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ЭТИКА ПРИНЯТИЯ РЕШЕНИЙ В МЕДИЦИНЕ В ЭПОХУ ТЕХНИЧЕСКОЙ РЕВОЛЮЦИИ

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Аннотация. Каким образом мировоззрение, научные открытия и эмпирические оценки соотносятся друг с другом при принятии решений в медицине? Ответ на этот вопрос дан в научном контексте. Существует теория принятия решений, которая востребована медицинскими специалистами, хотя пока и недостаточно [1, 2]. Итак, что же такое теория принятия решений и в какой степени ее развитие может быть применено к медицине с растущими противоречиями технологической революции и биоэволюции человека? Выбор тактики ведения пациента не зависит исключительно от клинических решений. Моральная позиция врача играет важную роль в принятии решений в медицине. В статье рассматриваются некоторые факторы, влияющие на этот тренд. Обоснована роль этической экспертизы. Это особенно важно в связи с внедрением технологий «улучшения человека» в медицинскую практику. Принятие решений всегда связано с выбором вариантов. Моральные соображения являются ключевым моментом, который должен повлиять на этот выбор в условиях неопределенности прогнозов, касающихся применения новых биотехнологий.

Ключевые слова: теория принятия решений, биоэтика, медицина, биотехнологии, ожидаемая ценность, гуманитарная экспертиза

Original article

ETHICS OF DECISION MAKING IN MEDICINE IN THE ERA OF TECHNICAL REVOLUTION

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Abstract. Which way do world outlooks, scientific findings and empiric evaluations correlate with each other in decision making in medicine? The answer to this question is given in the scientific context. There is a theory of decision making which is in demand by medical professionals, though not enough yet [1, 2]. So, what is the theory of decision making and to what extent its advancement may be applied to medicine with growing contradictions of technological revolution and human bioevolution? The choice of tactics in a patient's management does not depend exclusively on clinical decisions. A doctor's moral stand plays a significant role in decision making in medicine. This article deals with some factors that have effect on this stand. The role of ethical expert examination is substantiated. It is particularly important due to implementation of «human enhancement» technologies in medical practice. Decision making is always associated with a choice of options. Moral considerations are a key point that must influence this choice under uncertain predictions concerning application of new biotechnologies.

Keywords: theory of decision making, bioethics, medicine, biotechnologies, expected value, humanitarian expert examination

Introduction. Theory of decision making – is a methodology that involves a choice of actions that results in efficient achieving a desired goal [3].

There is a *normative theory* that describes a rational process of decision-making, and a *descriptive theory* describing the practice of decision-making. In medicine a descriptive theory is more in demand, but it is difficult to understand without knowing what a normative theory is.

To make "strict" statistically true forecasts for the future, a sampling from the future data should be made. As such sampling is impossible, so we should rely on the already existing data. But in this case forecasts

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become only "shadows of the past". There is previous experience and new challenges, new realities. Can we trust the forecasts based on the data of the past? In this sense practical medicine makes everything quite clear – prognosis for a disease and a treatment plan result from the past experience and clinical tests. In short it may be expressed like this:

Making a diagnosis. *If a number of symptoms in the patient occurred in Y % patients and was diagnosed as a chronic heart disease (CHD), consequently, there is a Y % probability that this patient suffers from CHD.*

Prognosis of drugs administration. *If X % patients with hypertensive crisis took N drug to recover from the crisis, there exist X-per cent probability that this very drug will help a particular patient recover from the crisis [4].*

Without sustainability of the series it is highly improbable to draw a valid conclusion. Though, it does not mean that the series ought to be absolutely sustainable. For example, it may have sustainable dispersions and absolutely non-stationary means; in this case we are able to draw conclusions only in relation to the dispersion and otherwise only to the mean. Sustainability may bear a more exotic character. The search for sustainability of the series is one of the purposes of statistics. In our case it is medical statistics. Epidemiologic explorations which correctness and completeness provide for a high probability of correct decision making in particular clinical cases may be of invaluable help.

