Covid'19 Vaccination Decision-Making Method and Subsystem Based on Civil Law

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Abstract

The conducted analysis of civil law grounds on the need and possibility of vaccination against Covid'19 in Ukraine made it possible to determine the categories of workers subject to compulsory vaccination, as well as a list of medical contraindications and warnings to vaccination against Covid'19. Developed Covid'19 vaccination decision-making method based on civil law provides: a conclusion on the mandatory or optional depending on the profession and place of work of the patient (but desirability) vaccination from Covid'19; conclusion on the possibility or contraindications to vaccination from Covid'19 - depending on the existing diseases and the current state of health of the patient; conclusion on the type of contraindication and its duration - in the case of a conclusion on contraindications to vaccination from Covid'19. Developed Covid'19 vaccination decision-making subsystem based on civil law provides a conclusion on whether or not vaccination from Covid'19 is mandatory or optional from the point of view of profession and place of work (but desirability); conclusion on the possibility or contraindications to vaccination from Covid'19; conclusion on the type of contraindication and its duration. So the subsystem will be useful for patients who, truthfully answering questions from the subsystem, will receive a conclusion on the need and possibility of vaccination from Covid'19 them or their relatives, as well as for family physicians, which will reduce the burden during patient counselling and make it easier to answer questions about the need and possibility of vaccination, as they will no longer need to know all the current legislation and civil law.

Keywords

Covid'19 vaccination, decision-making, Covid'19 vaccination decision-making method based on civil law, Covid'19 vaccination decision-making subsystem based on civil law.

1. Introduction

The information society in Ukraine is currently actively developing, which is characterized by the introduction of information technology in all spheres of human life to automate routine work, reduce physical load and eliminate or reduce the human factor [1-3]. Today, the decision-making process in the field of medicine (health care) remains difficult and ambiguous for both patients and physicians [4]. Decision support systems can facilitate the decision-making process in the field of medicine (health) and at the same time increase the productivity of doctors, are effective tools in the age of evidence-based medicine and can provide doctors with the necessary information, for example, about the latest medical resources or about civil law grounds relating to a decision [4].

At present, medicine around the world is facing a serious challenge in the form of the Covid'19 pandemic. The pandemic Covid'19 is continued to the massive burden of morbidity and mortality while disrupting economies and societies all over the world. Given the rapid spread of the pandemic of Acute Respiratory Infection of SARS-CoV-2 coronavirus, Covid'19 vaccination is a critical tool to contain the pandemic, combined with effective testing and precautions.

Now 61.9% of the world population has received at least one dose of a Covid'19 vaccine. Only 10.6% of people in low-income countries have received at least one dose. Share of people who received at least one dose of Covid'19 vaccine on February 14, 2022 is represented on Figure 1 [5].
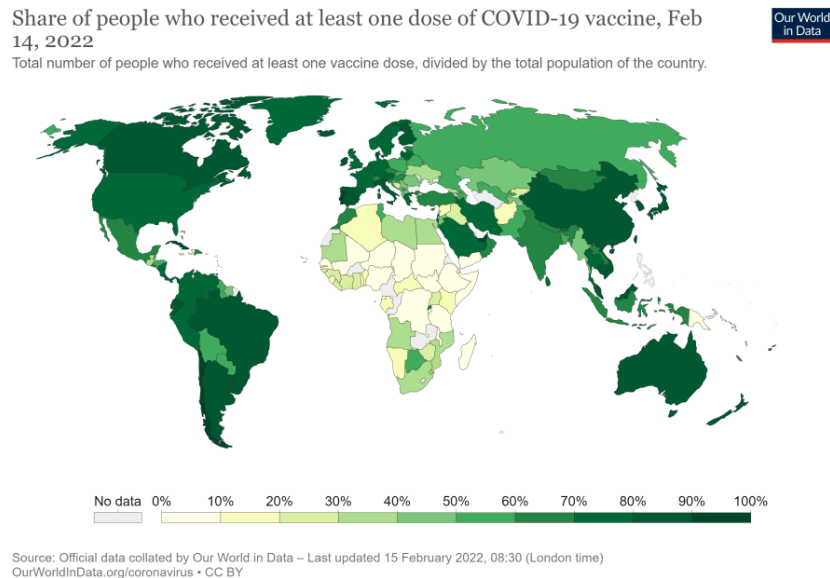

Figure 2: Share of people who received at least one dose of Covid'19 vaccine on February 14, 2022 [5]

