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SYSTEM OF METROLOGICAL SUPPORT AND CONTROL OF HEALTHCARE INSTITUTIONS IN UZBEKISTAN

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Annotation. Today, due to the implementation of state programs, work is underway to ensure that healthcare in our country meets the highest international requirements and standards and to improve this system. Measures have been identified to improve the quality of training qualified personnel, build and reconstruct new treatment and prevention institutions, and equip them with modern technology and equipment. The article also analyzes the role of metrological control of diagnostic equipment used in angiography and ophthalmology. Metrological support is considered an important systemic component in ensuring the accuracy, safety and efficiency of medical equipment.

Keywords: metrology, healthcare system, metrological service, metrological supply, medical institutions, measuring instruments, medical equipment control, quality control.

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Introduction. Medicine is an area that requires maximum accuracy. Therefore, medical equipment, from simple calipers, tonometers, scales, to devices for ultrasound, computed tomography, radiography - must strictly comply with certain technical parameters. In this case, it is necessary to ensure stable and proper operation of specialized equipment, maintaining the primary quality provided by its manufacturers.[1] After all, the accuracy of the diagnosis, and consequently the effectiveness of the prescribed treatment methods, depends on the accuracy of its indications.

That is why today the issues of metrological service for medical equipment are becoming extremely relevant all over the world. For example, the activities of the International Organization for Legal Metrology (IOLM) are aimed at developing general issues of legal metrology, establishing accuracy classes of measuring instruments, ensuring the uniformity of determination of types, samples and systems of measuring instruments, their comparison, calibration procedure, etc.[2]

The IOLM certificate confirms the compliance of measuring instruments with regulated regulatory documents and technical requirements, the definition of test procedures and the form of a report on research, and provides a guarantee to the manufacturer of measuring instruments of compliance with the requirements of international standards. In addition, other regulatory documents have been adopted in this area, compliance with which determines the quality, technical and other indicators of medical equipment.

The introduction of international standards in Uzbekistan is provided for by a number of regulatory documents, including the Law of the Republic of Uzbekistan “On Metrology”.[3] The law establishes the procedure for metrological verification and compliance with international agreements, requirements for the operation and development of the system for ensuring the uniformity of measurements and its harmonization with international standards. Regular comparison of measuring instruments in medical institutions is a factor that determines the quality of medical

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services provided by health care institutions. An agreed list of measuring instruments used, the availability of tables for their comparison and their timely implementation, and the appointment of persons responsible for the metrological support of medical institutions are important conditions for licensing a medical institution.[4] The number of medical and diagnostic institutions in Uzbekistan is increasing from year to year. In order to more fully cover their metrological support, the State Enterprise “Metrology Services Center” is introducing an integrated approach to ensuring the uniformity of measurements of medical equipment, which includes such services as comparison, metrological certification and information, transport and service services, laboratory research. To this end, first of all, innovative medical equipment was purchased, and the scope of accreditation was significantly expanded due to this. For example, the center currently provides services for comparison and metrological certification of ultra-high-frequency therapeutic devices, rheographs, electromyographs, ECG-holter, electroencephalographs. Also, ultrasound diagnostic equipment, Doppler apparatus, ExoEG, brain echo signal analyzers, low-frequency therapeutic and treatment equipment are being compared here.[5]

The practice of the Center shows that annual metrological inspection allows to ensure the conformity of medical equipment indicators. Almost all diagnostic equipment and most therapeutic devices include measuring functions, that is, a quantitative assessment of one or another medical parameter or a description of such parameters as electric potential, pressure level, time intervals, geometric dimensions of images. These parameters must also be checked. As an example, let's take X-ray machines, tomographs. If such medical equipment is not subjected to timely and appropriate calibration, then it will not be possible to check how much X-ray radiation the patient is exposed to during the examination. For example, over time, the focus of X-ray radiation and the quality of the detector reflecting the image deteriorate, and the operator of the device can increase the X-ray power at his discretion to obtain a more accurate image. And a metrological inspection would prevent the use of faulty equipment in healthcare.

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Even when conducting ultrasound studies, the accuracy of determining the geometric dimensions of organs and structures depends not only on the quality of the device, but also on how correctly the doctor chooses the observation and movement angle, as well as on the properties of the tissues under study, since when determining geometric dimensions, a certain recorded sound velocity in the tissues is set in the instrument program.[6] However, the diagnosis depends on the accuracy of the device readings, for example, the doctor's further actions depend on the size and structure of the ovarian cyst. If the initial stage is detected (small size), the appropriate course of treatment is prescribed without performing an operation, or vice versa. The correct operation of the UTT device can be determined by using a pretension ultrasound phantom that imitates various targets, which helps to determine the sensitivity of the device, its ability to determine dimensions, etc.[7]

ECG devices are widely used in all treatment and diagnostic institutions of our country, in specialized medical centers, in family and multidisciplinary clinics, and in rural medical centers. With their help, the doctor measures the heart rate. Depending on the rhythm proportion determined by the ECG and the interval between each beat, a diagnosis is made.[8] In the event of a malfunction of such equipment, the doctor may make the wrong decision.