Though, when we deal with revolutionary processes as implementation of "human enhancement" technologies, the situation is getting more complicated. It is evident that the process in this case is not stable and even if the probability functions of some expectations distribution may be calculated, these functions are "subject to unpredictable changes" and consequently the whole system is unpredictable. In modern practical medicine, such cases may be presented by rare diseases as well as rare combinations of the primary and accompanying diseases.

A typical example is doctors' behavior when the first few cases of West Nile fever occurred in Volgograd oblast of the Russian Federation. Uncertainty was associated with the cause of origin of this exotic disease. Mosquitoes were not considered as agents of the infection and now the measures taken against mosquitoes helped avoid development of the epidemics of the disease.

Uncertainty in decision making. In the theory of decision making uncertainly of the situation is associated with suspense, unpredictability of the results of the decision made.

As an example *of it is technologies of human genome editing Regularities of bonds in a genome have not been fully studied yet and it takes many years for monitoring the patients who had undergone such an operation in order to get any findings. Though, from the viewpoint of humanitarian expert examination it is impossible as it consciously violates human rights – the person's health and probably person's own life are jeopardized. At the same time development of scientific knowledge cannot be stopped and if any technology has been already developed, it is only the matter of time when it may be implemented. For this reason, a society with its control over such experiments is only able to "establish" some parameters of the experiment, to limit it, but not prevent its application.*

In such a situation, uncertainty analysis developed in decision theory is very useful. Consider its types on the material of practical medicine.

Stochastic uncertainty. There is some information on probability distribution in multiple results. ***Example:*** *lasting pain behind the sternum + arrhythmia + changes in the distal part of the ventricular complex in the ECG = CHD? No! It may be climacteric cardiopathy, coronary artery insufficiency, hyperthyroidism and a lot of conditions that require absolutely different medical treatment.*

Behavioral uncertainty. Information is available on its influence on the results of the participants' behavior. ***Example:*** the patient's incompetency minimizes efficiency of the correctly administered treatment.

Natural uncertainty. Information is available only concerning possible results but there is a lack of information about an association between decisions and their outcome. ***Example:*** *decision about pregnancy interruption may have neutral consequences but also may result in infertility.*

A priori uncertainty. No information about possible results. ***Example:*** *application of the drug that did not pass the third stage of clinical trials (CT). Application of the method for editing the genome of the embryo of HIV-infected parents.*

The task of substantiating decisions under conditions of uncertainty of all types, except a priori, is reduced to narrowing the initial set of alternatives based on the information available to the decision maker [5]. It is important to note that it is not correct to interpret such reduction in medicine only as a necessity to collect a super-detailed past history and doing numerous tests. The patient's personality who becomes an object of a medical intervention should also be taken into consideration. If a patient supports the doctor's decision, the uncertainty level decreases [6]. Practically, it is a binary subject – "doctor-patient" – which makes a decision in medicine. As soon as the binarity is violated, uncertainty increases. Hence, the optimal choice of the doctor-patient relation model enhances the chances to make a correct decision in diagnosis, treatment and rehabilitation which is a matter of ethical regulation. Still, a doctor possesses more freedom in decision making. Firstly, a doctor has a so-called "therapeutic privilege". Secondly, the freedom of the patient is limited by a certain degree of psychosomatogenesis, which prevents an adequate assessment of the situation. Consequently, the decision maker personality (DMP) in medicine usually means the personality of the doctor. So, the quality of recommendations for decision making under e.g. stochastic uncertainty increases taking into account such DMP characteristics as an attitude to gains and losses, inclination to take a risk, wish to play a leading role in relations with a patient, a rational criticism in relation to Standards and Rules of rendering medical assistance [7].

As for the application of "human enhancement" technology, we always deal with a prior uncertainty (not excluding other types of it). Decisions justification under a prior uncertainty in non-medical fields is possible by creating the algorithm of adaptive management but in medicine the situation is regulated by the "do not do any harm" principle, that is why the choice of a decision is subject more to ethical arguments than the arguments of scientific medicine. Just because the latter are absent.

