A New Paradigm for Ensuring Digital Drug Care Quality Monitoring Based on Ontology Tools

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Abstract. Systematizing and conceptualizing of the components of the patient's diagnosis at definite Clinical Situations are the important steps in constructing the medical electronic platforms to monitor the drug treatment quality and to realize the process of risk-management of drug care. The risk-management is a hard and expensive process for the non-profit hospitals. The Information technologies have a high potential for solving these problems. The conceptual schemes to construct the multimodal medical electronic platform were discussed. The Information Space of Clinical Practice, Information Field for formulating the detailed patient's diagnosis at the definite Clinical Situations, Information Environment for the components of the detailed patient's diagnosis were described.

Keywords. Conceptual schemes, drug quality care, medical electronic platform

1. Introduction

The basic principle of the drug treatment is to choose the right drug for a patient with a correct diagnosis, to administer the drug at the right time and in the right dose. The principles of "patient-centricity" are included into the law of the Russian Health Care system [1]. The process of safety drug treatment is one of the most important, complicated and expensive tasks for the non-profit hospitals. The Information technologies have a high potential for solving these problems. The methodological and theoretical approaches to improve the medication treatment process by using the tools of information technologies are very actual.

Any subject area of knowledge operates with specific terminology. The accuracy of the terms and concepts is especially important in medicine. Contemporary development of the knowledge about the accumulated clinical practice skills is in the process of transformation into a digital format [2]. *The* precise definitions of the terms and connections with their concepts are strongly needed for all professional areas in medicine. Conceptual apparatus is highly important and actual for constructing the medical electronic platforms.

1.1. Objective of the Work

The objective of the work is the deployment of the conceptual scheme of the Clinical Information Space based on the methodology of systematization of the Clinical

Situations to support clinicians at the moments of drug choice decisions, to predict the drug adverse events and to monitor the real Clinical Situations in the databases of medical electronic platform.

Object: conceptualization of the components of the *Information Field of the patient's diagnosis* for coding of the individual features (facets) of the patient's diagnosis at the definite Clinical Situations.

Subject: conceptualization of the Information Environment of the components in the information vectors of the individual patient's diagnosis at the definite Clinical Situations.

2. Material and Methods

The concepts of the Clinical Information Space were formulated on the base of the systemic principles: hierarchy, uniformity, sufficient diversity, symmetry of reflection, irreversibility of the time etc. [2,3,4]. The methodology of constructing schemes was based on the principles of the philosophical foundations of the science: logical, ethical and ontological [3,5,6,7,8]. The ontologies, the electronic intelligent system based on the knowledge (expert decision support system) and the system for digital coding of the individual patient's diagnosis at the definite Clinical Situations were simultaneously in demand.

The conceptual scheme of the multi-module medical electronic platform included 5 program modules: 1) data bases, 2) knowledge bases, 3) program for digital coding of the individual components of patient's diagnosis, 4) the module for identification: a) the drug prescriptions deviations from the recommended models, b) the triggers of the adverse events marked with the special key words controlled in the different parts of the patients' data, c) the signals of the adverse events in the laboratory and clinical parts of database; 5) module for monitoring of the Clinical Situations dynamic and clinical results in digital codes.

The prototype of the first module for decision support and drug prescriptions monitoring was made by the authors and registered. The algorithm for coding the of the patient's diagnosis components in the definite Clinical Situation was tested and showered the opportunity to solve these tasks [9]. The tools of ontology allowed to personalize the choice of the drugs, when the Clinical Situations had the additional factors and conditions affecting the decisions. The inference rules for decision support were carried out by the ontology tools from the knowledge-base. Other path for decision support by the ontologies took the start in the databases of real Clinical Situations. The new inference rules were constructed. In order to use these rules according to the regulatory demands the agreement with the medical commission was made.

3. Results

Conceptual scheme of the Information Space of Clinical Practice was constructed as the hierarchical tree: General Information Space of Clinical Practice > Information Spaces of the specialized (subject) areas of Clinical Practice > Information space of the diseases' names based on ICD-10 > Information Space of Clinical Situations at the moments of decisions and etc.

The Information Space is the result of human semantic activity [8]. *Information Space of Clinical Practice* was systematized. The first conceptual scheme of the Information Space was made for the subject area "Phthisiology".

Information Field - this concept is used in a great number of the scientific studies for description of the properties of the real space and real world [2,3,4,8].

Information Field of *Clinical Situation* was constructed with two interconnected parts:

1. Information Field of the Patient's diagnosis at definite Clinical Situation;
2. Information Field of the medications corresponding with the patient's diagnosis at definite Clinical Situation.

Information Field of *Patients' diagnosis at definite Clinical Situation* was constructed with two types of information vectors:

1. *The discrete information vectors* - stage, phase, severity of the patient's Clinical Status and the level of complexity of the definite Clinical Situation. These discrete vectors were constructed in the format of the constant dimensionality to monitor the process of treatment in dynamic by the program. All discrete information vectors had 5 levels of gradation. The corresponded definite criteria for each component of the information vectors were described.
2. The vector of information continuum - the ICD codes as the names of the diseases, the numbered entries of a linear array of the factors and conditions that affected the drugs' choice and medical interventions.

Information Field of medications for treatment – included the appropriate models of the medications for treatment according to the National Clinical Recommendations, Standards of medical care at the definite Clinical Situations, the collection of the declarative rules and the regulatory requirements for the quality drug care, background information on drugs interactions, risks of adverse events, etc.

The Information Environment for the components of the patients' diagnosis was described by using of the criteria for their boundaries. The digital code of the patient's diagnosis of Clinical Situation from database was used as the key to find the concordant Standard model of medication treatment in knowledge-base.

4. Discussion

The transformation of the scientific knowledge forms affects the process of cognition. The range of applications of the information technologies in the Clinical Practice expands very fast. But the medical information is still designated by numerous synonyms in the medical texts. For example, very important concept "stage" may be named as: stage=period=phase [10,11,12]. This requires to accelerate the   improvement and harmonization of the scientific terms and concepts in medicine. The vocabulary of the terms and concepts for the components of patients' diagnosis at the Clinical Situations - stage, phase, severity of Clinical status of the patient and complexity of the Clinical Situation were formulated by the authors, published and used for coding the detailed patients' diagnosis [9,13,14]. The medical electronic platforms for monitoring of medication care, decision support, predicting the adverse events are in emergence of demand for unambiguous of terms and definitions in order to collect the clinical diagnosis with exact details in codes in databases without disclosure of the private information about the patient.

The new paradigm for decision support and monitoring of drug treatment quality with the multi-module medical electronic platform using simultaneously the ontology tools, expert decision support systems and the detailed Clinical Situations coding in the conditions of the systematization of the clinical Information Space and conceptualizing the medical terms has the great opportunity to be useful in the improving of medication care.

5. Conclusions

1. The conceptual schemes of Clinical Practice Information Space gave the opportunity to use the digital codes for the personal patient's diagnosis at the definite Clinical Situations without disclosure of the private information about the patient.
2. The conceptual apparatus for the components of patient's information vectors allowed to use the digital codes for searching the standard models in the knowledge base.
3. The tools of ontologies were successful for decision support in Clinical situations with the additional factors and conditions affecting the clinical results.
4. The new inference rules were constructed by the ontologies, when the standard models were absent.
5. The tools of ontologies showed to be useful to identify the triggers and signals by the key words and laboratory data in the process of monitoring treatment.

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