

# Concept of Intelligent Decision Support System in the Legal Regulation of the Surrogate Motherhood

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**Abstract.** The analysis of known decision support systems (DSS) in the field of medical law showed that they don't solve the problem of decision support regarding the possibility or impossibility of conducting a surrogate motherhood procedure, although this paper shows the actuality and importance of this problem. So, the aim of this study is to develop the concept of an intelligent decision support system in the legal regulation of the surrogate motherhood. This article describes the process of assessing the sufficiency of information for conducting the surrogate motherhood procedure and develops a conceptual scheme of the intelligent DSS in the legal regulation of the surrogate motherhood. The proposed intelligent DSS provides: a numerical assessment of the level of sufficiency of information for conducting the procedure of surrogate motherhood; a conclusion on the sufficiency or insufficiency of information for conducting the surrogate motherhood procedure; a list of requirements and / or recommendations to be followed (if it's possible) for conducting the surrogate motherhood; justified and legally correct decision on the possibility or impossibility of conducting the surrogate motherhood procedure, taking into account absolutely all nowadays existing requirements and recommendations for conducting this procedure.

**Keywords:** Surrogate Motherhood, Legal Regulation, Medical Software, Software for Medical Law, Intelligent Decision Support System (DSS), Sufficiency of Information.

## 1 Introduction

One of the important indicators of the state of reproductive health of the population is the possibility of having a child (children). Currently, 10 to 15 percent of Ukrainian families suffer from infertility, leading to direct reproductive losses. One way to overcome infertility is to use assisted reproductive technologies, such as surrogate motherhood. The current legislation of different states is increasingly inclined to give infertile couples the right to use the institution of surrogate motherhood and to regulate in the national law the procedure for exercising this right and guarantees for the protec-

tion of the rights of the surrogate mother. Almost all states of the USA, Canada, Brazil, Argentina, Hong Kong, Australia, South Africa Republic, Israel, Greece, Romania, the United Kingdom, and Ukraine are an inexhaustible list of countries that allow surrogate motherhood today. The prohibition of surrogate motherhood is enshrined in legislation in France, Sweden, Hungary, Germany, Iceland, Italy, Japan, Switzerland, Pakistan, Saudi Arabia, and Serbia.

Ukraine is one of the countries in which the assisted reproductive technologies are permitted at the legislative level [1], although the legal regulation of the surrogate motherhood in Ukraine is imperfect. The main problem of surrogate motherhood in Ukraine is the lack of a clear mechanism of action, especially when program participants are the citizens of countries where such a procedure is prohibited [2]. The issue of responsibility between the surrogate mother, the genetic parents, the doctors and the mediators remains open, moreover not only under the law, but above all to the child, who came into the world at someone's persistent desire, through medical manipulations of doctors. Therefore, in spite of the quite successful practice, there are many controversial issues that require research and solution. In addition, the low awareness of the population about the surrogate motherhood procedure generates discussions and the emergence of misinformation, which is detrimental to its purpose – the fight against infertility [3].

Today, the problem of developing medical software in Ukraine is urgent. The successful introduction of this software will help doctors to quickly receive new information on their specialty, will significantly increase the productivity of doctors, will improve the efficiency of use of health care resources, will accelerate the integration of Ukrainian medicine into the European medical space [4, 5]. Systems based on artificial intelligence and machine learning that facilitate decision making in health care are promising new tools in the era of ‘personalized’ or ‘precision’ medicine [6]. The paper [7] reviews the computerised decision support systems, which are designed to support clinicians in making decisions and thereby enhance the quality and safety of care.

Even more important is the development of multidisciplinary medical software, which is developed at the intersection of the medical and other subject domains – for example, software for medical law. But in the process of formulation of requirements for such software, significant information losses occur due to incomplete and different understanding of the needs and context of information, since standards for software development and standards of subject domains of medicine and law need to be taken into account [8].

