

Modeling the Decision Making Process on Civil Law Regulation of Contracts for the Provision of Therapeutic Services

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Abstract. Currently, there is a need in Ukraine to design and develop a decision support system (DSS) on civil law regulation of Contracts for the Provision of Therapeutic Services (regarding the correctness or incorrectness of the Contract structure). For designing such a DSS, it's necessary the modeling of the decision making process on civil law regulation of Contracts for the Provision of Therapeutic Services, which is the goal of this research. The paper first time proposes a set-theoretical model, and a model of the ideal ontology of a Contract for the Provision of Therapeutic Services based on the ideal structure of the Contract in terms of civil law regulation. In addition, the modeling of the decision-making process on civil law regulation of Contracts for the Provision of Therapeutic Services (regarding the correctness or incorrectness of the Contract structure) was performed. The developed model of the decision-making process is a theoretical basis for the development and design of DSS on civil law regulation of Contracts for the Provision of Therapeutic Services.

Keywords: Contracts for the Provision of Therapeutic Services, Civil Law Regulation, Ontology-Based Decision Support System, Set-Theoretical Model, Model of Ontology, Model of Process of Decision Making, Correctness of the Contract Structure.

1 Introduction

Today, medical technologies must meet 4 requirements: efficiency, safety, novelty and economic benefits [1]. The modern therapist makes the decision, integrating several medical specialties. This solution is a daily problem, especially when using innovative medical technologies [2]. With the introduction of insurance medicine in Ukraine, every therapist should know the standards of diagnosis and especially the standards of treatment of therapeutic diseases, as failure to comply with the standards of treatment can lead to complaints of patients, legal conflicts and compensation of considerable financial resources at the expense of the doctor.

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In view of the above, the issue of concluding a Contract for the Provision of Therapeutic Services needs increasing attention today. A Contract for the Provision of Therapeutic Services can be defined as an arrangement whereby one party (provider) undertakes, on the task of the other party (customer), with complying the health care legislation, to provide a service of a therapeutic nature, and the customer agrees to pay the contractor the specified service unless otherwise specified by contract or law.

This service is to establish and treat the etiology, pathogenesis and clinical manifestations of diseases of the internal organs, their diagnosis, prevention, and rehabilitation. The parties to the agreement on the provision of therapeutic services may be health care institutions; individuals carrying out private medical practice; patients - individuals.

Depending on the subject of Contract, the following types of Therapeutic Service Contracts are currently being proposed: Contract for the provision of basic therapeutic services (that will interrupt the course of the disease and promote healing); Contract on the provision of special therapeutic services (which will prevent and eliminate the possible exacerbation of the underlying disease or the occurrence of relapses of concomitant pathological processes, the manifestation of possible side effects of drugs on special indications); Contract for the provision of additional therapeutic services (after discharge of a patient from the hospital).

Successfully implemented medical software and decision support systems can greatly increase the productivity of therapists [3].

Even more significant and important to support the work of therapists are multidisciplinary medical DSSs, which are being developed at the intersection of the medical and other subject areas – for example, the DSS for medical law, which would support decision-making on concluding Contracts for the Provision of Therapeutic Services, taking into account legislative grounds.

So today, *the actual task* is to develop an intelligent DSS for the civil law regulation of Contracts for the Provision of Therapeutic Services.

2 Literature Review

The review and analysis of known decision support systems for the medical law are represented on Figure 1.

This review has proven that none of these known DSS is intended to support decision-making on concluding Contracts for the Provision of Therapeutic Services, taking into account legislative grounds.

So today, it is necessary to develop an intelligent DSS for the civil law regulation of Contracts for the Provision of Therapeutic Services. For that, the decision-making process on civil law regulation of Contracts for the Provision of Therapeutic Services should first be organized, which is *the goal of this research*. This paper is devoted to, in particular, modeling the decision making process on civil law regulation of Contracts for the Provision of Therapeutic Services.