At present, a person has many questions when deciding whether or not to be vaccinated against Covid'19: whether he or she is subject to compulsory vaccination (due to his or her occupation and place of work), whether he or she can be vaccinated (given existing diseases and current health status). Of course, in order to do this, a person needs to study the civil law grounds for vaccination used in his country. A person can study all the legislation related to vaccination against Covid'19 himself, but most often people ask their family doctors, who are already overwhelmed during a pandemic and also do not always know civil grounds for the need or possibility of vaccination. This problem could be solved by the Covid'19 vaccination decision-making subsystem based on civil law, implemented as part of intelligent information technology for supporting medical decision-making taking into account the legal basis [6] in the form of a web-based application, which will be available 24/7, without any registration. Such a subsystem will be useful for patients who, truthfully answering the questions of the subsystem, will receive a conclusion on the need and possibility of vaccination from Covid'19 for them or their relatives, given the existing civil law, which will facilitate further independent decision-making (without consulting with family physicians). In addition, such a subsystem will be useful for family physicians, for them the burden of patient counselling on the need and possibility of vaccination will reduce, and they will find it easier to answer vaccination questions to those patients who still need a family physician (e. g. older people, who do not know how to use the Internet and web-based applications), because doctors will no longer need to know all the laws and civil law, but will need to answer the subsystem questions from the patient's words, considering his anamnesis and get the conclusions about the need and possibility of vaccination from Covid'19. Of course, the proposed subsystem is designed for true answers from users.

Thus, currently, the motivation of patients to himself make their own decisions about Covid'19 vaccination and facilitation of the work of family physicians to advise on Covid'19 vaccination by developing the Covid'19 vaccination decision-making method and subsystem based on civil law is an *actual problem in Ukraine and in the world*.

2. Literature Review

Let's review the known solutions on Covid'19 vaccination decision-making based on civil law.

Informing the general practitioners and other vaccinators provides patients with clear and reliable information to support a shared decision. These professionals are the defence against vaccine hesitation in the population, but only in the case if they have solid arguments to answer the questions of patients. The obtained findings can support policymakers, clinicians, and other stakeholders in prioritizing research and development to support operationalization of artificial intelligence for future pandemics [7, 8].

The study [9] was aimed to analyse the Covid'19 vaccination willingness level of the general public on the basis of the multi-criteria decision-making method known. The significant determinants of Covid'19 vaccination willingness were: cues to action, perceived benefits, positive attitude, government recommendation, and perceived stress. Determinants of willingness to uptake the COVID-19 vaccine were: individual decision, vaccine origin, adapting to change, perceived barriers to vaccinating.

Paper [10] aimed to development of the digital platform for communication between scientists and the general population and to use this digital platform for a pilot study on factors associated with the Covid'19 vaccination readiness. Multiple logistic regression models adjusted for personal covariates, factors affecting the motivation to vaccinate, and risk of infection/severe disease were built to investigate a vaccination readiness. Digital platform can help creating the data-driven dialogue on vaccination readiness, opening the evidence-based scientific discussion between state authorities and the population.

The paper [11] offers information about decision-making related to Covid'19 vaccine uptake, considering the importance of vaccine literacy, trust, and social responsibility in this process.

In the paper [12] the decision-making supporting system is proposed as an epidemiological prediction tool considering Covid'19 trends in several countries and regions, the big data clouds for important geophysical and socio-ecological characteristics and the expected potentials of the medical service, including vaccination and restrictions on population migration both within the country and international traffic. The numerical simulations of Covid'19 transition and results are mainly based on the deterministic approach and the algorithm for processing statistical data based on the instability indicator. The developed decision-making supporting system helps predict the effects of Covid'19 depending on the protection strategies against Covid'19 including vaccination.

Paper [13] proposes a behavioural economics-based framework to model vaccination choices. The model is constantly calibrated using up-to-date surveys on people attitudes toward vaccination as well as estimates of Covid'19 infection and mortality rates and vaccine efficacy for the UK population.

The paper [14] shows that pharmacists and other health care professionals may use motivational interviewing to enable individuals making informed decisions with regards to the Covid'19 vaccines with the purpose of the reduce Covid'19 vaccine hesitancy.

The paper [15] reviews the underlying mechanisms and predictions about Covid'19 vaccination risky decision-making offered by expectancy-value and dual-process theories. In addition, the authors of [15] highlight how fuzzy-trace theory builds on these approaches and provides further insight into how knowledge, emotions, values, and metacognitive inhibition influence risky decision-making.

The main goal of the study [16] was to synthesize a data-driven model for the predictors of Covid'19 vaccine willingness among students using decision tree and regression analyses. The proposed conceptual model was developed and tested through a machine learning approach to elicit factors related to students' willingness to get the Covid'19 vaccine. Machine learning analysis shows five important predictors of Covid'19 vaccination willingness: the economic level of the country, the individual's trust of the pharmaceutical industry, the individual's misconception of natural immunity, the individual's belief of vaccines risk-benefit-ratio, and the individual's attitudes toward novel vaccines.

