combined effect of different manufacturing factors in the activity of health workers is more common than in the conditions of production. In some cases, it is difficult to single out the most significant and leading factors out of a huge number of operating factors, it is important to take into account the effect of the complex of factors of the production environment and the labor process that affect the organism.

The levels of morbidity, disability and mortality of health workers are very high. In addition, the presence of a "hidden" incidence due to self-treatment or seeking help from colleagues is typical for medical workers (the number of medical workers who have a chronic pathology is 15-20% lower according to medical records than in a questionnaire survey). According to researchers, the average life expectancy of a doctor according to world statistics is only 54 years. The average life expectancy of a dentist is 51 years, 80 out of 100 male dentists do not live to the retirement age.

Therefore, at present, knowledge about the harmful factors of the working environment and the labor process of medical workers, the peculiarities of their action on the human body, the main means of preventing this adverse effect acquire special importance.

2. Specific objectives:

1. Classify the harmful and dangerous production factors affecting health workers.
2. Analyze and evaluate the harmful factors of the working environment that affect health professionals during the performance of their professional duties.

3. Basic knowledge and skills (interdisciplinary integration)

Name of discipline	Knowledge
Human anatomy	Analyze information about human body organization, systems, which make up it, organs and tissues. Determine the topographic and anatomical relationships between human organs and systems.
3.Medical and biological physics	Explain the physical basis and biophysical mechanisms of the action of external factors on the systems of the human body. To treat the general physical and biophysical regularities that underlie a person's vital activity.
Medical chemistry	Interpret the types of chemical equilibrium for the formation of a holistic physicochemical approach to the study of the processes of

	vital activity of the organism. To apply chemical methods of quantitative and qualitative analysis. Classify chemical properties and metabolism of bio-organic substances in the process of vital activity of the organism. Treat general physical and chemical patterns that underlie human life processes.
Microbiology and immunology	Interpret biological properties of pathogenic and non-pathogenic microorganisms, incl. viruses and patterns of their interaction with the macroorganism, with human population and the environment.
Physiology	Analyze the state of human health in different conditions on the basis of physiological criteria.
Biologic and bioorganic chemistry	Interpreting the importance of metabolic biochemical processes and their regulation in ensuring the functioning of organs, systems and the whole human body.

4. Task for individual preparing for the lesson

4.1. List of main terms and characteristics to be learned by the student during the preparation to the lesson:

Terms	Definition
Labor Hygiene	a branch of practical and scientific activity that studies the health of workers under the influence of working conditions and on this basis, develops measures and means to preserve and strengthen the health of workers, and to prevent the adverse effects of working conditions.
Occupational safety	a system of legal, socio-economic, organizational and technical, sanitary-hygienic and therapeutic and preventive measures and means aimed at preserving the health and working capacity of a person in the labor process.
Working conditions	a combination of factors of the working environment and the labor process that affect the health and working capacity of a person during the performance of his labor duties.
Safe working conditions	the state of working conditions in which the influence on the employee of hazardous and harmful production factors is eliminated, or the effect of harmful production factors does not exceed the maximum permissible values.
Harmful production factor	production factor, the effect of which on a worker under certain conditions can lead to a disease, a decrease in working capacity and (or) an adverse effect on the health of offspring.
Dangerous production factor	a production factor which under certain conditions may cause injury of an employee, acute poisoning or other sudden sharp deterioration in health status or death.
The maximum permissible value	the limiting value of the magnitude of the harmful production factor, which effect on a person in the case of his daily regulated duration

of the harmful (production) factor	does not lead to a decrease in working capacity and illness during the period of labor activity and in the next period of life, and also does not adversely affect the health of the offspring.

4.2. Theoretical questions to the lesson:

1. Definition of the concepts of "occupational health", "labor protection", "working conditions", "harmful production factor", "dangerous production factor," etc.
2. Classification of labor of medical workers.
3. Classification of hazardous and harmful production factors.
4. Psychophysiological harmful and dangerous factors of the working environment and their impact on the health status of health workers.
5. Physical harmful and dangerous factors of the working environment and their impact on the health status of health workers.
6. Chemical harmful and dangerous factors of the working environment and their impact on the health status of health workers.
7. Biological harmful and dangerous factors of the working environment and their impact on the health status of health workers.
8. Features of hygienic assessment of harmful factors in the production environment.

4.3. Practical tasks performing during the lesson:

Situational tasks:

Task 1

1. Describe the psychophysiological, physical, chemical and biological hazards that can affect surgeons when performing surgical interventions.

Doctors-surgeons in the operation are in a standing position with a torso at an angle of 35^0 for 70% of the working time. At the same time, they are forced to perform up to 100 torso inclinations up to an angle of 32^0 (energy consumption is 180 kcal / h). The work of surgeons is characterized by considerable emotional stress.

When conducting sanitary and hygienic studies it was found that the air temperature in the operating rooms (at permanent workplaces) in the warm season is 32^0 C, relative humidity 78%, air speed 0.01 m / s, infrared radiation levels 50 W / m2 (no more than 25% of the body surface of the worker is exposed to irradiation).

2. Give a hygienic description of the working conditions of surgeons.
3. Describe changes in the health status of surgeons that can occur under the influence of harmful production factors.

Task *2*

1. Describe the psychophysiological, physical, chemical and biological hazards that can affect dentists.

The labor process of dentists is a combination of mental and physical labor, which requires the stress of the functions of the visual analyzer and coordinated movements of the hands. The density of the working day is 92.8%.

Doctors-dentists in most of their functional duties are in a standing position with a torso at an angle of 35-400 for 80% of the working time. At the same time, they are forced

to perform up to 100 torso inclinations at an angle of 320. The rest of the shift (20%) dentists work in the sitting position. Their work is also characterized by considerable emotional stress.

Sanitary and hygienic research has shown that when working with high-speed drills and turbines, the following noise levels are created at dentists' workplaces:

Work place	Sound pressure levels in dB in octave bands with mean geometric frequencies, Hz									Sound`s levels, dBA.
	31,5	63	125	250	500	1000	2000	4000	8000	
Work place of a dentist	96	83	74	68	63	60	57	55	54	65

1. Give a hygienic description of the working conditions of dentists.

Permissible sound pressure levels, sound levels and equivalent sound levels in workplaces (Extract)

Type of employment, workplace	Sound pressure levels in dB in octave bands with geometric average frequencies, Hz									Noise levels and equivalent noise levels, dBA, dBAeq.
	31,5	63	125	250	500	1000	2000	4000	8000	
Enterprises, institutions, organizations 1. Creative activities, high-demand leadership, research, design and engineering, programming, teaching and learning, medical practice.	**86**	**71**	**61**	**54**	**49**	**45**	**42**	**40**	**38**	**50**

2. Describe the changes in the health of dentists, which can occur under the influence of harmful production factors.

5. Topic Content.

The healthcare sector is one of the most widespread area of human labor activity. There are more than 170 medical specialties in it. According to the WHO (2009, 2013), more than 143,000 doctors are employed in the health care system of Ukraine (31 per 10,000 population - 2009, 35.2 per 10,000 population - 2013), more than 388 thousand nursing and midwifery personnel (85 and 64.1 per 10 thousand population), more than 19 thousand dental staff (4 and 6.7 per 10 thousand population) and 22 thousand other health care providers (5 per 10 thousand population).