Let's review the known decision support systems in the field of medical law. Most of the papers in this field focus on the legal regulation of the use of clinical decision support systems, especially about data sharing and privacy requirements – for example, papers [9-11].

But the paper [12] presents a mobile decision support system (DSS) prototype designed for healthcare providers of an emergency department to identify and follow the correct procedure based on applicable laws to mitigate the chance of incorrect actions being taken, along with the associated risks and preserve both the patients' and their own rights. The resulting mobile DSS enables clinicians to quickly access the

correct information regarding their power and authority while also protecting the safety and welfare of the patient.

The article [13] presents a medical relational model (MRM) for the extraction of logical rules from medical law, required to design a medical decision support system (MDSS) that facilitates the process of exchanging data electronically with minimum human intervention. This methodology is to analyze the legal text and release records in compliance with the medical law.

Authors of [14] proposed the new content and infrastructure for harmonized documentation forms in the domain of organ transplantations enabling world-wide reuse and exchange.

The approximate reasoning system presented in the work [15] considers evaluation of a risk in the situation when physicians weigh necessity of the operation on a patient. The patient's clinical symptom levels, pathologically heightened, indicate the presence of a disease possible to recover by surgery. The authors wish to evaluate the extension of the operation danger by involving particularly designed fuzzy sets in the algorithm of approximate reasoning.

Obviously, none of the above known decision support systems in the field of medical law is intended to support decision-making about surrogate motherhood.

Given the above urgency and importance of the problem of legal regulation of surrogate motherhood, *the important and actual task* is the development of the DSS in the legal regulation of the surrogate motherhood. *The aim of this study* is the development of the concept of intelligent DSS in the legal regulation of the surrogate motherhood.

## **2 Basic Legal Issues of Using the Surrogate Motherhood**

For developing the DSS, which will bring real benefits to users, it is first necessary to find out what tasks it needs to solve and what properties it needs to have. For identifying these needs, and for identifying the content of the requirements, the subject domain analysis should be conducted. As a result of this activity, the goals and the set of tasks to be solved by potential users of the system should be clarified. In addition, subject domain analysis provides identifying the places of the potential improvements and assesses the impact of the made decisions. Therefore, during the analysis of the subject domain of the developed DSS should investigate the legal aspects and identify the main legal problems that arise when using surrogate motherhood.

Modern medicine identifies two types of surrogate motherhood [16]: 1) complete or gestational surrogacy – the transfer into the body of a surrogate mother the embryo of a person, which was conceived by family pair, wife and donor, donors; in this case, the surrogate mother has no genetic connection to the child; 2) partial or gender surrogacy – implies a genetic connection of the surrogate mother with the child, as the surrogate mother's egg is used. According to the Order of the Ministry of Health No. 787 [1], the surrogate motherhood is the artificial fertilization of an egg with the subsequent placement of an embryo in the uterus of another woman (surrogate mother). Therefore, the essence of surrogate motherhood is that the fertilized egg is transplanted to the organism of the genetically alien woman, who bears and gives birth to a child not for herself but for the family pair who cannot have children.

*Necessary conditions for conducting the surrogate (substitute) motherhood* are [17]: 1) the presence of medical indications for surrogate motherhood; 2) the presence of documents, which are necessary for surrogate motherhood; 3) the spouse (or one of the future parents), in the interests of whom surrogate motherhood is exercised, must have a genetic connection with the child. It should be noted that Part 2 of Art. 123 of the Family Code of Ukraine [18] was changed in 2011, namely: after the words "conceived by spouses" the words "*man and woman*" were supplemented. Such changes have excluded the possibility of participation in surrogate motherhood programs of the foreign nationals who are registered in single-sex marriages. Considering the problems, which arise in childbearing for citizens of countries where surrogate motherhood is prohibited, in our opinion, the approval of surrogate motherhood by the law of the country, whose citizens order surrogate motherhood, should also be an important condition.

*The surrogate mother may be* the adult legal capable woman, which has own healthy child, which voluntary signs the written consent of the surrogate mother, and which has no medical contraindications. It is allowed to bear pregnancy by the close relatives of future parents (mother, sister, cousin, etc.).