The choice under uncertainty is the most important problem in the theory of decision making because each choice is aimed at a certain result. Besides, this result presents some value for us, especially when it goes about changes in the human nature. Thus, the expected value directly affects decision making.

Expected value theory. It was Blaise Pascal in the XVII century who first wrote about expected value [8, 9]. Though, he meant "mathematical expectancy" and for this reason mathematical operations were supposed. Let us imagine that we have a few (and even a set of)] possible actions and each can produce a few possible results with various probabilities. For a correct decision we should determine all possible results, show their positive and negative values and probabilities and sum up the results. This is what expected value. But the question arises – who is this expected value for? It looks so that both the doctor and the patient have the same aim – the patient's health. Consequently, they have the same expected value. But in reality we see that there is a number of intermediate values manifested as the means to achieve the value. And the doctor and patient (or the patient's relatives) may imagine the value in absolutely different ways.

Example. *A 24 yo nullipara woman. She visited the gynecologist with a complaint of bleeding. She was hospitalized with a diagnosis "hysteromyoma". She was advised to be operated and she agreed to it. At the consultation the doctor explained that the uterus might be extirpated if no other possibility to remove the myoma existed. The patient signed the form of the Informed consent for the operation, though hysterectomy was not mentioned in it, During the operation the doctor had to extirpate the uterus as the myoma was located at the vascular bundle and its nodes were of an intricate configuration. The patient left the hospital in a satisfactory condition and never came to the clinic afterwards.*

Three years later the patient's father occasionally watched a health program on TV, and the presenter did not advise women to agree to the operation for hysteromyoma as there existed efficient drugs that made a myoma decrease in size and thus often made the operation needless. The drug mentioned was gonadotrophin agonist. The next day the patient's father went to the lawyer and prosecuted the clinic with a claim to compensate moral and physical damages caused to his daughter. The claim amount was USD 20 000. The substance of the claim was that the doctor had not administered the proper drug to his daughter but advised an operation instead. The plaintiff alleged that administration of gonadotrophin agonist might have prevented hysterectomy and his daughter could have had children.

At the trial the doctor expressed the opinion that the drugs might have been of no use and the patient could have wasted the money as she needed at least 5 injections 8–10 thousand rubles each. The plaintiff's attorney objected saying that it was possible to judge about the efficiency of treatment only if it had been conducted and it was the patient who could decide about the money and not the doctor.

The legal evaluation of this case may be based on one single fact – incorrect formulation of the informed consent. In fact, the patient did not agree to hysterectomy, as there was no such a paragraph in the document that she had signed and an agreement made in the oral form was not registered anywhere. As for recommendations to use gonadotrophin agonist, it cannot be the object of legal evaluation. Law does not describe probabilities and refers only to facts. The fact that the patient was not provided with complete information about alternative methods of treatment should be established by a medical expert, but in this case it is problematic, since in the medical history this case was described as not subject to therapeutic treatment.

As for ethical evaluation, it can be made for all the issues of the case. Firstly, irrespective of the doctor ought views, experience and competency, the doctor should have informed the patient about all existing methods of treatment and explain why administration of gonadotrophin agonists was ineffective in her case. Only if the patient had refused from the treatment it would have been possible to decide on the operation.

Secondly, it was necessary to explain in details all possible complications and consequences of the operation in the informed consent, as the patient should be aware of the correlation between the risks and benefits of the operation. In this very case the doctor used the so-called "therapeutic privilege" that makes it possible, as an exception, to take decisions for the patient or take them in the doctor's opinion to the correct decision. This particular problem was easy to settle and quite clear for a competent patient, that is why "therapeutic privilege" was superfluous.

Thirdly, the doctor cannot assume the role of the "financial counselor", these are only the patient and their relatives who can decide, whether they can pay for the treatment chosen. Though, this issue may be questionable if the patient is aware of the efficient treatment but unable to pay for it. It may lead only to frustration and deteriorate quality of life which is also ethically unjustified. There are no universal recommendations for such situations so far (they are described below), each time the issue has to be resolved only by the doctor and only for each particular patient.