According to WHO, in 2013, the total healthcare expenditure per capita in Ukraine was $ 234 (for comparison: in the US - 8233, Norway - 8039, Switzerland - 7699, Poland - 851, the Russian Federation - 670, Nauru - 596, Cuba - 583, Lebanon - 574, Mauritius - 465, Colombia - 407, Gabon - 309, Namibia - 269, Swaziland - 243, El Salvador - 238, Liberia - 41, Myanmar, Niger - 17, Ethiopia, Madagascar - 15 Eritrea - 13 Pakistan - $ 10).

Classification of medical workers by types of work

The work of health workers can be divided into:

– doctors' work;

– work of the average medical personnel (nurses, paramedics, doctors' assistants, dental technicians, etc.);

– work of junior medical personnel.

The following types of labor of doctors and nurses are distinguished: therapeutic, surgical, dental, hygienic profile, with special research methods, etc.

The type of work of medical workers of the same profile is significantly influenced by the type of medical institution (hospital, polyclinic, emergency medical service), the department in which they work.

The main harmful and dangerous factors of the working environment and the labor process of medical and pharmaceutical workers

Classification of hazardous and harmful production factors

1.1. Опасные и вредные производственные факторы подразделяются по природе действия на следующие группы: физические, химические, биологические и психофизиологические.

1.1.1. Physical hazardous and harmful production factors are divided into:

– increased dustiness and gassing of the air in the work area;
– increased or lowered air temperature of the working area;
– increased noise level in the workplace;
– increased level of vibration;
– increased level of ultrasound;
– increased or decreased air humidity;
– increased level of ionizing radiation in the work area;
– increased level of electromagnetic radiation;
– insufficient illumination of the working area;
– increased level of ultraviolet radiation, etc.

1.1.2. Chemical hazardous and harmful production factors are subdivided:

1) Depending on the character of influence on human body:

– toxic;
– irritating;
– sensitizing;
– carcinogenic;
– mutagenic;
– affecting the reproductive function.

2) The path of penetration into the human body through: respiratory organs, gastrointestinal tract, skin and mucous membranes.

1.1.3. Biological hazardous and harmful production factors include the following biological objects: pathogenic microorganisms (bacteria, viruses, rickettsia, spirochetes, fungi, protozoa) and products of their vital activity.

1.1.4. Psychophysiological dangerous and harmful production factors by the nature of the action are divided into:

a) Physical overloads: static and dynamic;

b) Psychic overload.

– Mental overstrain;
– Analyzer overload;
– Monotony of work;
– Emotional overload.

Psychophysiological harmful and dangerous production factors, their impact on the health status of medical workers.

The work of medical workers is characterized by considerable intellectual overload, and in some cases requires considerable physical endurance, attention and high working capacity under extreme conditions.

Emotional overload. For the majority of professional groups of medical workers emotional stress is one of the main harmful production factors that adversely affect their health. And the effect of this factor in recent years has not diminished, but continues to grow. So, for example, in the 80s of the last century, 60% of doctors believed that their work is accompanied by a emotional overload. At present, this percentage has increased to 74% for doctors, and for nurses - 82%. First of all, nervous and emotional stress is noted by the staff of psychiatric hospitals and dispensaries, intensive care units, obstetrician-gynecologists, hospital surgeons, neurologists, emergency medical personnel. Main causes of emotional overload:

– permanent responsibility for people's health and life (their own, patients, colleagues);

– daily contact with people of different ages (children, elderly people, etc.), social status (patients and their relatives, heads of various institutions, population), various psychological characters;

– the need to urgently make decisions, often the only true ones, with a lack of information and time;

– a significant number of stressful situations;
– shift work (with night shifts);

– socio-economic (lack of stable and full funding of the medical industry, and as a consequence, lack of necessary drugs, equipment, equipment, late payment and low wages), etc.

The work of medical workers, and especially doctors, is characterized by considerable intellectual load, requires a large volume of operational and long-term memory, contains elements of creativity and associated with responsibility for the health and life of others.

As shown by psychophysiological studies of different groups of medical workers, their work can be divided into two main categories: mental and mental-emotional. The first is the work of physicians of therapeutic profile, with the exception of doctors of intensive care units, hygienists, researchers. The second - the work of doctors in the surgical profile of hospitals, anesthesiologists, intensive care units, emergency doctors, etc.

In people who perform mental and emotional work, the emotional overload especially high. So, surgeons in the process of performing the operation there is a stronger increase in heart rate compared with therapists who are taking patients. At critical moments of the operation, surgeons can increase the latent period of the motor reaction, the number of errors in all types of reactions, until the end of the working day, the speed of perception and processing of information decreases, indicating the development of considerable fatigue. Fatigue of physicians in the therapeutic profile of a hospital is characterized by a decrease in mental capacity, and the function of sustained attention is particularly affected.

Many doctors, nurses and other medical staff have to work not only in the daytime, but also in the evening, and even in the night shift. This is due to the need for round-the-clock care of patients. Transition of medical workers from one shift to another is accompanied by destruction or reorganization of daily biorhythms. The change in the daily rhythm of functional activity can cause persistent sleep disturbances in the workers, a decrease in the reliability of the mechanisms of homeostatic regulation, and become the starting link in the pathogenesis of many somatic and psychic diseases.

In addition to the shift work, the duration of the shift can also significantly influence the medical workers. So, although for different categories of physicians a certain duration of the working day is fixed at 5-8 hours, the real working shift in many hospitals leaves 12 or even 24 hours. More than 30% of doctors and 50% of average medical personnel work additionally at part-time in the main workplace or in other health facilities, which increases the total time of contact with harmful factors of the working environment.

Work of a number of medical workers (doctors of ambulance, dentists, surgeons, etc.) is characterized not only by a combination of high emotional overload but physical overload.

Physical overload. The level of physical activity in performing different types of labor among medical workers is not the same. So, physicians, laboratory technicians, ophthalmologists, otolaryngologists and others, performing work in the sitting position, physical loads are insignificant. This group of workers is characterized by the presence of hypodynamia. For example, the motor activity of otolaryngologists is only 4.7% of the time taken. Especially unfavorable is the combination of hypodynamia with a high level of emotional stress. At the same time, the work of masseurs, traumatologists, surgeons, urgent and family care doctors, hygienists, nurses, and some groups of nurses is characterized by considerable energy expenditure. And for some groups of medical

workers is characterized by the performance of dynamic work (lifting and carrying the cargo by ambulance personnel, hospital attendants, etc.), and for others - static (surgeon during the operation, dentist, etc.). The length of time at the operating table is 94% of the working hours for obstetrician-gynecologists, 83% for obstetrician-gynecologists, 77% for surgeons. Significant static loads are often combined with uncomfortable forced working postures. So, in a forced posture, with a torso tilt, the therapist performs percussion, palpation, auscultation, measures blood pressure, examines the skin. Doctors and nurses work mostly sitting or standing, and when performing certain operations, combinations of poses are possible. When in a working posture, the load on the muscles of the lower limbs increases, a redistribution of blood and a possible worsening of the blood circulation are observed. Work in a sitting position is less unfavorable, as the height of the center of gravity over the support area decreases, the stability of the body increases, the muscle tension decreases, and the load on the cardiovascular system decreases. However, when sitting for a long time, the static tension of the muscles of the neck, shoulder girdle, and back is often observed. Change in the posture leads to a redistribution of the load on the muscle groups, improves blood circulation, limits the elements of monotony.

Often irrational work posture is associated with the fact that medical equipment (tables, medical couches, wheelchairs, etc.), currently used in medical institutions, does not meet the basic ergonomic requirements in terms of parameters and design features (chairs with firm fixation, lack of height regulation equipment, lack of armrests, etc.).

Pose with a slight inclination forward in writing many experts refer to the physiological.