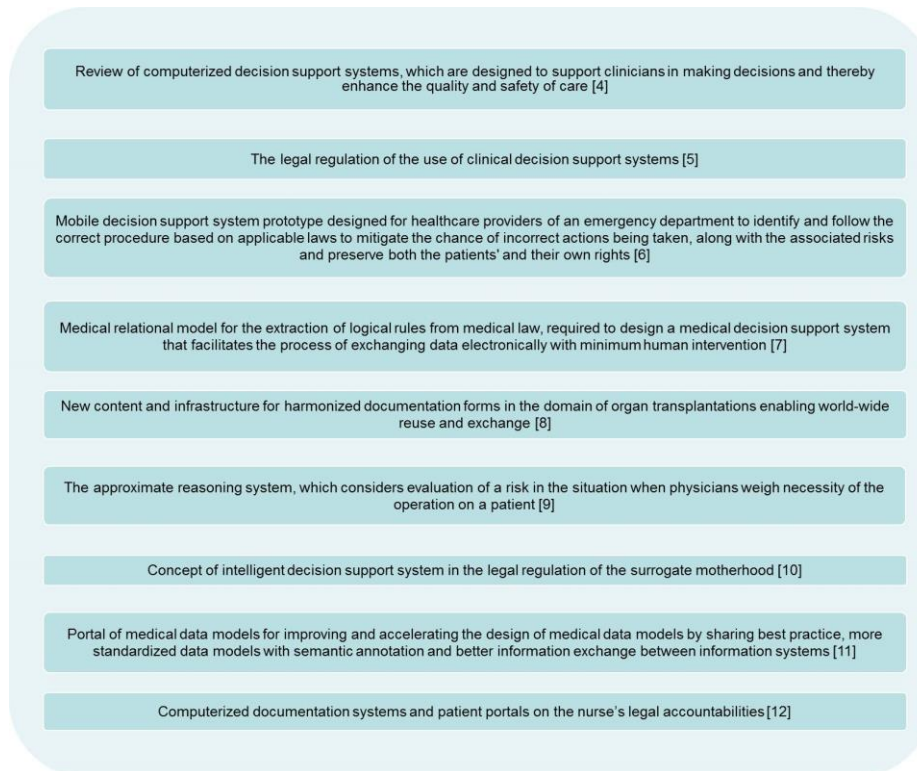


Fig. 1. Review and analysis of known decision support systems for the medical law

3 Civil Law Regulation of Contracts for the Provision of Therapeutic Services

Consider the structure of the Contracts for the provision of therapeutic services required in terms of civil law regulation. An essential condition of a Contract for the Provision of Therapeutic Services is the subject – medical service in therapy. The subject of this Contract is the provision of therapeutic services consumed in the carrying out therapeutic activities.

According to Part 3 of Art. 626 of the Civil Code of Ukraine [13], the Contract for the Provision of Therapeutic Services is bilateral. Based on the subjective structure of the Contract for the Provision of Therapeutic Services, these contracts in accordance with Part 1 of Art. 633 of the Civil Code of Ukraine [13] are public.

These Contracts are payable unless otherwise provided by Contracts, by law, or do not follow from the substance of the contracts. An important condition of contracts for the provision of therapeutic services is the price for services and the procedure for settlements. Therefore, the contract must specify the procedure for calculations. Issues of payment under the contract of the parties decide in accordance with Art. 632, 903-904 of the Civil Code of Ukraine [13].

Regarding the term, these Contracts may be concluded for a term that, as a matter of fact, depends objectively on the capabilities of a particular type of therapeutic service, as well as on the desired result to be achieved.

The text of the Contract for the Provision of Therapeutic Services should include the section "General Terms" and "Main Part". The General Terms section consists of the following clauses: subject of the Contract; theoretical principles of work; practical tools; limits of competence of the practitioner; duties, rights and responsibilities of the doctor (medical institution); duties, rights and responsibilities of the client; price of services and procedure of payments; timing and schedule of services; possible manifestations of concomitant and incidental adverse effects of exposure to therapeutic services; other conditions.