The paper [17] presents a model to study individuals' decision about stay-at-home during Covid'19 making based on decision and prospect theory, and conducts sensitivity analysis to study the fluctuations in optimal strategies when there are changes made to the model's parameters. This

research can help support decision making regarding control measures and policy development when public health emergencies appear in the future.

The goal of the study [18] is determining the variables affecting the likelihood of refusal and indecision toward a vaccine against Covid'19 and to determine the acceptance of the vaccine for different scenarios of effectiveness and side effects. A multinomial logistic regression method based on the Health Belief Model is used to estimate. The conducted analysis of hypothetical vaccine scenarios revealed that individuals preferred less risky vaccines in terms of fewer side effects, rather than effectiveness.

The aim of [19] is: to provide an overview of shared decision making and the use of patient decision aids and to determine the effect of shared decision making interventions on Covid'19 vaccine uptake. The authors of [19] examined the impact on vaccine hesitancy by searching for randomized controlled trials of shared decision making interventions, conducted a meta-analysis and calculated a pooled odds ratio.

The CAPACITI decision support tool [20] has been developed to structure and document an evidence-based, context-specific process for prioritizing or selecting among multiple Covid'19 vaccination products, services, or strategies. The CAPACITI decision-support tool is based on multi-criteria decision analysis, as a structured way to incorporate multiple sources of evidence and stakeholder perspectives.

The conducted review of the known decisions on Covid'19 vaccination decision-making based on civil law showed that with a large number of different solutions proposed in 2021-2022, Covid'19 vaccination decision-making method and subsystem based on civil law are not proposed today, and existing solutions cannot be used as a subsystem of intelligent information technology for supporting medical decision-making taking into account the legal basis [6] to obtain a conclusion on the need and possibility of vaccination from Covid'19. Thus, *the aim of this study* is to develop the Covid'19 vaccination decision-making method and subsystem based on civil law. Such a subsystem, like any classical decision support system, should consist of basic elements (based on the analysis of the subject area analysis), rules, and methods used to process information. Then, for developing a Covid'19 vaccination decision-making method and subsystem based on civil law, it is necessary to analyze the subject area to identify civil law grounds for the need and possibility of vaccination from Covid'19 and to develop rules for deciding on the need and possibility of vaccination from Covid'19.

3. Civil Law Grounds for the Necessity and Possibility of Vaccination from Covid'19 in Ukraine

Pursuant to paragraph 3 of Resolution 2361 (2021), the Parliamentary Assembly of the Council of Europe calls on and recommends that citizens be informed that vaccination is not compulsory and that no one may be subject to political, social, or other pressure to be vaccinated, and ensure that no one was not discriminated against for not being vaccinated. In the case of vaccines, individuals present with unique circumstances that may differ substantially from those of another and might be foreseen a priori. This means that an analysis must be performed individually before vaccination is imposed [21-23].

The first country to make vaccination from Covid'19 coronavirus disease mandatory for health professionals was Italy [24, 25].

In France, the Covid'19 coronavirus vaccination is also mandatory for physicians, nursing home staff, social workers, and volunteers working in health or care facilities [24, 25].

Let's consider the peculiarities of civil law regulation on the need and possibility of vaccination from Covid'19 in Ukraine, as the subsystem will be developed currently taking into account only Ukrainian legislation.

According to Article 284 of the Civil Code of Ukraine, the provision of medical care to an individual who has reached the age of fourteen is carried out with his consent. An adult able-bodied individual who is aware of the significance of his actions and can manage them has the right to refuse treatment.

The Law of Ukraine "Fundamentals of the Legislation of Ukraine on Health Care", in particular, Article 10, provides for the responsibilities of citizens in the field of health care, namely:

1. take care of their own health and the health of children, do not harm the health of other citizens
2. in cases provided by law to undergo preventive medical examinations and vaccinations
3. take measures provided by the Law of Ukraine "On Emergency Medical Care" to ensure the provision of emergency medical care to other persons in an urgent state (sudden deterioration of physical or mental health, which poses a direct and imminent threat to human life and health or people around her and occurs due to illness, injury, poisoning or other internal or external causes)
4. perform other duties provided by the legislation on health care

Considerable attention in the current legislation is paid to the patient's consent to medical intervention.

Patient consent is required for the use of methods of diagnosis, prevention, and treatment. In the case of a patient under the age of 14 (a minor patient), as well as a patient who has been declared incapable in accordance with the procedure established by law, medical intervention is carried out with the consent of their legal representatives.