However, as a result of improper organization of the workplace in the preparation of medical documentation, the doctor is often forced to rotate the upper part of the trunk around the axis, which leads to the formation of a rotation angle of the body to the front line. In such an artificially created forced pose, the doctor sometimes has almost a third of his working time. The fixed bent sitting position causes a significant strain on the muscles of the back and neck. In addition, while the blood supply to the internal organs worsens, especially in the pelvic region, respiratory movements become difficult, the muscles of the abdominal and pelvic floor are weakened. In this regard, people working sitting can develop curvature of the spine (kyphosis, scoliosis, lordosis) in women - changes in the position of the uterus, violations of menstrual function, weakness of labor, frequent gaps in the perineum during childbirth,

A fixed standing position can lead to diseases of the lower body organs - stagnant phenomena in the pelvic organs and vessels of the lower limbs, which can lead to flat feet, widening of the veins of the lower extremities, omission of the internal organs, changes in the position of the uterus in women,

Medical workers performing work in a standing position with a torso tilt and arms outstretched (dentists and other specialists performing surgical activities (thoracic, abdominal surgery, etc.), posture disorders, in particular, the development of kyphosis. Long standing causes pain in the muscles of the back, waist, neck and shoulders, causing the appearance of osteochondrosis.

Diseases of the musculoskeletal system and damage to soft tissues such as tendinitis arise as a result of the use of furniture and equipment that do not correspond to individual anatomical and physiological characteristics. Tendinitis can also develop as a result of

increased motor activity (the performance of stereotyped movements of individual parts of the body) and microtraction. It is manifested by pain in the chest, and also in the fingers of the hands from long letters, printing on the computer keyboard, etc.

Prolonged psychoemotional loads can cause severe cardiovascular diseases - hypertension, angina pectoris, myocardial infarction, heart failure, etc., as well as stroke, diabetes mellitus, diseases of the nervous system.

Burnout syndrome is highly prevalent among healthcare professionals due to the intense and continuous nature of contact with individuals receiving care. Burnout is a state of emotional, mental, and physical exhaustion caused by excessive and prolonged stress. It occurs when you feel overwhelmed and unable to meet constant demands. As the stress continues, you begin to lose the interest or motivation that led you to take on a certain role in the first place. Psychological changes such as difficulty in social relationships, moodiness, anxiety, and irritability are also frequent.

Physical hazardous and harmful factors in the working environment and their impact on the health status of healthcare workers

The implementation of the modern medical equipment led to the influence of physical factors on the medical workers: unfavorable microclimate, noise, ultrasound, vibration, ionizing, non-ionizing, laser radiation, etc.

Microclimate. A production microclimate is a combination of temperature, relative humidity, air speed and infrared (thermal) radiation in the work area. It largely depends on the meteorological, or climate-weather conditions of the region, and in certain types of work (outdoors) can be completely predetermined by them. Microclimate affects the heat exchange of a person with the external environment, largely determines its thermal state, well-being, work capacity, labor productivity.

Conditionally, all medical workers depending on the influence of microclimate on them can be divided into two groups:

- labor activity, that mainly occurs in the room (surgeons, dentists, otolaryngologists, psychiatrists, etc.);
- work, which is more or less related to staying outside the premises (district therapists, pediatricians, ambulance doctors, etc.).

In operating units in the warm period of the year, in the absence of artificial ventilation, the air temperature can reach 26-28 ° C or more, and in operating rooms with air conditioning - 24 ° C with low relative humidity (28-45%) and almost immobile air. Even in winter, the air temperature in the operating room may exceed the permissible values by 3-5 °C. As a result, 80.2% of surgeons complain of a heating microclimate. Much of the loss of moisture in surgeons during surgery depends not only on the degree of emotional load, but also on air temperature. At the temperature of the air in the operating room 21-22 ° C, the loss of moisture by the surgeon's body due to perspiration is 0.75 g / min, at 25-26 ° C - 2.75 g / min, sometimes reaching 700 g per operation. Possible overheating of the body in the members of the surgical team. This can be facilitated by an increase in the duration of the operation day, a gradual cumulating of heat in the body, and shortcomings in surgical clothing. A cap, mask, gown sleeves cover those skin areas that are usually actively involved in the increase in heat transfer during hyperthermia. Frequent treatment of dressing gowns (washing, sterilization, ironing) significantly reduces air

permeability of the tissue, which leads to even more heating of the body in medical workers.

In a number of rooms of the physiotherapeutic unit (balneological, shower rooms, swimming pools, etc.), as a rule, there is an increased humidity of air (up to 75-87%). And in the warm period of the year it often combines with high temperature of air (21-25 °C), and in the cold season - with a reduced (16-18 ° C). Irregularities in the organization of the work regime can also lead to the thermal discomfort of medical personnel. So, for example, in dental offices continuous work for 3 hours leads to an increase in the air temperature of working rooms to 22-24°C and relative humidity up to 70%. The maximum temperatures are noted in the offices of orthopedic dentistry, which is due to the use of gas burners in the work of prosthetists. This also applies to dental laboratories with a large number of dental workplaces that constantly use gas burners. Air humidity, as a rule, is within the norm in all rooms, except for the so-called "cooking", where it is increased to 80% due to the release of moisture during the polymerization of plastics.

Medical workers (district therapists, pediatricians, emergency and emergency medical personnel, etc.), whose work activities take place both inside and outside the premises, are exposed to a contrasting microclimate. Sudden and frequent changes in the temperatures of the external and internal (indoor) air, its humidity and speed of movement do not allow this category of workers to adapt to the often changing conditions of the microclimate.

Levels of infrared radiation in the health facilities (physiotherapy departments, laboratories, sterilization, disinfection, laundry, etc.), as a rule, do not exceed hygienic regulations.

Prolonged action on the body of high temperature can cause an increase in body temperature to several tenths of a degree, and if the mechanisms of thermoregulation are insufficient, 1-2 °C or more. When performing physical work, and, consequently, with higher heat production, the body temperature rises faster and larger. If the body's overheating is moderate, the heart rate increases and the blood flow accelerates.

The action of a high temperature of the ambient air on a person causes changes in the vessels tonus and the blood filling. In this case, the blood vessels of the muscles and internal organs narrow, and the peripheral vessels of the skin expand.

Under the influence of high air temperature and infrared radiation, in the body develops hypoxia, as well as significant water-salt exchange disturbances associated with the loss of a significant amount of water and electrolytes.

With the subsequent release organic and inorganic substances, which account for 0.26-0.78% of the total mass of sweat. About 2/3 of them are inorganic compounds and 1/3 - organic. Inorganic substances are mainly sodium chloride (64-74%); about half of the total mass of organic compounds is urea. The main component of sweat is water - about 99.5%.

In addition to sodium chloride, ions of magnesium, copper, iodine, manganese and other elements are subsequently removed, which can lead to a violation of the conduction of the heart muscle, increase the permeability of the vascular walls and membranes of blood cells.

Removal of water-soluble vitamins (ascorbic acid, thiamine, pyridoxine) with intense sweating can lead to a violation of their metabolism.

Noise, infra- and ultrasound. From a physical point of view, noise, infra- and ultrasound are acoustic mechanical vibrations. The human ear does not perceive the entire acoustic range of waves. We hear only sounds with a frequency of 20 to 20,000 Hz (audible range).

Noise is a collection of sounds of different frequency and intensity, randomly changing in time. In medical professionals and patients causes unpleasant sensations and objective changes in organs and systems. Implementation of new powerful equipment in medicine leads to a significant increase in noise levels.