*Concluding the contract about the surrogate motherhood, in our opinion, is actually possible under the following mandatory conditions:* 1) the surrogate mother must be adult, legal capable, have her own healthy child, provide voluntary consent on the surrogate motherhood and not have medical contraindications; she cannot also be an egg donor at the same time; 2) genetic parents who conclude such a contract cannot self bear and give birth to a child; wife and husband must be legally capable and they must have at least twenty-one years of age.

*A contract about the surrogate motherhood cannot be concluded by the wife and husband, who:* 1) are deprived of parental rights if these rights have not been renewed; 2) were party to the surrogate motherhood contract, but the contract was terminated by their fault; 3) were the adoptive parents (guardians, foster parents) of another child, but the adoption was abolished or invalidated because of their fault; 4) are registered or treated in a psychoneurological or narcological dispensary; 5) abuse of alcoholic beverages or drugs; 6) have no permanent residence and permanent income; 7) suffer from diseases, the list of which is approved by the Ministry of Health of Ukraine; 8) have been convicted of crimes against life and health, liberty, honor and dignity, sexual freedom and sexual integrity of a person, against public safety, public order and morality, in the sphere of narcotic drugs, psychotropic substances, their analogues or precursors, or have a criminal record which has not been cleared or not withdrawn in accordance with the procedure established by law; 9) require constant third-party care for health reasons; 10) are stateless persons.

*The essential conditions of contracts about surrogate motherhood* are also: the obligation of the surrogate mother to comply with all the doctor's instructions and to provide information on the state of her health and the health of her child; the consequences of not bearing the fetus or giving birth to a defective child, a child with physical or mental disabilities, with congenital anomalies or stillbirth; procedure in case of birth of twins; determination of the place of residence of the surrogate mother during the period of childbearing (recommended condition); the period during which the

surrogate mother must pass the child to the genetic parents and the parents are obliged to take the child (recommended condition); the amount of compensation to the surrogate mother for the birth of the child (recommended condition); procedure for reimbursement of expenses for medical care, food, surrogate mother's residence during the period of childbearing, childbirth and postpartum period (recommended condition).

In our view, for protecting the property and non-property rights and the legitimate interests of persons participating in the program of the surrogate motherhood, the following *legal means* can be applied: 1) preparation of a contract between surrogate mother and biological parents about carrying the child; 2) registration of the written consent of the biological parents for the carrying the embryo (obtained as a result of the extracorporal fertilization) by the surrogate mother (recommended condition); 3) registration of the written consent of the surrogate mother to carrying the embryo of the biological parents; 4) preparation of the statement of the surrogate mother about the absence of claim to the biological parents after the end of the program of the surrogate motherhood (recommended condition); 5) registration of the consent of the surrogate mother on the record of biological parents as parents of the child in the bodies of registration of acts of civil status (recommended condition).

*The doctor (medical institution) as the service provider (contractor) is obliged to provide in due time the necessary, complete and reliable information about the services in order to secure the consumer's right to choose a medical institution and a doctor. This information should be provided before concluding the contract on the use of assisted reproductive technologies, as it should also be elucidated in the contract about the surrogate motherhood. The parties should receive full information about possible fertilization options and receive comprehensive and detailed consultation from a doctor (medical institution) who will perform the procedure of the implantation of the embryo to surrogate mother. The contractor is obliged to provide medical services using up-to-date diagnostic and treatment methods, in full compliance with the contract, and to provide the involvement of highly-qualified medical personnel for the provision of services under this contract.*

Surrogacy involves a lot of decision-making, planning and preparation. So, all of the above results of the subject domain analysis are requirements (mandatory conditions) or recommendations (recommended conditions) that should be followed by future parents, surrogate mother or service provider (medical institution). Exactly these requirements and recommendations will form the basis of the decisions that will be offered by the developed intelligent DSS.