Of course, there are cases when the consent of the patient or his legal representative for medical intervention is not required, namely in the presence of signs of the direct threat to the patient's life if it is impossible for objective reasons to consent to such intervention from the patient or his legal representatives.

If the lack of consent can lead to serious consequences for the patient, the doctor must explain it to him. If the patient still refuses treatment, the doctor has the right to take written confirmation from him, and if it is impossible to obtain it - to certify the refusal by appropriate action in the presence of witnesses.

A patient who has acquired full civil capacity and is aware of the significance of his actions and can manage them has the right to refuse treatment.

Analysing other legislative acts, it should be noted that the Law of Ukraine "On Protection of the Population from Infectious Diseases" and the Law of Ukraine "On Ensuring Sanitary and Epidemic Welfare of the Population" [5] provide for preventive vaccinations against diphtheria, pertussis, measles, polio, tetanus, tuberculosis, which are mandatory and included in the vaccination schedule. Persons who refuse or evade mandatory vaccination and preventive medical examinations are suspended from work, and minors, pupils, and students - from visiting the relevant institutions. The Law of Ukraine "On Protection of the Population from Infectious Diseases" and the Law of Ukraine "On Ensuring Sanitary and Epidemic Welfare of the Population" establish a list of mandatory vaccinations, but these Laws do not establish mandatory Covid'19 vaccination.

However, according to the same Laws of Ukraine "On Protection of the Population from Infectious Diseases" and "On Ensuring Sanitary and Epidemic Welfare of the Population", certain categories of workers are subject to mandatory preventive vaccination to prevent the spread of other infectious diseases in connection with the peculiarities of production or work performed by them. Population groups and categories of workers subject to preventive vaccinations, including mandatory, as well as the procedure and timing of their implementation are determined by the central executive body, which ensures the formation of state policy in the field of health care.

The analysis of case law shows that courts take into account the case-law of the Supreme Court and the European Court of Human Rights.

In a decision of April 17, 2019 (case №682/1692/17) the Supreme Court concluded that the requirement for mandatory vaccination of the population against particularly dangerous diseases in view of the need to protect public health and the health of interested persons is justified. The principle of the importance of public interests prevails over the personal rights of the individual, but only when such interference has objective grounds and is justified.

The European Court of Human Rights has concluded that vaccination is one of the most successful and effective measures in the field of health care, which aims to protect the health of individuals and society as a whole from infectious diseases. Thus, the mandatory vaccination of a certain category of citizens from COVID-19 to prevent its spread among the population is justified and does not violate Article 8 of the Convention for the Protection of Human Rights and Fundamental Freedoms.

Thus, the Ministry of Health of Ukraine by its order of 04.10.2021 №2153, registered with the Ministry of Justice on 16.12.2021 on №1624/37246, expanded the list of organizations whose representatives are subject to mandatory preventive vaccinations from Covid'19.

So, the following categories of employees subject to mandatory prophylactic vaccination against acute respiratory disease Covid'19 caused by coronavirus SARS-CoV-2, for the period of quarantine established by the Cabinet of Ministers of Ukraine to prevent the spread of Covid'19 acute respiratory disease:

1. employees of central executive bodies and their territorial bodies
2. employees of local state administrations and their structural subdivisions
3. employees of institutions of higher, postgraduate, professional higher, professional (vocational), general secondary, including special, preschool, extracurricular education, specialized education, and research institutions, regardless of type and form of ownership
4. employees of local governments
5. employees of state and municipal health care institutions
6. employees of utilities, institutions, and organizations

The list of medical contraindications and warnings for which contraindications to vaccination against Covid'19 are provided, established by the relevant Orders of the Ministry of Health of Ukraine:

1. acute illness with a fever over 38.0 °C - temporary contraindications (up to 2 weeks from the onset of the disease)
2. history of Covid'19 (0 doses in the history) - temporary contraindications (up to 3 months from the time of Covid'19)
3. history of Covid'19 (1 dose in the history) - temporary contraindications (up to 3 months from the time of Covid'19)
4. treatment with monoclonal antibodies or convalescent plasma - temporary contraindications (3 months)
5. pregnancy - temporary contraindications (during pregnancy) and only for vaccines that indicate pregnancy as a contraindication (contraindicated live vaccines, CoronaVac/Sinovac Biotech vaccines)
6. lactation - temporary contraindications (during lactation) and only for vaccines that indicate lactation as a contraindication (contraindicated CoronaVac/Sinovac Biotech vaccine))
7. vaccination against other infectious diseases - temporary contraindications (14 days)
8. test with tuberculin or blood test for the release of interferon-γ (IGRA) - temporary contraindications (until the evaluation of the test/IGRA)
9. comorbidities (for example, chronic (stable and controlled) infection with human immunodeficiency virus (HIV), hepatitis C virus, and hepatitis B virus) - temporary contraindications (based on the level of immunosuppression)
10. thrombosis and/or thrombocytopenia - permanent contraindications for vector-based vaccines (AstraZeneca)
11. myocarditis and/or pericarditis - permanent contraindications for vaccine mRNA (Pfizer/BioNTech)
12. oncopathology - vaccination with caution (in case of allogeneic or autogenic transplantation or cell therapy - not earlier than 3 months after such procedures; the course of intensive cytotoxic chemotherapy - postpone vaccination until the recovery of absolute neutrophils; in the otherwise cases - vaccination is possible in any times)
13. persons with an immunodeficiency - vaccination with caution (contraindication to the introduction of live vaccines)
14. history of an allergic reaction (anaphylactic reaction to the previous dose of vaccine, anaphylactic reaction to the components of the vaccine) - constant contraindications (for such vaccines)
15. autoimmune conditions - vaccination with caution