The main sources of noise in hospitals include:

- ventilation and air conditioning systems;
- anesthetic and respiratory apparatus;
- apparatus that suck liquid;
- high-speed drills;
- engineering and technological equipment (elevators, water supply and sewerage systems).

For example, the air-conditioning system in the surgery units, sometimes can causes increasing of the noise level by 5-19 dBA above the maximum permissible levels (MPL), and some anesthetic and respiratory apparatuses increase it by 26-30dBA, reaching 73 dBA. The noise from the engineering and technological equipment (elevators, water supply and sewage systems, ventilation and air conditioning, centrifuges, electric vacuum cleaners, etc.) can reach 93 dBA.

Noise has an impact not only directly on the auditory analyzer, but also on the central nervous system that leads to violations of the functions of various body systems. Changes in the human body arising from the impact of noise on it can be conditionally divided into specific, appearing in the hearing organ, and nonspecific, which arise in other organs and systems of the body.

Changes that occur in the sound analyzer due to the impact of noise (sufficiently intense and prolonged) are characterized by a slowly progressive decrease in hearing as the type of cochlear neuritis.

Such levels of noise can have a harmful effect on the central nervous system, cardiovascular, immune system, vestibular analyzers of medical workers (nonspecific effects).

Noise is one of the most significant stressful production factors.

Against the backdrop of the intellectualization of doctors' work, there is an increase in the harmful effect of noise of medium intensity (below 80 dBA). Noise of this intensity does not cause hearing loss, but increases irritability and fatigue, which, with an increase in the length of service can lead to the development of somatic disorders and diseases.

Ultrasound in the frequency range is conventionally divided into low frequency (20-100kHz), which propagates through air and by contact, and high-frequency (100kHz - 1000MHz), propagating only by contact. Currently, high-frequency ultrasound is used to diagnose and treat many diseases in cardiology, surgery, obstetrics, gynecology, neurosurgery, neurology, ophthalmology, dentistry, otorhinolaryngology, dermatology and urology, physiotherapy. Low-frequency ultrasound is used to dissect and connect biological tissues, destroy neoplasms, sterilize instrumentation.

Medical personnel may be adversely affected by ultrasound in the systematic maintenance of diagnostic, therapeutic and surgical equipment, sterilization equipment, etc.

Low-frequency ultrasound with levels of intensity exceeding the maximum allowable, can cause in medical workers functional changes in the central and peripheral nervous, cardiovascular, endocrine systems, auditory and vestibular apparatus. The staff often complains of headache, general weakness, dizziness, memory impairment, irritability, decreased efficiency.

Long-term action of contact ultrasound causes lesions of the peripheral neurovascular apparatus (vegetative polyneuritis, finger paresis).

In the premises where using ultrasound equipment, infrasonic waves can occur when air conditioners, ventilation systems are operating. Depending on the frequency and time of their impact, changes in the body can be functional or pathological.

Infrasonic waves, due to resonance with fluctuations of internal organs, have a pronounced adverse effect on the body and cause changes in the CNS, the cardiovascular system and endocrine system, as well as disruption of the function of the cochleo-vestibular analyzer; while the severity of these changes depends on the intensity, frequency and duration of the infrasound influence.

Low-frequency acoustic vibrations, including the infrasonic range, cause a feeling of chest wall vibration, dry mouth, visual impairment, headache, dizziness, nausea, coughing, choking, discomfort in the hypochondrium, ringing in the ears and difficulty in modulating the tongue, swallowing and some other painful symptoms.

Vibration - complex mechanical vibrational movements of the instrument, floor, seat, which are transmitted to the body of a person or its individual parts in direct contact. The impact of vibration is determined by the intensity levels, the spectral composition, the way it is transmitted to the person and the physical properties of his body. Influencing the human body, the vibration spreads through the tissues, irritates the mechanoreceptors, causes reflex and subjective reactions. It can also directly affect individual organs or the entire human body as a whole.

Among medical workers, vibration mainly affect dentists, massage therapists and nurses of physiotherapy departments working with vibrating equipment (dental equipment, electric massagers, etc.), as well as ambulance and emergency medical personnel. Dentists massage therapists and nurses of physiotherapy departments are mostly affected by local vibration and emergency medical personnel – by general (transport) vibration.

Long-term exposure to vibration of medical workers can lead to persistent pathological abnormalities in nervous, cardiovascular, hearing system, causing a vibrational disease.

Effects of vibration on humans are determined by deformation or displacement of organs and tissues that disrupt their normal functioning and lead to irritation of numerous mechanoreceptors that perceive vibration. All this is reflected in the physiological and psychic reactions of the human body.

Vibration of low frequencies causes disturbances in the functional state of the vestibular analyzer, which manifest themselves as a state of "motion sickness" - a motion sickness manifested in the following main clinical forms: nervous, cardiovascular,

gastrointestinal and mixed. At high frequencies there is an increase in fatigue of the muscular system; conditions are created for microtrauma of the musculoskeletal system.

Low-frequency general vibration causes prolonged traumatization of intervertebral discs and bone tissue, displacement of abdominal organs, changes in motility of smooth muscles of the stomach and intestines, can cause pain in the lumbar region, the emergence and progression of degenerative changes in the spine, chronic sciatica disease.

When low-frequency vibration is applied, visual acuity is reduced, color perception is violated, visual field boundaries are narrowed, the stability of clear vision diminishes, functional mobility of eyeballs decreases, eye observation becomes impaired, the perception of objects is impaired, and reading becomes more difficult.

Vibration is considered as a strong stress factor, having a negative impact on the psychomotor performance, emotional sphere and mental activity of a person and increasing the likelihood of accidents.

Electromagnetic oscillations. Electromagnetic oscillations, depending on the energy, are divided into non-ionizing and ionizing radiation.

The ionizing radiation is electromagnetic oscillation, which quantum energy is sufficient for the ionization of molecules and atoms. If the energy of quanta of electromagnetic oscillations interacting with the tissue is insufficient for the ionization of atoms, they are called non-ionizing radiation.

Non-ionizing radiation. In nowadays electromagnetic oscillations are widely used in medicine with a therapeutic and diagnostic purpose: magnetic field therapy, pyrotherapy, electrosleep, infrared, ultraviolet radiation, etc. ; for heating chilled blood for rapid removal of hypothermia after open heart surgery; for the thawing of canned organs and tissues; in the treatment of frostbite. Promising is the use of electromagnetic fields to increase the immune resistance of tissues, as well as in the treatment of malignant neoplasms. Magnetic resonance tomographs are increasingly used to diagnose diseases. The scattering field near the tomograph can reach high values. The source of electromagnetic fields are also personal computers.

Electromagnetic waves can adversely affect a person. The intensity of the action depends on the power of the source (source) of electromagnetic radiation, the wavelength, the design features of the radiating devices, the technical state of the equipment, the duration and nature of the action (permanent, intermittent), the area of the irradiated surface, the effectiveness of protective measures, the location of the workplace, the anatomical structure of the organ, exposed to the fields, electrical and magnetic properties of biological tissues. Millimeter range Electromagnetic waves absorb superficial skin layer, centimeter - skin and the underlying tissues, decimeter - penetrate to a depth of 8-10 cm. For longer waves, the tissues of the human body are a good conductive medium.

The mechanism of disorders occurring in the body under the influence of EMF is due to their non-thermal and thermal action. The non-thermal effect of EMF is determined by biochemical changes occurring in cells and tissues. The most sensitive are the central nervous and cardiovascular systems. There are violations of conditioned reflex activity, a decrease in brain bioelectrical activity, changes in interneuronal connections, and deviations from the endocrine system are possible.

