POTENTIAL OF DIGITAL TECHNOLOGIES SUPPORTING THE PRINCIPLE OF PERSONALIZED MEDICAL AID IN CARDIOVASCULAR DISEASES

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A study was undertaken to estimate the potential of digital technologies to support the principle of personalized medical aid in cardiovascular diseases. The study was done on the basis of the Kostroma region healthcare system. Information and methodological basis of the study comprised the polled data of 1400 patients aged 18–80 years old. A mixture of study methods was used: literature analysis, systemic and logical analysis, sociological (monitoring, expert assessment, content analysis, questioning, comparative analysis), statistical (grouping, ranking, correlation), pharmacoeconomic (cost-effectiveness, ABC/VEN-DDD-analysis, cost minimization) analysis, and organizational and functional modeling.

ВОЗМОЖНОСТИ ЦИФРОВЫХ ТЕХНОЛОГИЙ В ОБЕСПЕЧЕНИИ ПРИНЦИПА ПЕРСОНАЛИЗАЦИИ МЕДИЦИНСКОЙ ПОМОЩИ КАРДИОЛОГИЧЕСКОГО ПРОФИЛЯ

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Проведено исследование с целью оценки возможностей использования цифровых технологий в обеспечении принципа персонализации медицинской помощи кардиологического профиля. Исследование проведено на базе системы здравоохранения Костромской области. Информационно-методическую основу исследования составили данные опроса 1400 пациентов в возрасте от 18 до 80 лет. Использовалась совокупность методов исследования: метод анализа литературы, системного и логического анализа, социологические (мониторинговый, экспертных оценок, контент-анализа, анкетирование, сравнительного анализа), статистические (группировка, ранжирование, корреляционный), фармакоэкономические («затраты — эффективность», ABC/VEN-DDD-анализа, минимизации затрат), организационно-функционального моделирования.

According to Presidential Decree of the Russian Federation as of December 1, 2016 No. 642 'On the Strategy of Science and Technology Development of the Russian Federation', 'implementation of personalized medicine and high-technology healthcare' refers to the priority areas of science and technology development of the country for the next 10–15 years. In the light of global trends, the Russian healthcare has entered the path of digitalization [1, 2, 3]. Being an important factor of successful development, digital medicine enables continuous control and monitoring of medical aid quality [4, 5], improves organizational processes based on the principles of lean management [6, 7], upgrades statistical data processing and exchange [8, 9], expands the processes of innovation implementation [10], and makes business activity of medical organizations more effective [11].

The role of information technology implementation in clinical practice quality improvement based on the 'smart hospital model' is significant [12]. Digitalization is especially important for implementation of the principle of personalized medicine,

as accounting of many factors that can influence a treatment outcome for a certain patient is rather a complex task. It can't be solved without digital support [13, 14]. This is about genetic, medical and social factors, factors of rational pharmacotherapy individual selection considering the drug effectiveness level of evidence [15, 16]. The issues are especially relevant as far as the cardiological aid goes, as it is required mainly by those of advanced and old age with a large factor loading of medical and social and medical and biological risk of cardiovascular complications [17]. Thus, digitalization of the cardiological aid system would allow to increase its productivity correcting the controlled factors. Analysis of these data has shown that in scientific publications, no attention was given to the issues of cardiological aid digitalization from the perspective of the personalized approach, making it relevant and necessary to study these aspects from a scientific point view.

Purpose of the study: to determine the potential of using digital technologies to support the principle of cardiological medical aid personalization.

METHODOLOGY

The study was carried out on the healthcare basis of the Kostroma region.

The information and methodological basis of the study comprised the interviews of 1,400 patients aged 18–80 years with the established diagnoses of arterial hypertension, coronary heart disease (exertional angina, acute coronary syndrome (acute myocardial infarction, instable angina) (based on the classification of WHO/Medical Society for Arterial Hypertension, 2004), who requested medical assistance in medical organizations of Kostroma and Kostroma region. The study included those patients who signed an informed consent form. The retrospective group (cases of aid provision) had 1,400 patients, the prospective group included 200 patients and 21 experts. The decisions made by the Expert Committee concerning 386 lethal cases and 71 complaints were analyzed as well. A set of research methods was used. They included methods of literature analysis, systemic and logical analysis, monitoring, expert assessment, content analysis, questioning, comparative analysis, statistical (grouping, ranking, correlation), pharmacoeconomic (cost effectiveness, ABC/VEN-DDD-analysis, cost minimization), organizational and functional modeling. The results of the Cardiological Medical Aid Effectiveness Factor Control automated monitoring were also used.

The study was conducted within the program of scientific research of the Yaroslavl State Medical University of the Ministry of Health of the Russian Federation, whereas the study protocol and design were approved by the Ethics Committee (protocol No. 21 as of February 08, 2018).

The data were processed using Statistica 11.0 software (StatSoft, Inc.). Qualitative attributes were tested to check whether they were normally distributed according to such known criteria as the Kolmogorov-Smirnov test, Shapiro-Wilk test, grouping of databases, and calculation of extensive values. Statistical significance of values in the trial arms was determined using the Student's t-test ($p < 0.05$ significance). Spearman's correlation analysis was used to study the interrelation between two attributes. The critical value for statistical significance is 5%.