### **3 Concept of Intelligent Decision Support System in the Legal Regulation of the Surrogate Motherhood**

The developed intelligent decision support system in the legal regulation of the surrogate motherhood will belong to the information-analytical medical software (software for identifying and planning all resources of the medical institution, which are necessary for conducting the medical-diagnostic activity and accounting in the process of providing the medical services [4]). It will be the clinical decision support systems

(CDSS), i.e. the computer systems designed to influence clinician decision making about individual patients when these decisions are made. It could prevent duty breaches, assist in documenting medical procedures, help avert the need for litigation, and helping lawyers perform due diligence and research.

In [19, 20], the ontological approach to assessing the sufficiency of information in the software requirements specifications was developed. We apply the developed approach to assess the sufficiency of information for conducting the procedure of the surrogate motherhood, taking into account the above requirements and recommendations, that should be followed by future parents, surrogate mother, and/or service provider (medical institution).

Then *the process of assessing the sufficiency of the information for conducting the surrogate motherhood procedure* consists of:

1. analysis of the preparatory documentation for surrogate motherhood and identification of the requirements and/or recommendations, that were not satisfied by future parents, surrogate mother or service provider (medical institution); the easiest way to do this – is by comparing the real ontologies that will be developed for each individual case with base (ideal) ontologies;
2. calculation of numerical assessments of the level of sufficiency of information for conducting the surrogate motherhood procedure – as the ratio of the number of satisfied requirements to the number of mandatory requirements and the ratio of the number of satisfied recommendations to the total number of recommendations – by the formulas:

$$D_{\text{req}}=(\text{qsreq}/\text{qnreq})\cdot 100\%, \quad (1)$$

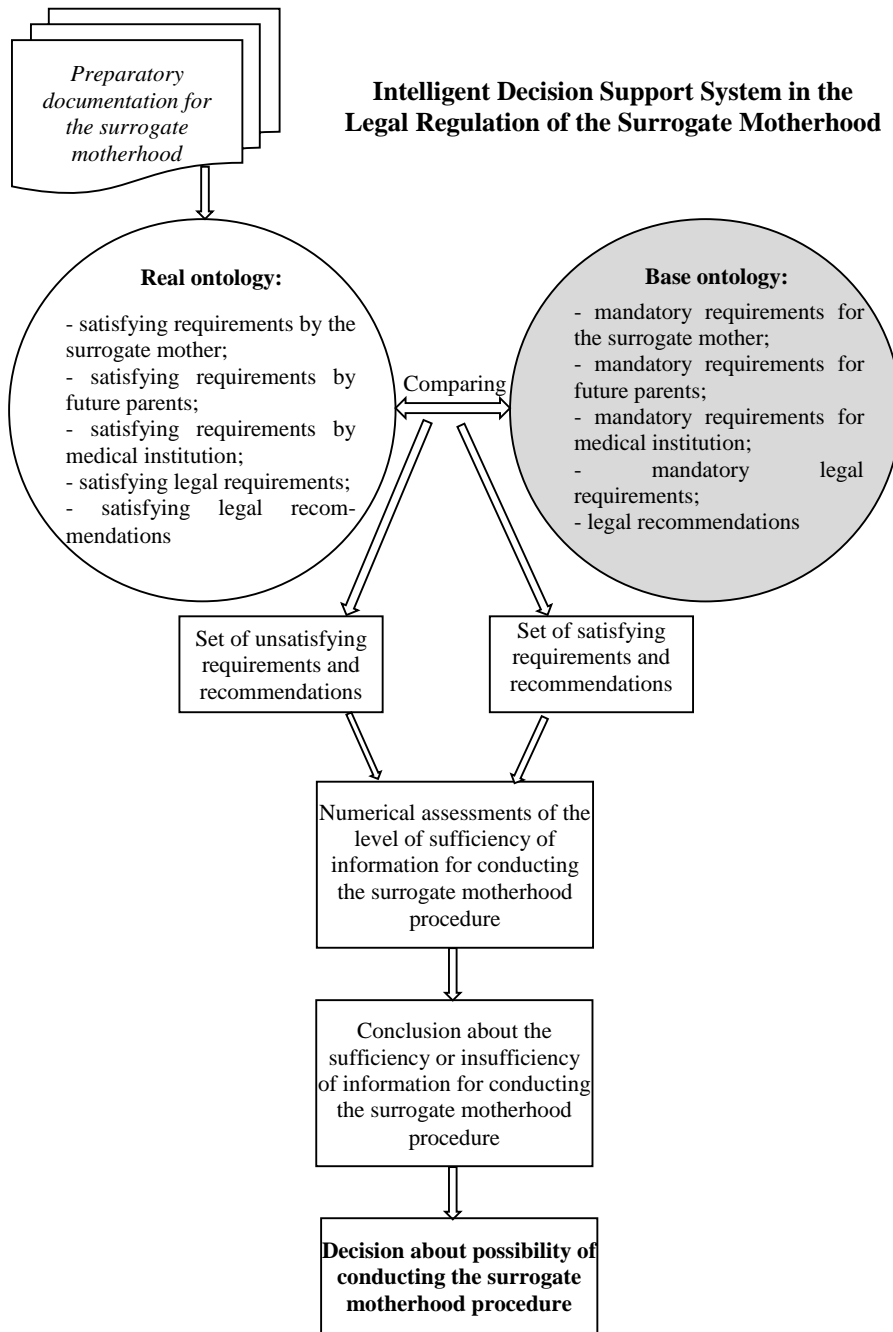
where qsreq – the number of satisfying requirements, qnreq – the number of mandatory requirements;