The Main Part section of the Contract may include the following units:

Unit I "Diagnostic Search" consists of the next clauses: patient's complaints, identifying individual signs (symptoms) of the disease based on complaints, medical history, patient's life history, objective survey data, general clinical and laboratory-instrumental research methods. The basic condition of this stage is compliance with the systematic and complete examination of the patient.

Unit II "Making the Diagnosis". There are the previous (syndromic) diagnosis, after the first examination; the clinical diagnosis, after additional examination and observation of the patient; the final diagnosis.

Effective treatment requires proper diagnosis based on a systematic examination of the patient, analysis of anamnesis, complaints and objective signs of the disease (revealed during the physical examination, as well as using routine laboratory and instrumental methods). Identified signs (symptoms) of the disease should be combined by the therapist into syndromes (a set of symptoms having common pathogenesis), on the basis of which a final conclusion can be drawn about a possible disease. If it is impossible to draw a clear conclusion about the disease, differential diagnosis of several similar diseases should be performed with additional laboratory and instrumental studies. In some difficult to diagnose clinical cases, trial treatment is prescribed, which provides the so-called "diagnosis ex juvantibus" (diagnosis based on evaluation of the conducted treatment results). Therefore, a syndromic diagnosis is first established, and the final step in this process is the formulation of a clinical diagnosis, which should include the following components:

1. the name of the disease;
2. stage of pathological process;
3. clinical form and manifestations of the disease;
4. functional state of individual organs and systems;
5. diagnosis of complications;
6. diagnosis of comorbidities.

Unit III "Purpose of Treatment". At this stage, the verification of the veracity of the diagnostic search is performed by the appointment of adequate treatment, which should include: optimal physical, diet and hygiene regimens; medication, physiotherapy facilities and/or surgical methods; spa offers.

4 Modeling the Decision Making Process on Civil Law Regulation of Contracts for the Provision of Therapeutic Services

In [4, 14], the authors have argued that information of the subject area, including the area of medical law, is advisable to submit as ontologies that allow for systematic and rapid analysis of this information. The paper [4] presents the concept of the decision-making process in the field of legal regulation of surrogate motherhood. A similar approach can be used for decision making process on civil law regulation of Contracts for the Provision of Therapeutic Services.

For decision making on civil law regulation of Contracts for the Provision of Therapeutic Services, an ideal ontology is needed, which will represent the necessary (ideal) structure (sections, units, clauses) of the Contract for the Provision of Therapeutic Services in terms of civil law regulation. For each case, the conclusion of a Contract for the Provision of Therapeutic Services will require a real ontology, which will contain the real structure of the real contract. Comparison of the real ontology with the ideal ontology makes it possible to determine the presence of the necessary points in the real Contract for the Provision of Therapeutic Services and to decide accordingly on the correctness or incorrectness of the structure of this Contract.

Let AP is the set of missing clauses in the Contract for the Provision of Therapeutic Services:

$$AP = Ideal_ontology \setminus (Ideal_ontology \cap Real_ontology) \quad (1)$$

At the requirement of the interviewed experts in the field of medical law, considering the obligation to guarantee by such a contract of the safety of services in therapy for the patient, for the conclusion of the contract for the provision of therapeutic services, it is mandatory to perform all the above points. Therefore, taking into account the theory described in [12], *the criterion of the correctness of the structure of the Contract for the Provision of Therapeutic Services* has the form:

- if $AP = \emptyset$, then structure of the Contract for the Provision of Therapeutic Services is correct;
- if $AP \neq \emptyset$, then structure of the Contract for the Provision of Therapeutic Services is incorrect.

For the filling of an ideal ontology, set-theoretical and ontological models are required. In addition, given the presented criterion of the correctness of the structure of the Contract for the Provision of Therapeutic Services, it is necessary to develop a model of the decision making process on civil law regulation of Contracts for the Provision of Therapeutic Services.