In the initial period of action, the excitability of the nervous system may increase, in the future, its function decreases, manifested in astheno-neurotic states. In this regard,

the chronic effect of EMF is characterized by headache, fatigue, deterioration of health, arterial hypotension, bradycardia, change in conduction of the heart muscle, etc.

The thermal effect of EMF is characterized by an increase in body temperature, local selective heating of tissues, organs, cells due to the transition of EMF energy to thermal energy. The intensity of heating depends on the amount of absorbed energy and the rate of heat outflow from the irradiated parts of the body. The outflow of formed heat is difficult in organs and tissues with poor blood supply. First of all, the lens of the eye, which does not have blood vessels, is affected. Under the influence of irradiation, coagulation of proteins can occur in it, which leads to the development of cataracts. The heating of the EMF of the parenchymal (liver, pancreas) and hollow organs containing fluid (bladder, stomach) can cause exacerbation of chronic diseases (ulcers, bleeding, perforations).

Ionizing radiation. The ability of ionizing radiation to penetrate the human body and ionize body tissues in medical practice is used for diagnostic and therapeutic purposes. The sources of ionizing radiation in medicine are various devices and radioactive substances. His exposure to the most exposed employees of X-ray rooms, radiological laboratories, offices and departments of radiation diagnosis and therapy, surgeons, traumatologists, less often other specialists.

The greatest exposure to the hands and head of the personnel is possible with long-term diagnostic manipulations, for example, in case of fluoroscopy of the patient, angiography, cardiosurgical interventions.

With frequent operations performed under X-ray control, the doses of irradiation of surgeons may exceed the maximum permissible values.

Radiological hygienists can be exposed to ionizing radiation from various industrial installations and other sources during their sanitary inspection. Radiation hygienists experienced the greatest exposure in the study of levels of contamination of the Chernobyl nuclear power plant with radioactive emissions after the accident.

The biological effect of ionizing radiation is based on its ability to cause ionization of atoms and molecules of the irradiated tissue. This is the first link in the biological effect of ionizing radiation. As a result of ionization, atoms acquire significant activity, so-called free radicals are formed that can cause chain chemical reactions, which are realized in damage to irradiated tissue.

Ionizing radiation in the human body creates two main groups of effects - deterministic (immediate) and stochastic (remote).

The deterministic include dose-dependent effects, the occurrence of which directly depends on the dose of irradiation of the organism. In other words, the occurrence of this effect is guaranteed at a certain dose of irradiation of the human body. The deterministic effects include acute and chronic radiation sickness, radiation burns, cataracts.

Stochastic effects do not relate to dose-dependent effects, they are of a probabilistic nature. That is, with increasing radiation dose, the probability of occurrence of a stochastic effect increases. Such effects can occur both in the irradiated organism and in subsequent generations. Stochastic effects, in turn, are divided into somatostochastic and genetic (that is, those that lead to hereditary changes).

Natural and artificial lighting

Light is the region of the spectrum of electromagnetic waves with a wavelength of 400 to 760 nm, directly perceived by the human eye.

Illuminance - the magnitude of the light flux F falling on the surface area S. The unit of illumination - lux (lx) - the illumination of a surface area of 1 m2 with a perpendicular luminous flux of 1 lm falling on it. Unlike light, the amount of light reflected by the surface is called brightness.

Lighting is divided into the following types:

• natural light (it is formed with the help of solar radiation: direct, diffused light from the sky and reflected light from the ground and various objects penetrating through the light apertures in the outer enclosing structures);

• artificial lighting (lighting only with artificial light sources);

• combined lighting (illumination, in which insufficient natural light is supplemented by artificial lighting).

Part of the premises - operating rooms, intensive care rooms, affiliated, reception, dressing, laboratories for urgent analyzes, the work in which cannot be stopped immediately, should be equipped with emergency lighting from autonomous power supplies.

Specific requirements are imposed on operating lighting - high illumination of the working surface (operating table) with simultaneous exclusion of shadows from the hands and head of the surgeon and preventing heat heating from the luminaries of the operated patient and surgeon's head.

Insufficient and irrational lighting can cause unjustifiably high voltage of the visual analyzer, reduced efficiency, visual impairment, injuries (cuts, pricks, electrical injuries). This is especially important for specialists such as dentists, otolaryngologists, ophthalmologists, surgeons, histologists, hematologists, etc., the specificity of which is that they in most cases deal with very small sizes of objects of discrimination (0.1-0, 3 mm), which are also difficult to access.

A number of specialists: microsurgeons, hematologists, histologists, microbiologists, etc. for the performance of their work use special optical instruments - microscopes. Work with operating or laboratory microscopes belongs to the category of visual works of the highest accuracy. In this case, the load on the eyes is determined not only by the small dimensions of this object, but also by the large contrast of the analyzed field and the surrounding background, the need for the accommodation of the eyes when the image is focused.

In the work of specialists such as pediatricians, dermatologists, infectious diseases, etc., it is necessary to use fluorescent lamps with the correct color transfer. The need for light adaptation in radiologists, otolaryngologists, etc. is not always taken into account.

Irrational coverage can adversely affect the health of health workers, causing diseases such as myopia, conjunctivitis, blepharitis, nystagmus, asthenovegetative disorders, neuroses, etc.

Prolonged performance of accurate visual work at close range with insufficient levels of illumination and a significant strain on the muscles of the lens may lead medical workers to develop so-called false myopia.

Unfavorable conditions of visual work can also lead to the early (up to the age of 40) development of senile farsightedness, when the lens loses its elasticity.

Low level of illumination, blinding effect of light sources, pulsation of light, reflected glare from polished shiny objects, uneven illumination of the working area can disrupt the correct perception of surrounding objects and lead to injuries.

Ultraviolet (UV) radiation is part of the spectrum of electromagnetic radiation with a wavelength of 10-400 nm.

In ultrasound, ultraviolet radiation is used to treat various skin diseases and other diseases - vitiligo, psoriasis, nesting baldness, neurodermia, cutaneous T-cell lymphoma, rheumatoid arthritis, and also for the prevention of UV failure.

Ultraviolet radiation is mainly influenced by medical workers engaged in appropriate physiotherapy procedures and dental doctors. UV radiation can also affect personnel when exposed to industrial facilities for the purpose of air disinfection, unless safety rules are followed.

The adverse effect of UV radiation on the body of medical workers is the occurrence of:

• Certain types of skin cancer: basal cell (basal cell), squamous (spiny) and malignant melanoma;

• Photokeratoconjunctivitis (acute inflammation of the cornea and conjunctiva of the eye);

• cataracts (damage to the lens of the eye, manifested in their opacification and the appearance of opalescence);

• photosensitization and phototoxic reactions when interacting with chemical substances - photosensitizers, which can be endogenous (tryptophan, riboflavin, etc.) and exogenous substances (cosmetics and perfumes containing musk, amber, bergamot oil, sandalwood oil, medicinal preparations - ibuprofen, antihistamines, sulfonamides, some non-steroidal anti-inflammatory drugs, antibiotics (tetracycline), St. John's wort extract, chlorpromazine, psoralen, etc.).

Laser radiation. Lasers are sources of electromagnetic radiation of the optical range with a wavelength of 0.2-1000 μm, which can have different but only one wavelength (monochromaticity), characterized by high order and directivity of the oscillations. This makes it possible to obtain parallel beams of light of extreme intensity, which basically distinguishes laser radiation from the radiation of ordinary light sources.

Priority areas in laser medicine are: treatment of tumor diseases; operations on hollow organs using laser endoscopic techniques and staplers; treatment of gunshot, burn and purulent wounds; laser lithotripsy, etc.

