In non-invasive diagnostics, sensor output signals have different physical nature and correspondingly different types of data representation - and the question arises how to process them. This, in turn, necessitates the use of ontological approach. It is proposed to use the domestic technology of complex life cycle support of semantically compatible intelligent computer systems of new generation (Open Semantic Technology of Intelligent Systems). Logical-semantic approach in diagnostic tasks will allow to carry out differential diagnostics (to put forward several diagnostic hypotheses).

The technological basis for the creation of an intelligent diagnostic system is the technology of OSTIS.

The project of intellectual non-invasive diagnostics is justified by the presence of technological basis of OSTIS, application of logical-semantic approach in diagnostic tasks, as well as different variants of non-invasive diagnostics.

In the future, one of the directions of development of this system is the development of a personal medical assistant for the patient, which is focused not only on early detection of the disease, but also on recommendations to the patient for possible additional examination.

The basis for the functioning of the personal medical assistant is a decision support system. Obtaining knowledge by the patient will contribute to the understanding of his condition and its possible causes.

Important aspects of the system functioning are accumulation of data and knowledge, their systematization and the possibility of system evolution

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ОСНОВАНИЯ ИНТЕЛЛЕКТУАЛЬНОЙ НЕИНВАЗИВНОЙ ДИАГНОСТИКИ

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В статье предложено обоснование направления работ по созданию системы интеллектуальной неинвазивной диагностики. В качестве ее основополагающих составляющих определены два аспекта: технологический базис для разработки и различные варианты неинвазивной диагностики.

Технологическим базисом для создания интеллектуальной диагностической системы является отечественная Открытая Семантическая Технология Интеллектуальных Систем (ОСТИС). Использование логикосемантического подхода в диагностических задачах позволит осуществлять дифференциальную диагностику (выдвигать несколько диагностических гипотез). Рассмотрено несколько направлений (вариантов) неинвазивной диагностики: функционально-спектральная диагностика (ФСД-диагностика), биоимпедансный анализ, предварительная диагностика на основе оценки основных параметров функционального состояния, диагностика по зонам Захарьина-Геда, диагностика по методу Накатани, частотно-резонансная диагностика.

Received 13.03.2024

Integration and Standardization in New Generation Intelligent Medical Systems Based on OSTIS Technology

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***Abstract*—The article discusses the integration of international medical standards in Russia, Belarus, and Kazakhstan using semantic technologies. It describes OSTIS (Open Semantic Technology for Intelligent Systems) — an open project for creating common semantic technologies for the component design of intelligent systems. An example of the integration of various medical records standards in intelligent medical systems is given. The advantages of such integration are the improvement of the exchange of medical information, simplification of the diagnosis and treatment process, and the possibility of creating a unified medical space within the region.**

***Keywords*—ontology modeling, OSTIS, medical information systems, standardization of medical data, integration of medical systems, International Classification of Diseases (ICD), flexibility and adaptability in healthcare systems.**

I. Introduction

The possibilities of application of new modern technologies in human life are growing day by day. Implementation of artificial intelligence in medical systems plays an important role in medical data processing. The huge amount of data processed in modern medical systems can be quickly analyzed and processed only using the artificial intelligence (AI) element that is being implemented in modern computer technologies. Processing medical data using AI enables the identification of diseases and the patterns and trends of their development, helps to identify pathologies and risks of disease, as well as forecasting the spread of infections and predicting epidemics. This helps doctors and healthcare organizations in general to make informed decisions [1]–[3].

The implementation of AI in medical systems can solve both complex and simpler problems. The complex challenges include the implementation of AI in robotic surgery. The application of AI in robotic surgery could significantly accelerate the development of surgical robots to perform complex surgeries with a high level of precision, which in turn will reduce risks and shorten patient recovery time after surgery. More straightforward challenges include the personalization of medicine, namely taking into account individual patient characteristics: genetic data and biomarker analysis, when developing personalized treatment plans and systematizing patients' medical histories [4], [5].

Electronic medical histories of patients, as well as digital data from medical examinations, patient monitoring data from medical devices, are part of a unified medical decision support system called a medical information system (MIS). MIS is a key element of the medical system. MIS providing automation of document flow and accounting in medical institutions has an important role in modern medicine. And the introduction of AI in MIS allows to move these systems to a new level of development.