Considering the above requirements to the structure of the Contract for the Provision of Therapeutic Services, we will present this Contract in the following formalized form:

$$CPTS = \langle GTC, MPC \rangle, \quad (2)$$

where **GTC** – General Terms of Contract, **MPC** – Main Part of Contract.

General Terms section consists of a number of clauses and can be presented in the following set-theoretical form:

$$GTC = \{ sc, tpw, pt, lcp, drrd, drrc, pspp, tss, pmaeets, oc \}, \quad (3)$$

where **sc** – subject of the Contract, **tpw** – theoretical principles of work, **pt** – practical tools, **lcp** – limits of competence of the practitioner, **drrd** – duties, rights and responsibilities of the doctor (medical institution), **drrc** – duties, rights and responsibilities of the client, **pspp** – price of services and procedure of payments, **tss** – timing and schedule of services, **pmaeets** – possible manifestations of concomitant and incidental adverse effects of exposure to therapeutic services, **oc** – other conditions.

Main Part section consists of 3 units and can be represented as a cortege:

$$MPC = \langle DS, MD, PT \rangle, \quad (4)$$

where **DS** – Diagnostic Search, **MD** – Making the Diagnosis, **PT** – Purpose of Treatment.

Unit I “Diagnostic search” should contain a number of clauses that can be formalized in the following set-theoretical form:

$$DS = \{ pc, iisd, mh, plh, osd, gclimr \}, \quad (5)$$

where **pc** – patient's complaints, **iisd** – identifying individual signs (symptoms) of the disease based on complaints, **mh** – medical history, **plh** – patient's life history, **osd** – objective survey data, **gclimr** – general clinical and laboratory-instrumental methods of research.

Unit II “Making the Diagnosis” also should contain a number of clauses that can be formalized in the following set-theoretical form:

$$MD = \{ pd, cd, fd \}, \quad (6)$$

where **pd** – previous (syndromic) diagnosis, **cd** – clinical diagnosis, **fd** – final diagnosis. Clinical diagnosis consists of many clauses:

$$cd = \{ nd, spp, cfmd, fsios, dc, dcb \}, \quad (7)$$

where **nd** – name of the disease, **spp** – stage of pathological process, **cfmd** – clinical form and manifestations of the disease, **fsios** – functional state of individual organs and systems, **dc** – diagnosis of complications, **dcb** – diagnosis of comorbidities.

Unit III “Purpose of Treatment” involves formulating and prescribing adequate treatment, which consists of the following clauses:

$$PT = \{ phdhr, mphtfsm, spao \}, \quad (8)$$

where **phdhr** – optimal physical, diet and hygiene regimens; **mphtfsm** – medication, physiotherapy facilities and/or surgical methods; **spao** – spa offers.

Then the model of the Contract for the Provision of Therapeutic Services with the ideal structure in terms of civil law regulation has the following form:

$$\begin{aligned}
CPTS = & \langle \{sc, tpw, pt, lcp, drrd, drrc, pspp, tss, pmaeets, oc\}, \\
& \{pc, iisd, mh, plh, osd, gclimr\}, \{pd, \{nd, spp, cfmd, fsios, dc, dcb\}, fd\}, \\
& \{phdhr, mphtfsm, spao\} \rangle .
\end{aligned} \tag{9}$$

Considering formalized form of the Contract for the Provision of Therapeutic Services with the ideal structure in terms of civil law regulation (equation (9)) and relations between concepts “influences_the_decision”, *model of the ideal ontology of the Contract for the Provision of Therapeutic Services*, can be represented in the form:

$$\begin{aligned}
IO_CPTS = & \{CPTS, "influences_the_decision" \} = \\
= & \{ \{sc, tpw, pt, lcp, drrd, drrc, pspp, tss, pmaeets, oc\}, \{pc, iisd, mh, plh, osd, gclimr\}, \\
& \{pd, \{nd, spp, cfmd, fsios, dc, dcb\}, fd\}, \{pd, \{nd, spp, cfmd, fsios, dc, dcb\}, fd\}, \\
& \{phdhr, mphtfsm, spao\}, "influences_the_decision" \}.
\end{aligned} \tag{10}$$