$$D_{\text{rec}}=(\text{qsrec}/\text{qnrec})\cdot 100\%, \quad (2)$$

where qsrec – the number of satisfying recommendations, qnrec – the total number of recommendations;

3. formation of the conclusion about the sufficiency or insufficiency of information for conducting the surrogate motherhood procedure (with the visualization of what requirements and recommendations are not currently satisfied): compliance with all requirements by future parents, surrogate mother and service provider (medical institution) is necessary, so the value of  $D_{\text{req}}$  must be 100% for decision making about conducting the surrogate motherhood procedure; the interviewed medical law experts agreed that it was sufficient to fulfil at least half of the recommendations, so the value of  $D_{\text{rec}}$  must be minimum 50% for decision making about conducting the surrogate motherhood procedure.

Taking into account the described process of assessing the sufficiency of the information for conducting the surrogate motherhood procedure, we developed *the conceptual scheme of intelligent decision support system in the legal regulation of the surrogate motherhood* – Fig. 1.



**Fig. 1.** Conceptual scheme of intelligent decision support system in the legal regulation of the surrogate motherhood

#### **4 Assessing the Sufficiency of Information for Conducting the Surrogate Motherhood Procedure**

*Preparatory documentation for surrogate motherhood for two families* (which is planned to be conducted by one of the reproductive clinics in Khmelnytskyi) was used to conduct the experiment.

Nowadays, the mandatory requirements for a potential surrogate mother are:

1. adult age;
2. legal capacity;
3. own healthy child;
4. voluntary written consent of the surrogate mother;
5. absence of medical contraindications to pregnancy and childbirth;
6. potential surrogate mother cannot also be an egg donor;
7. the obligation of the surrogate mother to comply with all the doctor's instructions;
8. the obligation of the surrogate mother to provide information on the state of her health.

