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ANALYSIS OF HEALTHCARE IT SOLUTIONS WITHIN VALUE-BASED AND PERSONALIZED MEDICINE PARADIGMS

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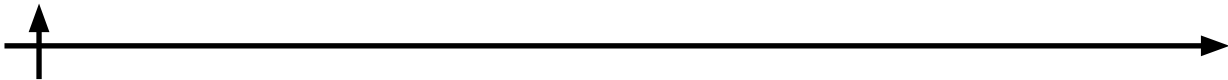
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Abstract. In the modern world, in the conditions of the dynamic development of technologies, the focus of attention of enterprises is directed not only on technologies for the implementation of core activities, but also on management technologies. The leading ideological concepts, under the influence of which a modern healthcare system is being formed, are: value medicine, personalized medicine, Health 4.0 concept. This article analyzes the models of IT solutions for IT support of the medical organization, which implements the principles of value and personalized medicine and following the development trends of modern digital technologies. The analysis of the key characteristics and features of IT support for this type of medical organization.

Keywords: IT support, value-based medicine, IT solutions, technology

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Научная статья

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АНАЛИЗ ИТ-РЕШЕНИЙ В ЗДРАВООХРАНЕНИИ В РАМКАХ ЦЕННОСТНО-ОРИЕНТИРОВАННОЙ И ПЕРСОНАЛИЗИРОВАННОЙ ПАРАДИГМ МЕДИЦИНЫ

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Аннотация. В современном мире, в условиях динамичного развития технологий, внимание предприятий направлено не только на технологии осуществления основной деятельности, но и на технологии управления. Ведущими мировоззренческими концепциями, под влиянием которых формируется современная система здравоохранения, являются: ценностная медицина, персонализированная медицина, концепция Здоровье 4.0. В данной статье анализируются модели ИТ-решений для ИТ-поддержки медицинской организации, реализующей принципы ценностной и персонализированной медицины и следующей тенденциям развития современных цифровых технологий. Проведен анализ ключевых характеристик и особенностей ИТ-поддержки данного типа медицинской организации.

Ключевые слова: ИТ-поддержка, ценностная медицина, ИТ-решения, технологии

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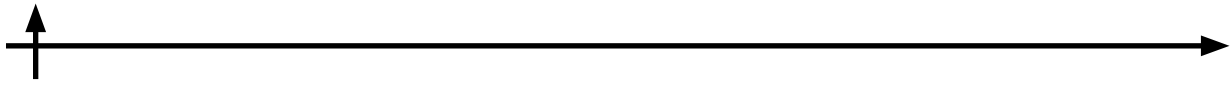
Introduction

Today, a medical institution at any level needs modern management technologies. The pursuit of continuous improvement is the key to the gradual successful growth of the institution.

The modern world is characterized by the active penetration of information and digital technologies into all spheres of human life. Automation and digitalization have a significant impact on any activity, changing the established rules and procedures. Continuous improvement with the use of modern information and digital technologies, the introduction of innovations and the encouragement of employee initiative can become a significant incentive for promotion among competitors.

The main goal of healthcare management is to reduce social losses due to morbidity, disability and mortality. To achieve this goal, effective activity is required, both of the entire healthcare system, and of each medical organization, for which it is necessary to introduce other methods, principles, approaches and management models for absolutely all parts of the medical organization aimed at achieving the following interrelated goals:

- improving access to quality services and prompt medical care;
- improving the quality of life and public health;
- increase the profitability and profitability of the medical organization (Begkos et al., 2020).



However, not everyone understands and realizes the necessity and importance of economic efficiency and profitability for a public health organization. At the same time, practice shows that medical organizations that actively attract additional extra budgetary funds are the most effective.

Health management includes managing financial, labor and medical resources. In the healthcare sector, there is a tendency to increase the efficiency of healthcare institutions, therefore, it is necessary to introduce new modifications and ways to manage all elements of the organization (Siyam et al., 2019).

The leading concepts setting the development trend of the modern healthcare system are: value medicine, personalized medicine and the concept of healthcare digitalization Health 4.0 (Thuemmler and Bai, 2017).