Taking into account the developed criterion for the correctness of the structure of the Contract for the Provision of Therapeutic Services and the model of the ideal ontology of the Contract for the Provision of Therapeutic Services, let conduct modeling the process of decision making on civil law regulation of Contracts for the Provision of Therapeutic Services.

If **AP** is the set of missing clauses in the Contract for the Provision of Therapeutic Services, then:

$$AP = IO_CPTS \setminus (IO_CPTS \cap RO_CPTS), \tag{11}$$

where **RO_CPTS**– model of real ontology, which contains the real structure of the real Contract for the Provision of Therapeutic Services.

The production rule for deciding on the correctness or incorrectness of the structure of the Contract for the Provision of Therapeutic Services is:

$$\begin{aligned}
& \text{if } AP = \emptyset, \\
& \text{then "structure of Contract is correct",} \\
& \text{else "structure of Contract is incorrect"}
\end{aligned} \tag{12}$$

The developed models are used to systematize the information obtained from the Contract for the Provision of Therapeutic Services and bring it to a general (unified) form in accordance with the civil law of Ukraine, so it is advisable to develop such models in static set-theoretical form.

The developed set-theoretical models are the basis for modeling the process of decision making on civil law regulation of Contracts for the Provision of Therapeutic Services.

The process of decision making on civil law regulation of Contracts for the Provision of Therapeutic Services (regarding the correctness or incorrectness of the Contract structure) is presented on Figure 2.

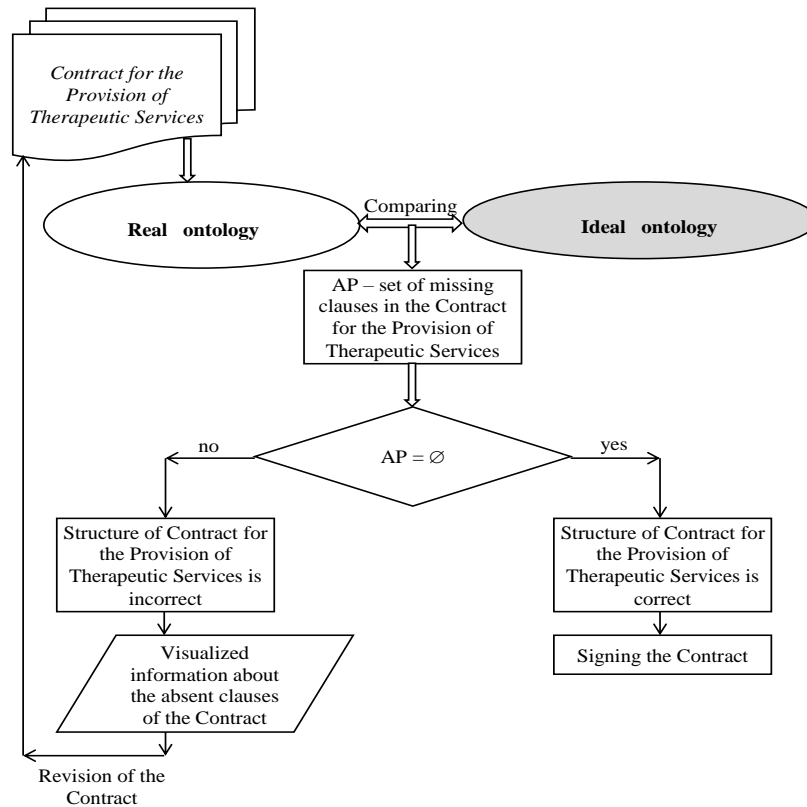


Fig. 2. Process of decision making on civil law regulation of Contracts for the Provision of Therapeutic Services (regarding the correctness or incorrectness of the Contract structure)

The proposed process of decision making on civil law regulation of Contracts for the Provision of Therapeutic Services is an iterative process based on the comparison.