The mandatory requirements for potential parents who want to use the services of the surrogate mother are:

1. the presence of medical indications for surrogate motherhood – genetic parents who conclude such a contract cannot self bear and give birth to a child;
2. the spouse (or one of the future parents), in the interests of whom surrogate motherhood is exercised, must have a genetic connection with the child;
3. family pairs (future parents) are man and woman (not single-sex marriage);
4. the approval of surrogate motherhood by the law of the country, whose citizens order surrogate motherhood;
5. legal capacity;
6. adult age of both members of the spouse – at least 21 years old;
7. are not deprived of parental rights or these rights have been renewed;
8. were not a party to the surrogate motherhood contract, which was terminated by their fault;
9. were not the adoptive parents (guardians, foster parents) of another child, if the adoption was abolished or invalidated because of their fault;
10. are not registered or treated in a psychoneurological or narcological dispensary;
11. don't abuse of alcoholic beverages or drugs;
12. have permanent residence and permanent income;
13. don't suffer from diseases, the list of which is approved by the Ministry of Health of Ukraine;
14. have not been convicted of crimes against life and health, liberty, honor and dignity, sexual freedom and sexual integrity of a person, against public safety, public order and morality, in the sphere of narcotic drugs, psychotropic substances, their analogues or precursors, or have not a criminal record which has not been cleared or not withdrawn in accordance with the procedure established by law;
15. don't require constant third-party care for health reasons;
16. are not stateless persons.



The mandatory requirements for a potential service provider (medical institution) are the following requirements:

1. providing the necessary, complete and reliable information about the services;
2. time of providing the information about the services – before concluding the contract on the use of assisted reproductive technologies;
3. providing the full information about possible fertilization options;
4. providing the comprehensive and detailed consultation from a doctor (medical institution) who will perform the procedure of the implantation of the embryo to surrogate mother;
5. providing the medical services using up-to-date diagnostic and treatment methods;
6. providing the involvement of highly-qualified medical personnel for the provision of services under this contract.

The mandatory legal requirements are:

1. the obligatoriness of concluding the contract about the surrogate motherhood;
2. description in the contract of the consequences of not bearing the fetus;
3. description in the contract of the consequences of giving birth to a defective child;
4. description in the contract of the consequences of giving birth to a child with physical or mental disabilities;
5. description in the contract of the consequences of giving birth to a child with congenital anomalies;
6. description in the contract of the consequences of stillbirth;
7. description in the contract of the procedure in case of birth of twins.

The legal recommendations are:

1. registration of the written consent of the biological parents for the carrying the embryo (obtained as a result of the extracorporal fertilization) by the surrogate mother;
2. preparation of the statement of the surrogate mother about the absence of claim to the biological parents after the end of the program of the surrogate motherhood;
3. registration of the consent of the surrogate mother on the record of biological parents as parents of the child in the bodies of registration of acts of civil status;
4. determination (in the contract) of the place of residence of the surrogate mother during the period of childbearing;
5. determination (in the contract) of the period during which the surrogate mother must pass the child to the genetic parents and the parents are obliged to take the child;
6. determination (in the contract) of the amount of compensation to the surrogate mother for the birth of the child;
7. determination (in the contract) of the procedure for reimbursement of expenses for medical care, food, surrogate mother's residence during the period of childbearing, childbirth and postpartum period.

The analysis of the preparatory documentation of the *first potential procedure of surrogate motherhood* showed that service of the surrogate motherhood is sought to be ordered by a man and woman who are Italian nationals (but Italian law prohibits

surrogate motherhood). The couple independently selected a surrogate mother who turned out to be a minor citizen of Ukraine. In addition, a careful examination of the couple revealed that they can conceive on their own, bear and give birth to a child. Therefore, 3 mandatory requirements (from 37 existing) have not been satisfied. Regarding legal recommendations, then all 7 recommendations were satisfied.

The numerical assessments of the level of sufficiency of information for conducting the surrogate motherhood procedure – by formulas (1) and (2) – are:

$$D_{\text{req}_1}=(34/37)*100\%=91,9\%, \quad (3)$$

$$D_{\text{rec}_1}=(7/7)*100\%=100\%. \quad (4)$$

Intelligent DSS concluded that there is insufficient information for conducting the surrogate motherhood (the value  $D_{\text{req}}$  should be 100%), so this *system recommended conclusion to the lawyers and doctors that surrogate motherhood is not possible in this case.*

The analysis of the preparatory documentation of the *second potential procedure of surrogate motherhood* showed that in the contract about the surrogate motherhood there are no points about the place of residence of the surrogate mother during the period of childbearing, about period during which the surrogate mother must pass the child to the genetic parents and the parents are obliged to take the child, and about the amount of compensation to the surrogate mother for the birth of the child. Therefore, 3 legal recommendations (from 7 existing) have not been satisfied. Regarding mandatory requirements, then all 37 requirements were satisfied.