When working with lasers, medical personnel can be exposed to direct radiation emitted directly from the laser, as well as scattered and reflected (mirror and diffuse) radiation.

In general, the labor of medical workers using laser systems is typically characterized by the effect of laser radiation exceeding the RCA by 54.5% of workplaces, low light levels in 93% of cases, the presence of substances in the air that are released when the laser beam interacts with tissues, and a large density of working time in 86.5% of cases.

The energy of laser radiation when absorbed by biological tissues is transformed into thermal energy. It can potentiate photochemical processes, violate electronic transitions and have other damaging effects on medical personnel.

There are thermal and nonthermic, general and local effects of laser radiation.

The thermal effect of laser radiation is the instantaneous effervescence of the tissues, which leads to their mechanical damage, and a section of necrosis with a crateral deformation arises. Therefore, a characteristic feature of laser burn is a clear isolation of the affected area from the intact.

The nonthermal action of laser radiation is due primarily to electrical and photochemical effects. Laser radiation with prolonged exposure to the body leads to disruption of the functions of the nervous and cardiovascular systems, causes changes in hematological and immunological parameters, reduces the activity of certain enzymes and mediators. In most cases, these changes are manifested as asthenic and asthenovegetative syndromes, accompanied by compensatory-adaptive reactions.

Local effects of laser radiation can cause damage to the eyes and other organs that selectively react to this type of radiation. At a high radiation energy, the denaturation of the corneal proteins leads to complete loss of vision. Part of the laser radiation, hitting the eye, repeatedly reflected from the inner walls of the eyeball, enhances its effect.

Aeroionization. Considering the factors of the production environment, one should remember about the so-called low-intensity factors. To them, for example, refers to aeroionization. The level of ionization of the rooms of the US, as well as the atmosphere, depends on the temperature, humidity, air movement, the intensity of thermal radiation, dust of the air, static electricity. The presence of impurities of chlorine, iodine, bromine reduces the number of negative light ions.

Most researchers believe that the organs that perceive air ions are the upper respiratory tract and human skin. Complete deionization of the air occurs at the level of the trachea bifurcation, and the nasopharynx is considered to be the main site for neutralizing the ions.

Under the influence of aeroions in the body, changes in vegetative processes, serotonin content, qualitative and quantitative parameters of blood, blood pressure, and heat exchange are observed. The magnitude of ionization of air can affect the frequency of attacks of bronchial asthma, exacerbations of rheumatism, migraine and other diseases.

In the physiotherapy units (cabinets), operating rooms and other premises of the health facilities in the conditions of formation of electric and magnetic fields, due to the use of synthetic clothing (dressing gowns, underwear), the staff and patients create an additional factor - static electricity. It can significantly reduce the concentration of ions in the room, making the air virtually de-ionized.

Chemical hazardous and harmful factors of the working environment and their impact on the health status of medical and pharmaceutical workers

The work of most medical workers is in contact with various chemicals. Many of them are dangerous to humans.

An essential feature of the effect of chemicals on medical workers is their complex (the same chemical compound enters the body in different ways, for example, inhalation and through the skin) and combined (exposure to two or more chemicals simultaneously or sequentially with the same pathway) character. It should be noted that some physical, biological and psychophysiological factors of the production environment can enhance the effect of chemical factors - combined action.

Most often, medical workers have to contact aerosols of medicinal substances, disinfectants and narcotics.

The air of many production facilities of the US (pharmacies, operating rooms, laboratories, procedural, dental offices, etc.) is contaminated with chemicals. A special place among them belongs to medicinal substances. In the air of operating rooms, the content of vapors of ether, ethyl alcohol, iodine, carbon dioxide can exceed the MPC several times, gradually increasing during the operation.

The unfavorable state of the air environment is created directly in the breathing zone of the members of the operating team, which is, as it were, closed by the participants of the operation, and in the upper part - by the shadowless lamp. In the respiratory zone of the surgeon, the content of the most common anesthetic - ether can exceed the MPC by 3 times, and in the respiratory zone of the anesthesiologist - by 10-11 times. The concentration of ethyl alcohol in the respiratory zone of the anesthetist is 0.75 MAC, the surgeon and the operating nurse are 1.3, in the neutral part of the operating room, 0.3.

Aether vapor, connecting with air oxygen and nitrous oxide in certain proportions, can form explosive mixtures. Trichlorethylene can decompose with the formation of toxic and flammable dichloroacetylene, which in turn decomposes into phosgene and carbon monoxide.

Protezists and dental technicians come into contact with a variety of chemicals in various aggregate states (dust, vapor, gases), among which there are many toxic compounds (cadmium, lead, mercury, carbon monoxide, acids, alkalis, silicon dioxide, acrylates, etc.). In the process of manufacturing metal dentures, about 20 kinds of metals (gold, silver, platinum, chromium, nickel, molybdenum, cobalt, titanium, etc.) are used.

Contact with metal mercury and its compounds during amalgamation of metals in dental practice, work with technically faulty measuring devices (thermometers, manometers), use of preparations containing mercury (ointments, powders), can cause medical workers to defeat the nervous system, digestive tract and other bodies.

Employees of clinical and biochemical laboratories, patho-anatomical departments, physiotherapeutic offices in the disinfection and disinfestation of departments contact various chemical substances - reagents, many of which are highly toxic and dangerous substances. Chlorine lime, nitric acid, sulfuric acid, hydrochloric acid, acetic acid, hydrogen sulphide, formaldehyde and others have an irritant effect on the mucous membrane of the respiratory system, skin, conjunctiva of the eyes.

Currently, radiopharmacological preparations are widely used as diagnostic agents - substances labeled with radioactive isotopes (iodine-125, cobalt-60, etc.).

Physiotherapy uses radon to prepare radon baths. Of the three radon isotopes, radon-222 has an adverse effect on the human body. Radioactive decay of radon produces short-lived radioactive isotopes (polonium-214, 218, lead-210, 214, bismuth-214), which are often adsorbed on microscopic particles of air.

With a lot of chemicals, we have to contact toxicologists-experimenters, often with new, unexplored substances.

Toxic substances, depending on their properties and exposure (effective concentration and time of exposure) can cause acute or chronic poisoning.

Acute poisoning usually begins suddenly, rapidly progresses and hard, which often causes life-threatening conditions. They usually occur in emergency situations, in cases of

gross disruption of the technological process, safety precautions, resulting in the formation of high concentrations of toxic substances.

Chronic poisoning is caused by a prolonged, often intermittent, intake of poisons in small (sub-toxic) doses. Intoxication begins with the appearance of low-specific symptoms, which reflect the primary damage to the functions of primarily the nervous and endocrine systems. The initial signs of poisoning usually depend on the way toxic substances enter the body - through respiratory (inhalation), skin, mucous membranes, etc. However, one must remember that many toxic substances, especially fat-soluble, enter the body in several ways at the same time.

Biological dangerous and harmful factors of the working environment and their impact on the health status of medical and pharmaceutical workers

Among biological factors affecting medical workers, it is necessary to distinguish two groups: causative agents of infectious diseases and antibiotics and preparations containing them.

The professional activity of infectious disease doctors, phthisiatricians, bacteriologists, surgeons, therapists, otolaryngologists and others is accompanied by significant contact with infectious agents.

Examination and treatment of the oral cavity, throat, nasopharynx is accompanied by reflex spattering of the patient's saliva, along with which pathogens fall into the face, on the doctor's clothes, in the air environment.

The introduction of high-speed drills and turbines into stomatological practice also contributes to the formation of bacterial aerosols in the air of the working zone, which together with dust create the danger of contamination of the face, eyes and entering the airway of the doctor.