Valuable medicine is a result-oriented approach to the organization of a health care system, which assumes that from among several options, one should choose the method of patient care that is expected to give the best result at a relatively lower cost.

This approach assumes that medical care should be provided primarily with a focus on value for the patient. Of course, such aspects of medical care as accessibility, convenience, service are also important, but they are of secondary importance (Brown et al., 2003). With this approach, ideally, those who provide medical services are paid for actually helping the patient improve their health, reduce the incidence of chronic diseases and their complications, and also contribute to a better health of society as a whole. Of course, this approach should be used with extreme caution, since in medicine there is a huge share of uncertainty in the result, and often the most correct approaches and best techniques may be ineffective due to force majeure circumstances or unpredictability of the patient's reaction. Moreover, some experts believe that prioritizing some quality criteria will underestimate others and cause an imbalance in the provision of assistance. But, nevertheless, changing the wage system in medicine and avoiding increasing aid volumes today is considered a key point that can increase its effectiveness provided that resources are saved, the acute shortage of which worries health systems around the world.

In conditions of existing trends in the development of health care, the urgent task is to develop a model of the medical organization that implements the principles of value-based and personalized medicine, takes advantage of the technologies of the Health 4.0 concept, and allows for quick and flexible response to dynamically changing environmental conditions.

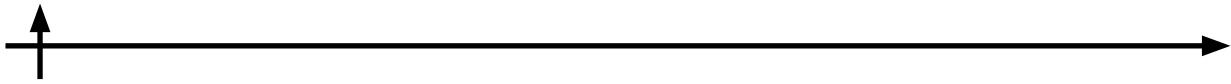
The requirements for compliance with the principles of value and personalized medicine should be reflected in the model of business processes of a medical organization. The possibilities for applying technologies of the Health 4.0 concept set requirements for the structure of IT support and the technological infrastructure that ensures the implementation of processes.

This makes it urgent to analyze models of IT solutions for IT support of a medical organization, which implements the principles of value and personalized medicine and follows the development trends of modern digital technologies.

Materials and methods

A characteristic feature of the Health 4.0 concept is that it involves the introduction of modern digital tools and technologies (big data management, the Internet of things, blockchain, telemedicine, predictive analytics, etc.) in medical activities, in order to increase its accessibility and efficiency from various points of view (Ilin et al., 2020). In the realities of the modern world, most medical organizations are faced with the problem of lack of resources to process the ever-increasing flows of information. This is largely due to the fact that the existing management architecture in organizations, and one of its components – the architecture of information systems and applications, today does not meet modern requirements and conditions for building effective interaction with modern digital technologies (Borremans et al., 2019; Ilin et al., 2019; Lee and Youn, 2015).

Ensuring accessibility requirements for medical care and compliance with the principles of value and personalized medicine are directly related to the possibility of increasing economic efficiency. The



provision of medical care that is adequate, according to the patient, to a particular case, creates the prerequisites for the efficient use of the resources of medical organizations. Modern management technologies, including digital ones, have significant potential in solving a number of problems on the way to providing more affordable, cost-effective and high-quality medical care.

Health 4.0 is defined as a strategic concept for the healthcare industry based on the Industry 4.0 concept (Bause et al., 2019, p. 0). The primary goal of Health 4.0 is to provide progressive virtualization to personalize patient health in real time. Personalization of healthcare will be achieved through the widespread use of cyber-physical systems, cloud computing, the Internet of things, predictive analytics, blockchain technology, streaming data from wearable devices, and various mobile systems (5G) (Cáceres et al., 2019, p. 0). To understand the benefits of using the concept in the healthcare sector, it is necessary to precisely define the main advantages and goals of using the concept of the fourth industrial revolution as a whole (Müschenich and Wamprecht, 2018). To date, the concept of "Industry 4.0" is one of the most significant organizational and technical systems. Such a solution involves the end-to-end digitalization of all existing physical assets and their subsequent integration into the digital ecosystem together with partners participating in the value chain (Hermann et al., 2016). The main strategy of the fourth industrial revolution is to expand the possibilities of relations between manufacturers and suppliers in various industries, which allows to increase the volume of individualization and personalization of customers.