5 Experiment, Results and Discussions

Let consider the functioning of the developed model of the process of decision making on civil law regulation of Contracts for the Provision of Therapeutic Services (concerning the correctness or incorrectness of the Contract structure). The analysis of the real Contract for the Provision of Therapeutic Services, ready to be signed by the parties, using the developed model of the decision making process on civil law regulation of Contracts for the Provision of Therapeutic Services, showed that the set $AP = \{ pt, iisd, pd, phdhr \}$. So, there are no clauses “practical tools”, “identifying individual signs (symptoms) of the disease based on complaints”, “previous (syndromic) diagnosis”, “optimal physical, diet and hygiene regimens” in the prepared contract. The signatories were informed that “Structure of Contract for the Provision of Therapeutic Services is incorrect” with providing the information about the absent clauses of the

Contract, and were invited to revise the Contract. The Contract was revised; the Contract was re-analyzed using the developed model, which resulted in the set $AP = \emptyset$, thus concluding “Structure of the Contract for the Provision of Therapeutic Services is correct” followed by singling the Contract.

The developed set-theoretical model, model of the ideal ontology of the Contract for the Provision of Therapeutic Services, model of the process of decision making on civil law regulation of Contracts for the Provision of Therapeutic Services (concerning the correctness or incorrectness of the Contract structure) provided the possibility to perform a fast check of the Contracts for the Provision of Therapeutic Services concerning the correctness or incorrectness of the Contract structure in terms of civil law regulation. Such check allows making automatically, without human participation, unmistakable (in terms of civil law regulation) decisions about the correctness/incorrectness of the structure of the Contract, the possibility/impossibility of concluding (signing) the Contract, and significantly improves the effectiveness of the therapist work and insurance medicine, as well as can protect both patients and doctors.

The described example proved the workability and effectiveness of the developed model of the process of decision making on civil law regulation of Contracts (concerning the correctness or incorrectness of the Contract structure).

6 Conclusions

Currently, there is a need in Ukraine to design and develop a decision support system on civil law regulation of Contracts for the Provision of Therapeutic Services (regarding the correctness or incorrectness of the Contract structure), which can significantly improve the effectiveness of the therapist work and insurance medicine, as well as can protect both patients and doctors.

The set-theoretical model, and the model of the ideal ontology of the Contract for the Provision of Therapeutic Services based on the ideal structure of the Contract from the point of view of civil law regulation, has been developed. These models make it possible the modeling the process of decision making on civil law regulation of Contracts for the Provision of Therapeutic Services (regarding the correctness or incorrectness of the Contract structure).

The model of the process of decision making on civil law regulation of Contracts for the Provision of Therapeutic Services (concerning the correctness or incorrectness of the Contract structure) is first time developed. This model is based on a comparative analysis of ontologies. The developed model reflects the features of decision making regarding the correctness or incorrectness of the Contract structure. Such a model is the theoretical basis for the development of methods and design of DSS on civil law regulation of Contracts for the Provision of Therapeutic Services (regarding the correctness or incorrectness of the Contract structure).

The perspective directions of future authors' work are: the development of the modeled ideal ontology, the development of the decision-making method and evaluation of its effectiveness, and realization of the ontology-based decision support system (as a part of intelligent information technology) on civil law regulation of Contracts

for the Provision of Therapeutic Services (regarding the correctness or incorrectness of the Contract structure) on the basis of the proposed model of process of decision making on civil law regulation of Contracts for the Provision of Therapeutic Services.

Successfully implementation of the proposed decision support systems can greatly increase the productivity of therapists by support decision-making on concluding Contracts for the Provision of Therapeutic Services, taking into account legislative grounds.

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