RESULTS

The Cardiological Medical Aid Effectiveness Factor Control automated platform is a part of the organizational and functional cardiovascular aid digitalization in the Kostroma region (A. A. Gruzdeva et al. Management of cardiological medical aid effectiveness factors. Application software. Patent of Russia No.

2018612060, 2018. Bulletin No. 2). The method of automated monitoring is 1C: Accounting platform-based (i. e. can be accessed by any medical organization (MO)). An automated database is built based on the interviews of patients, registration of data associated with material-and-technical and carrier-oriented readiness of a medical organization for provision of aid and expert assessment of the aid provision technology. The base is the foundation for building predictive graphic models and finding the factors that need to be corrected. The base is built by medical workers in technical support of automated control system specialists (patient's data are entered by a doctor and a nurse, material and technical base data are entered by the chief nurse of the department/hospital, expert assessment results are introduced by a MO expert (head of the department)).

The medical and organizational structure of management of effectiveness limiting risks and quality of medical aid includes as follows: f) an automated platform necessary to build a database about factor dependence of aid effectiveness according to three blocks (medical and social, technological and infrastructure); b) algorithms and check lists correcting unfavorable factors; c) a model of expert activity concerning the cases of cardiological aid provision. It includes 10 options of building expert conclusions and determining pharmaco-economical therapy effectiveness.

The clinical and organizational approach of personalized continuous management of risks decreasing the effectiveness of pharmacotherapy and quality of aid for people with cardiovascular diseases is as follows: the leading factors determining the effectiveness of pharmacotherapy, quality and effectiveness of medical aid are provided; parameters and criteria of their estimation, automated monitoring technology are developed; an automated platform is created to build models of aid provision considering institutional, technological, medical and biological conditions and limitations at the individual, medical and organizational levels (at the level of a medical organization); algorithms and recommendations associated with correction and modification of quality reducing risks and cardiological aid effectiveness are established; the criteria assessing the effectiveness of risk management are suggested. The use of the automated monitoring method ensures continuous management; potential of building automated models of possible risk factorial dependence for every patient allows to implement not only a population, but also a personalized approach (for every case of patient management and aid provision). This is important when tasks of expert activity are implemented and reasons for unfavorable outcomes are found out.

Let's consider a digital approach to the management of cardiological aid effectiveness factor control based on situational factors. The situational factors include unfavorable time (night) and day of week (weekends, holidays) to provide aid; high workload of doctors, including serious patients; not typical pathology in a patient; health of the doctor who provides aid; intervention of third parties while rendering aid. The information platform enables analysis of factorial data, determines their frequency and specter of required administrative effects. Basic measures of management include organization of control checks and video-control; photography and work schedule recording; assignment of competent persons at departments during holidays; development of personnel duty cards during a shift; sorting patients by the aid provision priority; teaching medical personnel about the rules of interaction with patients' relatives; creating an individual surveillance plan for patients with unique and not typical signs of diseases, etc.

In our article, we didn't aim at introducing changes into the available structure of medical aid quality control and criteria

of its estimation. It is known that they are determined by the orders of the Ministry of Health of the Russian Federation and Federal Compulsory Medical Insurance Fund. Our work is based on the preventive strategy of aid quality support and effectiveness. We tried to determine which factors create conditions for aid unfavorable outcomes and prevent from complete implementation of medical aid quality potential (optimal level). It is important because not everything depends on medical workers; much is dependent on those factors that can't be changed or can be changed in the short-term (that takes time). This is important for timely determination and correction of deviations. We have found out that technically, it can be perfect as far as compliance with maintenance of orders, clinical protocols, standards go, though the outcome can be unfavorable. Working with digitalization of cardiological aid, we suggest a universal methodology instrument. The instrument can be used by doctors who could be aware of the factors influencing the outcome of their activity; by heads of medical organizations who could collect data about the factors, which have to be affected; by experts of medical aid quality who could obtain data about the reasons influencing the decrease in quality and unfavorable outcome.

The frequency of factors in two comparison groups was analyzed using the Cardiological Medical Aid Effectiveness Factor Control automated platform (A. A. Gruzdeva et al. Management

of cardiological medical aid effectiveness factors. Application software. Patent of Russia No. 2018612060, 2018. Bulletin No. 2): in the group of patients with a positive (optimal) outcome (convalescence, condition improvement, reduced number of exacerbations) ('a group with a positive outcome') (GPO) (304 cases) and in the group of treatment with a non-optimal outcome (deterioration in condition, frequent cases of exacerbation, readmission, disability, death) ('a group with a negative outcome') (GNO) (96 cases). The data form the basis for building a model of factorial dependence of quality reduction risk implementation and effectiveness of cardiological aid in regions.

CONCLUSION

The data obtained during a trial allowed to offer the concept of the personalized strategy of risk management in cardiological patients. It is novel because of the individual approach assessing the influence of different factors on every patient and solving the set tasks considering distance barriers. Increased quality of cardiological aid in a region and improvement of demographic characteristics are achieved by improvement of health in every patient. Approval of this model using mathematical and statistical methods not considered in clinical recommendations enabled to decrease a number of unfavorable outcomes by a factor of 1.7 while rendering aid to cardiological patients.

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