The Industry 4.0 concept is defined by the following characteristics (Bartodziej, 2017, p. 4):

1. Digitalization and integration of vertical and horizontal value chains, from development and procurement to production, logistics and service. All existing data on the effectiveness of process control are available in real time in an integrated network. Horizontal integration allows you to reach suppliers, consumers and other key partners. Such integration uses a variety of technologies: from tracking and control devices to integrated planning integrated with real-time execution.

2. Digitalization of products and services, which includes the addition of existing products with various smart sensors or communication devices that are compatible with data analytics tools, as well as the creation of new digital products designed to provide comprehensive solutions. Due to the introduction of innovative methods of data collection and analysis, enterprises have the opportunity to obtain data on the use of products and modify these products in accordance with the new requirements of end users.

3. Digital business models and customer access, including comprehensive, personalized, data-driven services and integrated platforms. The main focus of new business models is to obtain additional profit from digital solutions, optimize interaction with the client and improve customer access (Kagermann et al., 2013).

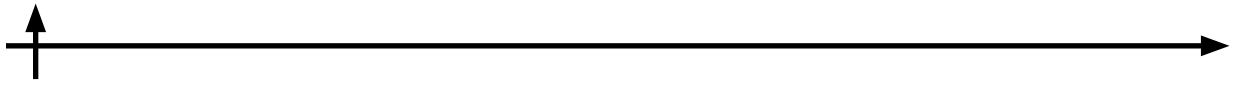
This research paper will review technologies related to Health 4.0 from various global software and hardware vendors in order to analyze general trends in building the structure of IT support.

Results

The implementation of information systems and technologies at various types of enterprises, as a rule, is based on goals related to solving the most important business problems. An analysis of organizations in the healthcare sector showed that such tasks from the point of view of management include:

1. Improved diagnosis / treatment. The institution is not only a platform for the introduction of new technologies, but also achieves a significant improvement in the results of applying traditional approaches by using predictive modeling methods based on patients' medical data to select the optimal treatment depending on individual characteristics and organizational decisions.

2. Organization of "seamless" patient flows. Effective organization of patient flows means a reduction in waiting time and length of hospital stay, increasing the satisfaction of patients and doctors with the care process. The information system is configured to identify bottlenecks, analyze the causes and develop approaches to address them, which contributes to the optimal distribution of patient flows.



3. The active use of distance medical technologies and hospital to home technologies. One of the key tasks of remote monitoring methods is to expand the boundaries of the hospital with the possibility of further assistance to the patient at home. For these purposes, there are various medical devices – wearable, implantable, portable. But their main task is to provide information about certain vital functions of the patient (blood pressure level, electrical activity of the heart, oxygen saturation of the blood, glucose level, etc.) in real time to the clinic. Some devices are associated with additional therapeutic options, such as remote control of the dose of the drug. The most promising is the use of remote rehabilitation technologies, including during orthopedic operations, after a stroke, etc. This significantly reduces the need for patients to be hospitalized and, consequently, reduces the cost of providing care, along with an increase in patient satisfaction with the opportunity to receive the necessary help. at home. Data from wearable devices and applications originating from patients is medical information, a description of symptoms, biometric indicators, medical history, lifestyle indicators that are collected, recorded by the patient or his relatives. It is important to note that these data were collected outside the medical care process, because patients (not medical personnel) are responsible for collecting information and its quality, as well as maintaining its confidentiality (unless they are part of the services provided by the “smart clinic”) (Iljashenko et al., 2019). The advent of affordable wearable devices, sensors, and data transfer technologies, such as patient portals, provides a unique opportunity for long-term, continuous monitoring of daily activity and indicators of patients with chronic diseases. This promotes the involvement of patients and their relatives in the care process and the development of a continuously learning health system. Data from wearable devices can potentially fill many existing information gaps and provide a unique opportunity to track the patient’s condition and his adherence to treatment between visits to the clinic.

4. Improving patient safety. Improving the quality of medical care and the proper organization of patient flows leads to increased patient safety.