4. Covid'19 Vaccination Decision-Making Method and Subsystem Based on Civil Law

Taking into account the above civil law grounds on the need (category of employees) and the possibility (existing medical contraindications and warnings) of vaccination from Covid'19, let's develop rules for deciding on the need and possibility of vaccination from Covid'19.

Rules for deciding on the need of vaccination from Covid'19:
1. if the person is the employee of central executive bodies and their territorial bodies, then $n[1]=1$, else $n[1]=0$
2. if the person is the employee of local state administrations and their structural subdivisions, then $n[2]=1$, else $n[2]=0$
3. if the person is the employee of institutions of higher, postgraduate, professional higher, professional (vocational), general secondary, including special, preschool, extracurricular education, specialized education, and research institutions, regardless of type and form of ownership, then $n[3]=1$, else $n[3]=0$
4. if the person is an employee of local governments, then $n[4]=1$, else $n[4]=0$
5. if the person is an employee of state and municipal health care institutions, then $n[5]=1$, else $n[5]=0$
6. if the person is the employee of utilities, institutions, and organizations, then $n[6]=1$, else $n[6]=0$

Rules for deciding on the possibility of vaccination from Covid'19:
1. if the person has now acute illness with a fever over 38.0 °C, then $p[1,1]=1$, else $p[1,1]=0$
2. if the person has a history of Covid'19, then $p[2,1]=1$, else $p[2,1]=0$
3. if the person passes or has passed treatment with monoclonal antibodies or convalescent plasma, then $p[3,1]=1$, else $p[3,1]=0$
4. if the person is pregnant, then $p[4,1]=1$, else $p[4,1]=0$
5. if the person is in lactation, then $p[5,1]=1$, else $p[5,1]=0$
6. if the person has been vaccinated against other infectious diseases, then $p[6,1]=1$, else $p[6,1]=0$
7. if the person has been tested with tuberculin or blood tested for the release of interferon-γ (IGRA), then $p[7,1]=1$, else $p[7,1]=0$
8. if the person has human immunodeficiency virus (HIV), or the person has hepatitis C virus, or the person has hepatitis B virus, then $p[8,1]=1$, else $p[8,1]=0$
9. if the person has thrombosis and/or thrombocytopenia, then $p[9,1]=1$, else $p[9,1]=0$
10. if the person has myocarditis and/or pericarditis, then $p[10,1]=1$, else $p[10,1]=0$
11. if the person has oncopathology and passes or has passed allogeneic or autogenic transplantation or cell therapy, then $p[11,1]=1$, else $p[11,1]=0$
12. if the person has oncopathology and passes or has passed the course of intensive cytotoxic chemotherapy, then $p[12,1]=1$, else $p[12,1]=0$
13. if the person has an immunodeficiency, then $p[13,1]=1$, else $p[13,1]=0$
14. if the person has a history of an allergic reaction (anaphylactic reaction to the previous dose of vaccine, anaphylactic reaction to the components of the vaccine), then $p[14,1]=1$, else $p[14,1]=0$
15. if the person has the autoimmune conditions, then $p[15,1]=1$, else $p[15,1]=0$

Given the developed rules, *Covid'19 vaccination decision-making method based on civil law* consists of the following steps:
1. compilation of questionnaires for determining the need for vaccination and the possibility of vaccination from Covid'19, based on the above civil law on the need (category of employees) and the possibility (existing medical contraindications and warnings) of vaccination from Covid'19
2. filling the second column of the matrix *p* in order to further form a conclusion about the type of contraindication and its duration: $p[1,2]$ = "temporary contraindications (up to 2 weeks from the onset of the disease)"; $p[2,2]$ = "temporary contraindications (up to 3 months from the time of Covid'19)"; $p[3,2]$ = "temporary contraindications (3 months from completion of treatment)"; $p[4,2]$ = "temporary contraindications (until the end of pregnancy is contraindicated the live vaccines, CoronaVac/Sinovac Biotech vaccines)"; $p[5,2]$ = "temporary contraindications (until the end of lactation is contraindicated the CoronaVac/Sinovac Biotech vaccine)"; $p[6,2]$ = "temporary contraindications (14 days since the another vaccination)"; $p[7,2]$ = "temporary contraindications (until the evaluation of the test/IGRA)"; $p[8,2]$ = "temporary contraindications (based on the level of immunosuppression)"; $p[9,2]$ = "permanent contraindications for vector-based vaccines