II. Problematics of modern medical information systems

MIS is an information system designed for processing, accumulation, storage and retrieval of a patient's electronic medical record. MIS can be classified depending on the area of activity of medical institutions. For example, MIS for hospital usually collects and processes information from all blocks of the information system, including operating and resuscitation units. They may include modules for managing patients, staff, equipment, as well as for monitoring the performance of medical procedures and treatment. And MIS for outpatient clinics, in turn, usually focus on automating processes such as making appointments, working with waiting lists, and maintaining patient registries. They may also include functions for managing doctors' schedules, tracking patients' medical histories, and sharing medical information between different specialists and departments [6].

Thus, it can be concluded that MISs vary depending on the specific needs of the healthcare facility, but all systems will perform functions such as completing a patient's medical record and tracking medical history.

The first thing patients encounter when moving from one health care facility to another is the need to refill out their data for their medical records. Although personal data remains unchanged, the medical history may be incomplete because the patient cannot access all the data about all the examinations they have undergone.

This can make diagnosis difficult and distort the overall picture. It is worth noting that the more systems in which a patient enters their personal data, the greater the risk of this data being leaked.

Protection of patients' personal data is an important element of MIS operation. When implementing an information system, the staff of a health care institution should make certain efforts, for example, they should follow the algorithm of working with the selected information system, enter information into the system using available templates and forms and consistently maintain electronic medical records.

In 2020, during a roundtable discussion at the BELTA press center, representatives of the Ministry of Health and practical medicine discussed the promising directions of Belarusian e-health. And even earlier, in March 2018, the Concept of e-health development of the Republic of Belarus for the period until 2022 was developed and approved. The purpose of which was to develop ehealth and create a centralized health information system (CHIS) for the formation of a unified information archive of patients and exchange of medical data [7].

The activity of the CHIS aims to improve the availability and quality of health care by assisting in clinical decision-making, improving the quality and efficiency of management decisions based on statistical and analytical data.

CHIS consists of functional and support subsystems and other subsystems. Supporting subsystems include software and hardware complexes information protection system and subsystems that ensure proper technical functioning and interdepartmental information interaction of the CHIS. One of the subsystems included in the CHIS is the electronic medical record of the patient and the clinical decision support system.

Thus, we can conclude that the electronic medical record is a MIS, a subsystem of the CHIS. And the main obstacle to the creation of CHIS is the lack of standards in the field of e-health and regulations for the exchange of electronic medical information

As recommended by the World Health Organization and the International Telecommunication Union, a national eHealth system requires the following components: standards and interoperability (component); an enabling environment (role); and standards that will ensure the holistic and accurate capture and exchange of health information across all health systems and services (functional purpose).There are also a number of principles that should be considered when developing a CHIS:

- utilization of cloud computing technologies;
- use of open source software;
- service-oriented architecture, microservices, modularity, possibility to create additional services through open interfaces;
- elimination of duplication of engineering andtelecommunication infrastructure;
- Web client technology;
- ensuring information security and information protection;
- scalability;
- simple and user-friendly interfaces, ergonomic and intuitive to use;
- single entry and repeated use of primary information;
- Interoperability of MIS with CHIS.

Thus, there is a need for technology that meets all the requirements for the realization of CHIS and, in particular, MIS.

The results of the implementation of the Concept in eHealth is the creation of the following systems:

1) National registers:
   - State Register "Diabetes Mellitus";
   - State register of persons exposed to radiationas a result of the Chernobyl catastrophe andother radiation accidents;
   - Belarusian Kancer Register;
   - Republican register of HIV-infected patients;
   - Republican register "Tuberculosis"
2) Medical information systems:
   - AIS "Electronic Prescription". This system is designed to automate the process of prescription writing and control over its fulfillment.
   - RSTMC (Telemedicine). Telemedicine system allows doctors to counsel patients from a distance using video, audio or messenger chat.
   - IAS "Zdravookhranenie". This system is designed to automate the recording and analysis of medical information, including data on the health status of patients.
   - IAS "Drug Supply". This system is designed to automate the process of planning and control of centralized procurement of medicines for healthcare organizations.

All these systems are aimed at improving the quality and efficiency of medical care through the use of modern information technologies. They also promote standardization and centralization of medical information, which facilitates data exchange and collaboration between different specialists and medical institutions. In addition, these systems help to ensure the security and confidentiality of medical data.

There are a number of foreign analogs of MIS. Here are a few MIS popular in Russia:

1) ArchiMed+ is a versatile medical software that is suitable for private physicians, medical centers, dental offices, and chain clinics. ArchiMed+ is easily scalable, offers many integrations including third-party labs, labeling system, telemedicine and more.