Very dangerous procedures for the treatment and dressing of infected wounds, examination and treatment of infectious patients, laboratory examination of bacterial materials.

Infectious diseases of a professional genesis can arise in medical workers directly working with sick people or infected biosubstrates (blood, urine, sputum, bronchial water, discharge from the birth canal, duodenal contents).

Currently, more than 100 names of antibiotics are used for medical purposes. Antibiotics and drugs that contain them fall into the air of the treatment rooms, bandages, pharmacies, bacteriological laboratories, etc.

The problem of antibiotics in production conditions should be considered in two aspects. First, antibiotics can exert a direct toxic effect on the human body, which is characterized by organotropic and specific effects, as well as causing allergic reactions. Secondly, antibiotics can suppress not only pathogenic microorganisms, but also a part of normal human microflora. The other part of the normal human microflora, insensitive to antibiotics, has the ability to actively multiply, leading to a violation of normal biocenosis. As a result, medical workers who have constant professional contact with antibiotics can develop various forms of dysbiosis and candidiasis.

The method of hygienic assessment of factors in the production environment

Hygienic assessment of the factors of the production environment provides for the establishment of the possibility of harmful effects on the body of workers, and in some cases, also the type and severity of the impact.

Assessment of the state of the production environment can be factorial, that is, harmful production factors are taken into account independently of each other, or complex, when the mutual influence of factors is taken into account: summation, potentiation of each other's actions or, conversely, mutual weakening (antagonism).

When conducting a factor assessment of the condition of the production environment, the measured levels or concentrations of harmful factors are compared with their hygienic regulations (maximum permissible concentration - MPC in the air of the work area, maximum permissible level - remote control, etc.). It is believed that finding the measured indicators of production factors within their hygiene regulations ensures harmless working conditions for the health of workers and their descendants. An exception can be selected individual workers who are highly sensitive to a certain production factor, which may have negative consequences. In this case, these people are not allowed to work in the conditions of the «particularly harmful factor for them», or certain additional preventive measures are mandatory.

Establishment of hygienic regulations is a complex, expensive and lengthy process that is carried out by highly qualified specialists of the appropriate profile using special approaches, techniques, laboratory experiments on animals, modern high-precision equipment. The rationale for hygienic regulations is based on many principles of rationing, one of which is the principle of threshold. According to him, many factors of the production environment can have a damaging effect on the human body only when a certain quantitative threshold is reached or as a result of summation of actions of subthreshold levels (concentrations). On this basis, hygienic regulations are set at a level below the threshold, which guarantees no harmful effects and provides for safe working conditions. With the hygienic regulation of certain factors in the production environment for which it is not possible to determine the threshold of harmful effects (whose action is «zero-threshold», for example, ionizing radiation, chemicals capable of causing tumors, etc.), other approaches are used that can justify safe for health of working hygienic regulations.

Proceeding from this, for most production factors, their hygiene regulations are the highest permissible values, if exceeded, a harmful effect on the working organism is possible. For example, if permissible concentration of nitrogen oxides is continuously exceeded in the air of the working area, workers may experience chronic poisoning with these substances, and if it is significantly exceeded during one working shift, it is acute intoxication. If the noise levels are exceeded for a long time sensorineural hearing loss can develop, and for a brief significant excess of the permissible level, pain sensations and even barotrauma. For some production factors, such as air temperature, both the upper and lower limits are set-that are the range of permissible and optimum temperatures. Because both high air temperature and low unfavorable effect on the body of workers. And for the indicators of natural (the coefficient of natural illumination - CNI) and artificial illumination (illumination), a lower limit is set, below which illumination negatively affects the working organism.

When conducting a comprehensive assessment of the factors of the production environment, the mutual influence of factors on the human body is taken into account. So, for example, in a complex assessment of the effect of microclimate on the body, such parameters as equivalent-effective temperature, the resulting temperature, the heat load index of the environment (WBGT-index), etc. are calculated and evaluated. All these indicators model and evaluate the joint effect of microclimate factors when the change one indicator of the microclimate can compensate (or strengthen) the change of the other. Thus, the WBGT -index allows us to roughly estimate the external heat load taking into account the temperature, air humidity and thermal radiation.

A factor assessment of the state of the production environment consists of the following stages:

1. Selection of parameters and units of measure characterizing a specific factor of the production environment (for example, for the industrial microclimate, the air temperature in 0C, the air speed in m / s, the relative humidity in %, the level of infrared radiation in W / m2 is measured and estimated. In some cases, additional indicators are also calculated).

2. Selection of appropriate measurement techniques, instruments and measurements. It is considered that the results of measurements are representative only if the requirements of specially approved procedures are fully met, the devices authorized for specific measurements that have passed special verification were used, the study was carried out by specially trained specialists having appropriate certificates.

3. Use of special regulatory documents, which provide hygienic regulations for the assessed factors of the production environment.

4. Comparison of the measured factors of the production environment with their hygienic regulations. Be sure to consider all the conditions on which the hygiene regulations of a particular factor depend. Thus, the permissible values of air temperature, air speed and relative air humidity depend on the workplace, the time of the year and the category of work, and the intensity of the thermal exposure of workers depends on the amount of the irradiated body surface of the worker.

5. Justification and execution of the conclusion, development of preventive measures. In the case when the real (measured) factors of the production environment do not correspond to their hygienic regulations, we can consider that such factors are harmful (dangerous) to the health of workers. Such a situation requires immediate justification, development and implementation of preventive measures aimed at improving the working conditions with subsequent verification of their effectiveness.

Sanitary norms for the microclimate of industrial premises state building codes (ДБН) 3.3.6.042-99 (Extraction)

Terms and definitions

1. Production premises - a closed space in specially designed buildings and facilities in which people are constantly working (by shifts) or periodically (during part of the working day).

2. Work area - the space in which the workplaces of a permanent or temporary (temporary) stay of employees are located.

3. Workplace - the place of permanent or temporary stay working in the process of work.

4. Permanent workplace - a place where the worker is more than 50% of the working time or more than 2 hours continuously. If the work is carried out at different points in the work area, the whole area is considered a permanent workplace.

5. A non-permanent workplace is a place where the employee is less than 50% of the working time or less than 2 hours continuously.

6. Microclimate of industrial premises - the conditions of the internal environment of these premises, affecting the heat exchange of workers with the environment by convection, conduction, heat radiation and moisture evaporation. These conditions are determined by the combination of temperature, relative humidity and speed of air movement, the temperature of the surfaces surrounding the person and the intensity of thermal (infrared) radiation.

7. Optimal microclimatic conditions - a combination of microclimate parameters, which, with prolonged and systematic effects on humans, ensure the preservation of the normal thermal state of the organism without activating the mechanisms of thermoregulation. They provide a sense of thermal comfort and create the prerequisites for a high level of efficiency.

8. Admissible microclimatic conditions - a combination of microclimate parameters, which, with prolonged and systematic exposure to humans, can cause changes in the body's thermal state, quickly pass and normalize and are accompanied by a voltage of the thermoregulatory mechanisms within the physiological adaptation. At the same time, there are no injuries or disturbances in the state of health, but uncomfortable warm sensations, deterioration of well-being and decrease in working capacity can be observed.

9. Warm period of the year - the period of the year, characterized by an average daily temperature of the environment above $+10^0$C.

10. Cold period of the year - the period of the year, characterized by an average daily outdoor air temperature of $+ 10^0$C and lower.