(AstraZeneca)"; $p[10,2]$ = "permanent contraindications for vaccine mRNA (Pfizer/BioNTech)"; $p[11,2]$ = "vaccination with caution (not earlier than 3 months after such procedures) "; $p[12,2]$ = "vaccination with caution (postpone vaccination until the recovery of absolute neutrophils)"; $p[13,2]$ = "vaccination with caution (contraindication to the introduction of live vaccines)"; $p[14,2]$ = "constant contraindications (for specific vaccines to which or to components of which an allergic/anaphylactic reaction was noticed)"; $p[15,2]$ = "vaccination with caution"

3. conducting a survey (using the developed questionnaires) of a patient who plans to vaccinate, on his profession and place of work for determining the need for vaccination, as well as to identify existing patient diseases and current health, which may be contraindications for vaccination, in order for determining the possibility of vaccination from Covid'19

4. analysis of the answers provided by the patient and filling the array n using each of the developed rules for deciding on the need for vaccination from Covid'19

5. if $n[i]=1$ $(i=1..6)$, the patient is issued a conclusion on the necessity of his vaccination from Covid'19, else, if all elements of the array n are 0, the patient is issued a conclusion on the optional Covid'19 vaccination from the point of view of profession and place of work (but desirability)

6. analysis of the patient's answers and filling the first column of the matrix p using each of the developed rules for deciding on the possibility of vaccination from Covid'19

7. if $p[j,1]=1$ $(j=1..15)$, the patient is given a conclusion on contraindications to his vaccination from Covid'19, else, if all elements of the first column of the matrix p are 0, the patient is given a conclusion on the possibility of his vaccination from Covid'19

8. if $p[j,1]=1$ $(j=1..15)$, the patient is also given a conclusion on the type of contraindication and its duration - the element $p[j,2]$ $(j=1..15)$ of the matrix p

Developed Covid'19 vaccination decision-making method based on civil law provides: a conclusion on the mandatory or optional (but desirability) vaccination from Covid'19 - depending on the profession and place of work of the patient; conclusion on the possibility or contraindications to vaccination from Covid'19 - depending on the existing diseases and the current state of health of the patient; conclusion on the type of contraindication and its duration - in the case of a conclusion on contraindications to vaccination from Covid'19.

The developed method is the basis for the Covid'19 vaccination decision-making subsystem based on civil law, which is part of the intelligent information technology for supporting medical decision-making taking into account the legal basis [6], and will be further implemented as a web-based application, which will be available 24/7, without any registration. This subsystem provides a conclusion on whether or not vaccination from Covid'19 is mandatory or optional (but desirability) in terms of profession and place of work; conclusion on the possibility or contraindications to vaccination from Covid'19; conclusion on the type of contraindication and its duration.

So the subsystem is useful for patients who, truthfully answering questions from the subsystem, will receive a conclusion on the need and possibility of vaccination from Covid'19 them or their relatives. In addition, such a subsystem is useful for family physicians, for them the burden of patient counselling on the need and possibility of vaccination will reduce, and they will find it easier to answer vaccination questions to those patients who still need a family physician (e. g. older people, who do not know how to use the Internet and web-based applications), because doctors will no longer need to know all the laws, but will need to answer the subsystem questions from the patient's words, considering his anamnesis and get the conclusions about the need and possibility of vaccination from Covid'19.

The structure of the Covid'19 vaccination decision-making subsystem based on civil law is represented in Figure 2.