And fourthly, the situation that cannot but attract our attention, as it is typical of our time. The patient's father learned about the above drug from a popular health program. Can the source be reliable? Can it be considered as the doctor's consultation? Why no reservation was made in the program that administration of these drugs

should be discussed in each individual case and only with a competent specialist? We assume that "advice" of this kind that our mass media are overfull with and, in fact, present only a hidden advertisement of expensive services and drugs, are immoral. They mislead patients and provoke conflicts in medicine. It makes the question arise if censorship should be introduced for medical information in mass media.

This example makes it clear how many variables are engaged when making a decision and how the doctor's and the patient relatives' viewpoints differ in relation to the expected value. That is why arguments of those experts who insist on decision making in medicine as only information-logical activity look unconvincing. Only efficient computer programs are thought to help a doctor in the situation of limited time of decision making or limited opportunities of its implementation. New algorithms for such decisions are being developed for various fields of medicine and even for various nosologies. Though it is impossible **to make an algorithm for patients' attitude towards the expected value and making a decision;** an ethical and emotional component is too strong and the level of competency in clinical issues is low. As the doctor has no right to implement his/her decision without the patient's consent, all programs used turn out to be useless.

"Losses are more sensitive than gains". Besides, the probability of the correct choice using such programs is not high enough. Though, even it could reach 99 %, the risk of their use could be too high because 1 % would mean at least one unjustified death. All this makes us be cautious about the possibility to use the theory of expected value in medicine. Still, there are other variants to optimize the process of decision making.

Example. *In 1738, Daniel Bernoulli published an article called "Exposition of a New Theory on the Measurement of Risk" [10], where he proves that the theory of expected value is normatively incorrect. He gives an example in which a Dutch merchant tried to insure the cargo shipped from Amsterdam to Saint Petersburg in winter, though there was 5% risk that the ship and the cargo would be lost. In his decision he determines the function of usefulness and calculates the expected usefulness and not expected financial value.*

In the last century, Abraham Wald (1939) expressed the opinion that all subproblems of decision making are united in one single theory [3]. He developed a categorical construct of this theory introducing such notions as "loss function", "risk function", "acceptable decision rule", "bayesian decision rules", "a priori distributions", etc. Now it is evident that consideration of *subjective* components of decision making refers directly to medical decisions, especially when Wald's followers – Frank Ramsey [11], Bruno de Finetti [12] and Leonard J. Savage [13] developed a concept of subjective probability, application of which made it possible to describe the situations, using the expected utility theory when only subjective probabilities are possible. It is particularly significant for modern medicine, as it allows to describe decision making under different risks (clinical, ethical, social, financial, administrative, etc.).

In general, we can suggest that expected value theory is mostly applied to scientific researches and the expected utility theory – in the development and implementation of new biotechnologies. At present, in spite of the attempt to describe the interaction of science and engineering as "technoscience" [14], it is evident that scientific and technological issues in medicine possess a very modest share of complementarity. Pessimists also say that technologies displace science and technological decisions become more preferable than theoretical ones. Of course it goes about fundamental sciences,

Both for practical, "technological" and fundamental medicine the most important is the proof of D. Kahneman and A. Tversky's theses that for personal decision making "losses are more sensitive than gains" [5]. Besides, people are focused more on "alterations" of their own utility condition than utility conditions themselves and evaluation of the corresponding subjective probabilities is shifted in relation to the specific "reference point". This theory is principal for the decision making process in medicine. In fact, it was Hippocrates who by saying "do not do any harm" established a moral maxima of a correlation between losses and gains. He did not call for to cure but called for not to do worse, not to lose the human life.

But in the medical community the principle "do not do any harm" was always accepted without any relation to a possible gain. Hence, the strive for hyper-diagnostics and excessive administration of drugs in modern medicine. Most important is not to make a mistake. Most important is not to lose what already exists. But, if in a pure theory minimization of losses leads to inaction, then in medicine inaction is also harm. For this reason decisions are always made, but they are always preceded by a fear to make a wrong decision.