The numerical assessments of the level of sufficiency of information for conducting the surrogate motherhood procedure – by formulas (1) and (2) – are:

$$D_{\text{req}_2}=(37/37)*100\%=100\%, \quad (5)$$

$$D_{\text{rec}_2}=(4/7)*100\%=57,1\%. \quad (6)$$

Intelligent DSS concluded that there is sufficient information for conducting the surrogate motherhood (the values  $D_{\text{req}} = 100\%$ ,  $D_{\text{rec}}>50\%$ ), so this *system recommended conclusion to the lawyers and doctors that surrogate motherhood is possible in this case.*

Thus, the proposed intelligent DSS provides to lawyers and doctors of reproductive medicine clinics the possibility to make an informed and legally correct decision about the possibility or impossibility of conducting the surrogate motherhood procedure, taking into account all currently existing requirements and recommendations for this procedure.

## 5 Conclusions

Today in Ukraine there is an urgent problem of informatization of the health care sector by the development of medical software, the successful implementation of which is critically important for improving the efficiency of the work of the said industry. Even more important is the development of multidisciplinary medical software, in particular, software for medical law domain.

The conducted analysis of known DSS in the medical law domain showed that they don't solve the problem of decision support regarding the possibility or impossibility of surrogate motherhood procedure, although this paper proves the urgency and importance of such a problem.

The article describes the process of assessing the sufficiency of information for conducting the surrogate motherhood procedure and develops the conceptual scheme of the intelligent DSS in the legal regulation of the surrogate motherhood.

The proposed intelligent DSS provides: 1) a numerical assessment of the level of sufficiency of information for conducting the surrogate motherhood procedure; 2) a conclusion on the sufficiency or insufficiency of the information for conducting the surrogate motherhood procedure; 3) a list of requirements and/or recommendations, which have to be satisfied (if possible) for conducting the surrogate motherhood procedure; 4) reasonable and legally correct decision on the possibility or impossibility of conducting the surrogate motherhood procedure, taking into account absolutely all existing requirements and recommendations for carrying out this procedure.

In addition to the above, the advantages of the proposed intelligent DSS also are: 1) doctors and/or lawyers of reproductive medicine clinics cannot miss any requirement or recommendation; 2) providing a list of requirements and recommendations that should be guided by doctors and lawyers of reproductive medicine clinics in preparation for surrogate motherhood procedure; 3) easy expansion of the system – if necessary, it is very easy to add new or remove unnecessary requirements and/or recommendations.

Of course, the benefits of offered by the intelligent DSS will only be provided by during its conscious use - if there are a careful examination of all documents and facts, providing truthful information by doctors and lawyers on the basis of processed documents, serious attitude to the surrogate motherhood procedure and preparation for it.

The future work of authors will dedicate to: 1) development of base (ideal) ontology – on the basis of defined mandatory requirements and legal recommendations; 2) estimating the weights of the requirements and the legal recommendations, since not all requirements, as well as all recommendations, are equally important; 3) development of the weighted base (ideal) ontology – on the basis of defined requirements and recommendations taking into account their weights; 4) implementation of the described intelligent DSS in the legal regulation of the surrogate motherhood – implementation of the automated decision-making on the possibility or impossibility of conducting the surrogate motherhood procedure, which consists of automated gathering of information, automated bypassing of the base and the weighted base ontologies, formation of real ontology, calculation of numerical assessments, and formation of the conclusion of sufficiency or insufficiency of the information for conducting the surrogate motherhood procedure.

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