5. Reliability. A good reputation is a competitive advantage when choosing between different organizations. Reliability is also determined by the level of adherence to treatment and the creation of an integrative care system for patients, as this affects the results that a medical organization can achieve.

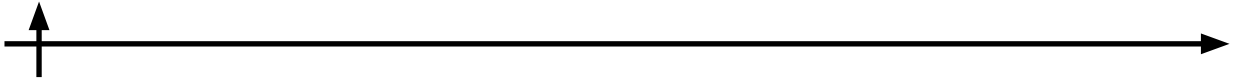
The world’s largest software manufacturers, SAP, Microsoft, Oracle, etc., when developing IT solutions for the healthcare sector are guided, first of all, by the need to implement the ideas of value and personalized medicine. The main goal of modern IT solutions is to maintain a balance between medical and economic efficiency of a medical institution. It is important to provide cost-effective treatment, create a digital network for the new consumer-centric healthcare ecosystem, and enable real-time information exchange between healthcare providers and patients. It is necessary to maintain a more personalized interaction between patients and a medical organization at all stages of the process, from prevention and diagnosis to treatment and postoperative care.

SAP IT-solutions

Digital technologies help the healthcare industry forecast the demand for medical services and provide real-time services, optimize the provision of preventive care and treatment, and give patients the opportunity to better control their health. Frequent changes in patient service quality standards require quick and constant adaptation by medical organizations, insurance companies, life sciences organizations, and software developers. There is a health ecosystem focused on the concept of Health 4.0, which goes beyond traditional management systems.

A modern consumer of medical services is informed, proactive, and is included in a single digital space for interaction with representatives of medical organizations. According to the CEO of SAP SE Healthcare Providers, SAP is developing digital solutions to bring patients and the healthcare industry closer together, using high technology to achieve more personalized care (“SAP SE. SAP Software Solutions | Business Applications and Technology,” n.d.).

SAP’s experience in digitally processing every aspect of the customer value chain is designed to help healthcare stakeholders improve their customer service delivery at an affordable price.



The SAP solution for the healthcare industry consists of 3 main modules:

1. patient care – the patient care module is focused on solving many problems, such as organizing access to personal and medical data of a patient directly in real time, including using mobile devices; improving the overall health of patients while controlling costs.

2. collaboration in the field of healthcare – ensuring collaboration between providers and consumers of health services contributes to the promotion of health and well-being and reduces hospital visits. To ensure collaboration, this module helps to manage patient transitions from one healthcare provider to another when moving through the network, identify health problems before the patient needs to be in the hospital, and monitor patient redirection to maintain them within the network. This reduces the number of hospital visits, and collaboration between healthcare providers and consumers becomes more active. The healthcare collaboration module includes 2 submodules: patient involvement and patient relationship management.

3. health analytics and research – the main purpose of the application is to consolidate health data from various sources. The application includes 3 submodules: Healthcare Analytics, Medical Research Insights, Connected Health.

Thus, SAP IT solutions for healthcare include special solutions related to medical activities (Patient care, Care Collaboration, Healthcare Analytics and Research), and solutions supporting financial (Finance), human resources (Human Resources) and procurement (Procurement) activities. SAP provides IT architecture components with analytics solutions, application platform and infrastructure, information and database management, database and data management, IT management, and security software (Security Software), the Internet of Things and technology services (IoT Business and Technology Services).

Microsoft IT-solutions

Microsoft IT solutions implement the concept of Mental Health. The company provides Microsoft Digital Transformation for Health.

This solution improves patient care and allows them to receive medical care outside the home, anywhere in the world. With the help of wearable sensors and service solutions, the number of repeat visits is reduced, and doctors are able to provide timely preventive care. Microsoft solutions empower the digital healthcare industry.