Currently, Covid'19 vaccination decision-making subsystem based on civil law helps to decide on the need and possibility of vaccination only on the basis of the current legislation of Ukraine, but it can be adapted to the legislation of any country and changes in Ukrainian legislation (e. g. expanding the categories of employees for whom vaccination is mandatory) - this requires an analysis of civil law grounds for the need and possibility of vaccination against Covid'19 in a particular country; supplementing or amending the rules for deciding on the need for vaccination against Covid'19, as well as the rules for deciding on the possibility of vaccination against Covid'19, taking into account the analysis of the civil law grounds of a particular country.
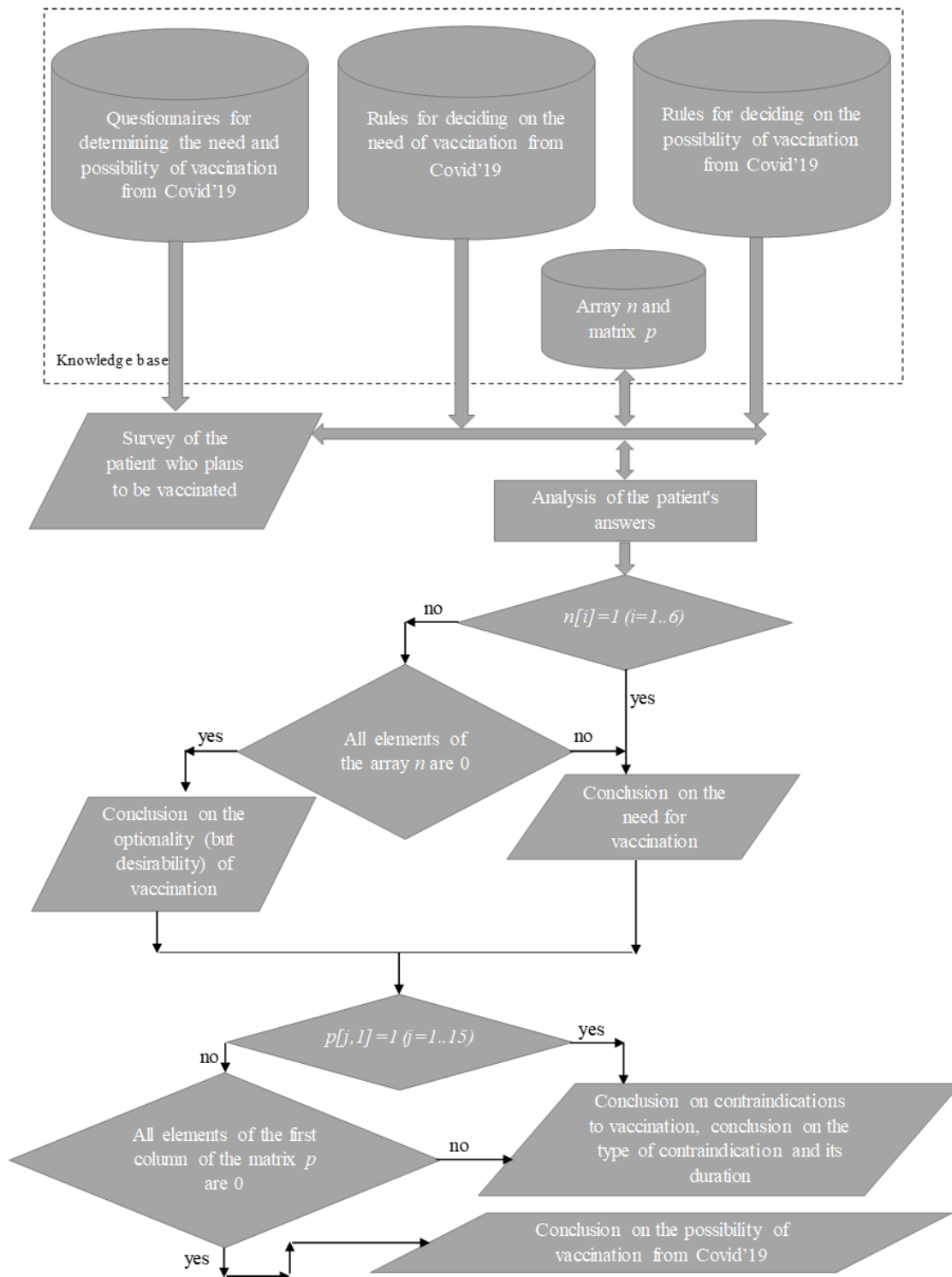
Figure 2: The structure of the Covid'19 vaccination decision-making subsystem based on civil law

5. Results & Discussion

Let's consider the functioning of the Covid'19 vaccination decision-making method and subsystem based on civil law.

On the basis of the above civil law grounds on the need (category of employees) and the possibility (existing medical contraindications and warnings) of vaccination from Covid'19, questionnaires for determining the need for vaccination and the possibility of vaccination from

Covid'19 were compiled. The second column of the matrix p is completed in order to further draw a conclusion about the type of contraindication and its duration in accordance with step 2 of the developed Covid'19 vaccination decision-making method based on civil law. A patient who plans to be vaccinated against David'19 was interviewed about his profession and place of work and about the patient's existing diseases and current health status in order to determine the need and possibility of vaccination.