11. The average daily temperature of the outside air is the average value of the outside air temperature measured at certain times of the day at the same time intervals. It is adopted according to the meteorological service.

12. The category of works is the delineation of works on the severity based on the total energy costs of the organism.

13. Light physical work (category I) covers activities in which the energy expenditure is 105-140 W (90-120 kcal / hour) - category Ia and 141-175 W (121-150 kcal / h.) - category Ib . Category Ia includes work performed sitting and not requiring physical exertion. The category Ib includes work performed sitting, standing or associated with walking and accompanied by some physical stress.

14. Medium-sized physical works (category II) cover activities in which the energy expenditure is 176-232 W (151-200 kcal / hour) - category IIa and 233-290 W (201-250 kcal / h.) - category IIb. Category IIa includes work related to walking, moving small (up to 1 kg) items or objects in a standing or sitting position and requiring a certain physical

strain. The category IIb includes work performed standing, associated with walking, moving small (up to 10 kg) weights and accompanied by moderate physical stress.

15. Heavy physical work (category III) covers activities in which energy costs are 291-349 W (251-300 kcal / h). Category III includes work related to the permanent movement, the transfer of significant (over 10 kg) cargo, requiring greater physical effort.

General regulations

Sanitary standards apply to microclimate conditions within the working area of industrial premises of enterprises, institutions, etc., regardless of their form of ownership and subordination.

This document regulates the normative values of the optimal and permissible parameters of the microclimate and establishes requirements for methods for measuring microclimatic parameters and their evaluation.

The norms do not apply to the microclimate of underground and mining excavations, mobile vehicles, livestock and poultry farms, storage facilities for agricultural products, refrigerators, warehouses, etc., as well as premises in which the microclimate parameters are set in accordance with technological requirements.

1. Requirements to parameters of the microclimate.

Microclimatic conditions of industrial premises are characterized by the following indicators:

- air temperature;
- relative humidity;
- speed of air movement;
- the intensity of thermal (infrared) radiation;
- temperature of surface.

By the degree of influence on the thermal state of a person, the microclimatic conditions are divided into optimal and permissible.

For the working area of industrial premises, optimal and permissible microclimatic conditions are established taking into account the severity of the work performed and the period of the year. With the simultaneous performance of works of different severity in the work area, the level of microclimate indicators should be set taking into account the most numerous group of workers.

The values of the microclimate in the work area are shown in Table 1 and 2, and explanations to them - in clauses 1.1 and 1.2.

1.1. Optimum microclimate conditions

1.1.1. The optimum microclimate conditions are set for permanent jobs (Table 1).

1.1.2. The parameters of the air temperature in the working area along the height and across the horizon, and during the working shift should not exceed the limits of the normalized values of the optimum temperature for this category of work, indicated in Table. 1.

1.1.3. The temperature of the internal surfaces of the working area (walls, floor, ceiling), technological equipment (screens, etc.), external surfaces of technological equipment, enclosing structures should not exceed 20C beyond the optimal values of air temperature for this category of work specified in Table. 1.

1.1.4. When carrying out operator-type work related to the emotional stress in the cabinets, consoles and posts of technological processes control, in the rooms of computer

facilities and other premises, optimal conditions of the microclimate should be observed (air temperature 22-24^{0}C, relative humidity 60-40%, speed of movement air no more than 0.1 m / sec.).

Table 1

Optimum values of temperature, relative humidity and air velocity in the working area of production premises

Period of the year	Work category	Air temperature, ^{0}C	Relative humidity, %	Air speed, м/с
Cold Period of the year	Light physical work Ia	22-24	60-40	0,1
	Light physical work Iб	21-23	60-40	0,1
	Medium-sized physical works IIa	19-21	60-40	0,2
	Medium-sized physical works IIб	17-19	60-40	0,2
	HeavyII	16-18	60-40	0,3
Hot Period of the year	Light Ia	23-25	60-40	0,1
	Light Iб	22-24	60-40	0,2
	Medium-sized IIa	21-23	60-40	0,3
	Medium-sized IIб	20-22	60-40	0,3
	HeavyIII	18-20	60-40	0,4

1.2. **Permissible microclimate conditions**

1.2.1. The permissible values of microclimatic conditions are established in cases when it is impossible to provide optimal microclimate values at workplaces according to technological requirements of production, technical unattainability and economically justified inexpediency.

1.2.2. The values of the indicators characterizing the permissible microclimatic conditions, established for permanent and non-permanent jobs, are given in Table. 2.

1.2.3. The air temperature difference over the height of the working area, while ensuring the permissible conditions of the microclimate, should not be more than 30C for all categories of work, and horizontally the working area and during the work shift - go beyond the permissible temperatures for this category of work specified in Table 2.

Table 2

Permissible values of temperature, relative humidity and air velocity in the working area of production premises

Period of the year	Work category	Air temperature, ^{0}C				Relative humidity, %	Air velocity, м/с
		Upper bound		Bottom line			
		on permanent	on non-permanent	on permanent	on non-permanent		

		workplaces	workplaces	workplaces	workplaces		
Cold Period of the year	Light Ib	25	26	21	18	75	no more 0,1
	Medium-sized IIa	24	25	20	17	75	no more 0,2
	Medium-sized IIb	23	24	17	15	75	no more 0,3
	Heavy III	21	23	15	13	75	no more 0,4
	Light Ib	19	20	13	12	75	no more 0,5
Hot Period of the year	Light Ib	28	30	22	20	55 – at 28^0C	0,2-0,1
	Medium-sized IIa	28	30	21	19	60 – at 27^0C	0,3-0,1
	Medium-sized IIb	27	29	18	17	65 – at 26^0C	0,4-0,2
	Heavy III	27	29	15	15	70 – at 25^0C	0,5-0,2
	Ligh Iб	26	28	15	13	75 – at 24^0C	0,6-0,5

1.2.4. The temperature of the interior surfaces of the rooms (walls, floor, ceiling), as well as the temperature of the external surfaces of the process equipment or its protective devices (screens, etc.) must not exceed the limits of the permissible air temperature values for this category of work indicated in Table. 2.

1.2.5. The intensity of thermal irradiation of process equipment, lighting devices, insolation from glazed enclosures, which does not work on heated surfaces, should not exceed 35.0 W / m2 - when exposed to 50% or more of the surface of the body, 70 W / m2 - at an irradiated surface of 25-50% and 100 W / m2 - when irradiating no more than 25% of the body surface of the worker.

6. Materials for self-monitoring

A. Tasks for self-control:

1. Describe the main types of adverse effects of physical factors on the body of medical workers.

2. Describe the main types of adverse effects of chemical factors on the body of medical workers.

B. Tasks for self-control:

1. Describe the psychophysiological, physical, chemical and biological hazards that can affect physician-therapists in out-patient departments.

2. Describe the changes in the health status of physicians-therapists in out-patient departments, which can arise under the influence of harmful production factors.

7. Literature:

Principal:

1. Occupational Physiology. / Allan Toomingas, Svend Erik Mathiassen, Ewa Wigaeus Tornqvist/ - 2011 by CRC Press - 309 Pages.

2. Occupational health and safety in the medical sector. / Yavorovsky O.P., Veremey MI, Zenkina V.I. etc. - K., 2017. - 208 pp.

3. Hygiene and ecology / Under the editorship of V.G.Bardov. – Vinnytsya: Nova knyha, 2018. – 688 pages.

Additional:

1. https://www.ors.od.nih.gov/sr/dohs/Documents/DLib_2.4_SHMS_roadmap_508.pdf

2. Occupational health and safety risks in the healthcare sector. Guide to prevention and good practice. European Commission – 282 pages.