This is a single integrated platform that combines several solutions (“Microsoft Collaborative Health: Healthcare Solutions,” n.d.):

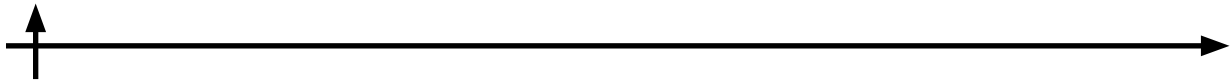
- Health360 Care Coordination – coordination of patient care.
- Microsoft Dynamics 365 Sales and Field – A solution for field sales and service.
- Power BI – business intelligence.
- MS SharePoint – a platform for developing a corporate portal and managing corporate content.
- MS Azure – Microsoft’s cloud platform.

The need for the continuous development of the healthcare system is constantly growing with limited resources. In addressing the issues of improving the quality of medical services, digital e-health solutions are becoming an integral component of the digital transformation of a medical organization.

Conclusions

Thus, after analyzing the decisions of the world’s largest software vendors, several key features of the structure of IT solutions were formed to support value-based and personalized medicine.

– Integration and connectivity to other products. As a rule, the IT landscape of any medical organization is characterized by the integration of many different information systems into a single environment. In this regard, it is necessary to check that the selected information systems will be able to use different types of databases (SQL, NoSQL), work with different versions of existing data storage and transmission standards (XML, JSON), and will also provide integration with software from various vendors, primarily large ones, such as SAP, IBM, Oracle;

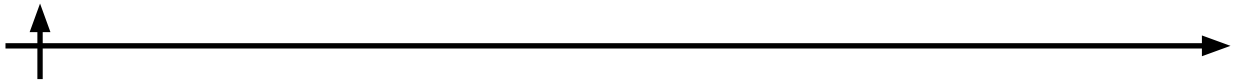


- Performance. It is extremely important to assess in advance the amount of data that will be stored and transmitted in information systems, as well as to estimate the approximate number of users who will use information systems at the same time in order to calculate the values of peak loads for the entire IT landscape of the organization;
- Security. It is known that the specificity of medical activity involves the collection and storage of a large amount of personal data of patients, which are confidential and protected by medical confidentiality and medical ethics. In this regard, systems that work with personal data must meet certain requirements. Firstly, they should be able to customize roles and access rights to data, and secondly, it should be possible to partially isolate these systems from the "outside" world, without interrupting interactions with other systems used in the landscape;
- Reporting. Reporting documentation is an important aspect that accompanies most types of activities, including medical. However, filling out these documents often takes up a huge amount of working time from doctors, and accordingly, the time that a specialist can spend on treating a patient is reduced. In this regard, it is important that the process of preparing documents is automated as much as possible through the use of information systems, which will increase labor costs for the direct responsibilities of employees;
- Using cloud technology. Modern medical organizations use a large number of different sensors and equipment that allow them to monitor and regulate certain processes remotely. To ensure effective remote interaction in the IT landscape of a medical organization, systems and services must be provided that will partially or fully function in the cloud (Catarinucci et al., 2015; Meng et al., 2011; Piniewski et al., 2010).

The main advantage of modern technology is that it integrates the entire medical environment, thereby offering physicians a detailed understanding of the aspects needed to improve diagnosis, treatment and patient care. While the use of technology influences various indicators of health outcomes, such as reducing costs, the introduction of technology without proper planning can lead to a number of problems. For this reason, several important aspects need to be considered, including the preparedness of the organization, a good understanding and knowledge of modern technologies, and taking into account the risks of digital technologies. Reforming the activities of medical organizations, caused by the need to introduce modern management technologies, in accordance with the concept of enterprise architecture, should be carried out systematically, taking into account the interconnections and interdependencies of all elements of the organization's management system.

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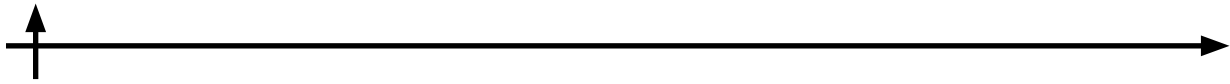
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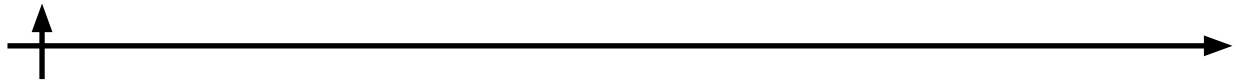
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