The patient provided answers, based on which the completion of array n using each of the developed rules for deciding on the need of vaccination from Covid'19. The patient is a doctor, so the array $n = [0\ 0\ 0\ 0\ 1\ 0]$. Since $n[5] = 1$, the patient is issued a conclusion on the necessity of his vaccination from Covid'19.

Based on the analysis of the answers provided by the patient, the first column of the matrix p was filled using each of the developed rules for deciding on the possibility of vaccination from Covid'19. The patient has thrombosis and thrombocytopenia, in which case the matrix p has the form - Table 1.

Table 1

Matrix p, which contains signs of presence/absence of contraindications against vaccination from Covid'19 (for this example), as well as the type of contraindication and its duration

I column	II column
0	temporary contraindications (up to 2 weeks from the onset of the disease)
0	temporary contraindications (up to 3 months from the time of Covid'19)
0	temporary contraindications (3 months from completion of treatment)
0	temporary contraindications (until the end of pregnancy is contraindicated the live vaccines, CoronaVac/Sinovac Biotech vaccines)
0	temporary contraindications (until the end of lactation is contraindicated the CoronaVac/Sinovac Biotech vaccine)
0	temporary contraindications (14 days since the another vaccination)
0	temporary contraindications (until the evaluation of the test/IGRA)
0	temporary contraindications (based on the level of immunosuppression)
1	permanent contraindications for vector-based vaccines (AstraZeneca)
0	permanent contraindications for vaccine mRNA (Pfizer/BioNTech)
0	vaccination with caution (not earlier than 3 months after such procedures)
0	vaccination with caution (postpone vaccination until the recovery of absolute neutrophils)
0	vaccination with caution (contraindication to the introduction of live vaccines)
0	constant contraindications (for specific vaccines to which or to components of which an allergic/anaphylactic reaction was noticed)
0	vaccination with caution

Since $p[9,1]=1$, the patient is given a conclusion on the contraindications to his vaccination from Covid'19, as well as a conclusion on the type of contraindication and its duration - "permanent contraindications for vector-based vaccines (AstraZeneca)". Therefore, the patient has contraindicated vaccination with a vector-based vaccine (AstraZeneca), but he may be vaccinated with a different type of vaccine. After analysing the findings, the patient decided to be vaccinated with a non-vector vaccine, received two doses of Pfizer/BioNTech, which he successfully tolerated. The coagulogram did not show significant abnormalities after vaccination, so the vaccine did not exacerbate his thrombosis and thrombocytopenia.

6. Conclusions

The conducted review of the known decisions on Covid'19 vaccination decision-making based on civil law showed that with a large number of different solutions proposed in 2021-2022, Covid'19 vaccination decision-making method and subsystem based on civil law are not proposed today.

The conducted analysis of civil law grounds on the need and possibility of vaccination from Covid'19 in Ukraine made it possible to determine the categories of employees subject to compulsory vaccination, as well as a list of medical contraindications and warnings for contraindications to vaccination from Covid'19.

The developed Covid'19 vaccination decision-making method based on civil law provides: a conclusion on the mandatory or optional (but desirability) vaccination from Covid'19 - depending on the profession and place of work of the patient; conclusion on the possibility or contraindications to vaccination from Covid'19 - depending on the existing diseases and the current state of health of the patient; conclusion on the type of contraindication and its duration - in the case of a conclusion on contraindications to vaccination from Covid'19.

The developed Covid'19 vaccination decision-making subsystem based on civil law is a part of the intelligent information technology for supporting medical decision-making taking into account the legal basis and will be further implemented as a web-based application, which will be available 24/7, without any registration. This subsystem provides a conclusion on whether or not vaccination from Covid'19 is mandatory or optional from the point of view of profession and place of work (but desirability); conclusion on the possibility or contraindications to vaccination from Covid'19; conclusion on the type of contraindication and its duration. So the subsystem will be useful for patients, who truthfully answering questions from the subsystem, will receive a conclusion on the need and possibility of vaccination from Covid'19 them or their relatives, and for family physicians, which will reduce the burden during patient counselling and make it easier to answer questions about the need and possibility of vaccination, as they will no longer need to know all the current legislation.

Currently, Covid'19 vaccination decision-making subsystem based on civil law helps to decide on the need and possibility of vaccination only on the basis of the current legislation of Ukraine, but it can be adapted to the legislation of any country and changes in Ukrainian legislation - this requires an analysis of civil law grounds for the need and possibility of vaccination against Covid'19 in a particular country; supplementing or amending the rules for deciding on the need for vaccination against Covid'19, as well as the rules for deciding on the possibility of vaccination against Covid'19, taking into account the analysis of the civil law grounds of a particular country.

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8. References

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