In order to prevent such situations, as well as to organize the comparative and metrological examination of medical equipment in medical institutions in accordance with modern requirements and in a high-quality manner, mobile comparative laboratories have been established at the center to conduct comparisons and provide on-site services.

The systematic role of metrological control in angiography and ophthalmology. The fields of angiography and ophthalmology are areas of medicine that require high accuracy, and a wide range of technological equipment is used in diagnostic and treatment processes. The correct and reliable operation of such equipment is directly related to its being under metrological control. Therefore,

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metrological control in these areas should be considered not only as a technical requirement, but also as a necessary systemic component ensuring diagnostic quality and patient safety.

Metrological control in the field of angiography. Angiography is an important visual diagnostic method that allows you to see the vascular system of the heart, brain and other organs. The equipment used in this field (digital subtraction angiography - DSA systems) consists of complex technological platforms and requires metrological control in the following aspects:

Radiation dose accuracy: Angiography uses X-ray radiation. High radiation levels pose a risk to the patient and the medical worker, while low levels negatively affect image quality. Therefore, metrological control of radiation doses is carried out annually.

Injection system accuracy: Automated injectors used to inject contrast media into the vessels must accurately inject the specified volume. Here, deviations in the volume measurement and pressure range are controlled by metrological tests.

Image accuracy and calibration: The size, contrast, and geometry of the visual images on the screen must comply with the technical specifications. Each element of the image-generating sensors and projection algorithms must undergo metrological calibration.

Angiography systems are often used in central clinics and are subject to constant technical and metrological control by the specialists servicing them.

The importance of metrological control in ophthalmology. Ophthalmological equipment operates with microscopic accuracy, therefore, metrological accuracy and stability are particularly important in this field. The following devices must be regularly metrologically controlled:

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Tonometers (intraocular pressure measuring devices): In the diagnosis of glaucoma, even a deviation of 1–2 mmHg can lead to an incorrect diagnosis. Therefore, tonometers are subject to annual metrological testing of pressure sensors and calibration units.

OCT (Optical Coherence Tomography): Shows the structure of the retina at the micron level. Indicators such as image layer, laser wavelength, axial resolution require constant metrological verification.

Fundus cameras and biomicroscopes: Images of the fundus, lens and other internal structures. Technical requirements for image clarity, illumination intensity, field of view are tested.

Laser devices (photocoagulation, LASIK equipment): Radiation power, aiming accuracy and pulse duration must be flawless. Otherwise, excessive tissue damage or the desired result will not be obtained.

The need for a systematic approach. Metrological control requires a systematic approach, not just technical checks. These include:

Certification based on state regulations,

The presence of internal technical service systems in healthcare institutions,

The activities of qualified metrologists and technical engineers,

The introduction of automated monitoring and electronic metrological reporting.

The approach in Uzbekistan's healthcare sector is gradually improving. Since 2020, the mechanisms for testing and accreditation of new medical technologies have been strengthened. In particular, test methods have been developed in accordance with international standards for angiographic and ophthalmological devices.

In accordance with the resolution of the Agency for Standardization, Metrology and Certification of Uzbekistan and the Ministry of Health of the Republic of

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Uzbekistan No. K-2 102 dated July 31, 2017, a list of measuring instruments and test equipment intended for medical use that are subject to metrological verification in the territory of the Republic is provided. The frequency of metrological verification of all medical devices included in the list is set at 12 months.

Conclusion. Following the process of digitizing the healthcare system in Uzbekistan and introducing high-tech diagnostic equipment, the issue of constant monitoring of the metrological status of medical equipment is becoming urgent. Optical, laser and radiological devices used in angiography and ophthalmology in particular are diagnostic tools that require precision, and their reliability directly affects the patient's life. From this perspective, the role of metrological services is not only technical control, but also a guarantee of safety and quality in healthcare. Incorrect measurements or the use of uncalibrated devices in diagnostic processes can lead to incorrect diagnosis and treatment. Therefore, it is possible to improve the quality of services in healthcare institutions by regularly inspecting, calibrating existing medical equipment, and ensuring their compliance with regulatory documents. It is also necessary to eliminate some of the existing problems in the system - resource shortages in the provision of metrological services, a lack of qualified personnel, or weak control mechanisms. In the future, improving this area through digital control systems, automated diagnostic platforms, as well as strengthening the provision of metrological services based on international standards should be one of the strategic priorities of the Uzbek healthcare system.

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