Errors in decision making. In the theory of decision making special attention is focused on possible errors. Usually, they are divided into two types. They are usually divided into errors of the first and second kinds. The cause of such classification lies in the consequences of erroneous decisions which differ in that the missed gain has less effect on the situation than the real loss. For example, for an exchange broker the consequence of failure to buy shares when they should have been bought differs from that when the shares were bought and he should not have done it. The first situation means the missed profit and the second – direct losses including the broker's ruin. The same is for a politician: the consequences of refusal to take the power in a revolutionary situation differ from the failed attempt to take the power. For a general to start a military operation that will be lost is much worse than to miss the situation for a successful operation [15]. For a medical doctor the goal set "at all costs" may cost much higher than following the natural course of events with a minimal correcting intervention.

Example. *Primigravida and primipara K., 23yo, was referred to the maternity home by her attending*

gynecologist a few days before the supposed date of delivery with a diagnosis "39 weeks of pregnancy. EDEMA but no hydrops gravidarum, Rh-negative without antibodies" was not diagnosed. The analysis of the pregnant woman's case history showed that the indication for hospital admission was an abnormal weight gain of 15 kg and edematous shins.

Examination at the pathologic pregnancy department showed traces of albumin in the urine and cardiotocography (CTG) of the fetus showed a questionable CTG type IUGR (intrauterine growth retardation). Diagnosis: Pregnancy 39–40 weeks. Moderate preeclampsia. Chronic fetoplacental insufficiency(CFPI). Rh-negative without antibodies".

It was decided to prepare the woman for delivery at full-term pregnancy, preeclampsia, and lack of readiness for delivery. During her stay at the pathologic pregnancy department repeated CTG, and ultrasonography were normal, blood and urine tests were without pathology, though the shins were still edematous. The woman was offered induction of labour induction with amniotomy – artificial rupture of the fetal bladder] as the gestational age was 40 weeks with moderate preeclampsia?

Induced labour was complicated by the abnormal labour forces and required a medical correction. At labour assistance the fetus's condition got worse (acute progressing intrauterine hypoxia). Labour ended in caesarian section and the baby was born with 4–5 Apgar score (neonatal asphyxia).

From the attending gynecologist's point of view the reason to hospitalize the woman was her weight gained during pregnancy and edema of the shins, so she interpreted these signs as a pregnancy complication – preeclampsia. At this stage the attending gynecologist evidently wanted to be on the safe side and avoid responsibility shifting it to the doctors of the maternity home even with minimal changes (within the individual norm) in the pregnant woman. Besides, the woman experienced psychological pressure (non-conformity with medical standards of weight, tests and blood pressure) and was intimidated that complication might happen both to the woman and her baby. This way, the woman admitted to the pathological pregnancy department at the end of pregnancy without any convincing reasons had only to be placed in the delivery room. Labour induction with immature birth canals provoked abnormal labour and required stimulation which was useless in this situation and finally led to caesarian section. In V.E. Radzinsky's opinion [16] this tactics bears the name "crocodile phenomenon" – "not a single step backwards", not because it is as aggressive as this nice animal but because the crocodile cannot move backwards and besides it attacks the first thing that comes to hand, or better to say, to tooth.

At the same time, classification of errors into the first and second types is justified when the record and analysis of risks is done accurately. So, in economics raising profit is not as important as minimizing risks. The main difference lies here.

In many cases we can see a paradoxical situation when a wide choice can result in a poor decision and even in the refusal to take any decision. Sometimes it may be theoretically explained by the so-called "analytical paralysis", real or imaginary and by a "rational ignorance" that is also quite possible. As the medical doctor cannot afford "analytical paralysis", sooner or later he/she is doomed to make an error being aimed at the successful treatment and not minimizing losses. As Barry Schwarz suggests, the choice did not give us more freedom but limited us, did not make us happier but always causes dissatisfaction. It fully refers to healthcare professionals. For this reason it is so important to know the logics how to solve clinical problems to avoid errors of both the first and second type.

The process of problem solving in practical medicine. In practical medicine the process of problem solving consists of such main subprocesses as:

1. Detection of a problem situation – making a diagnosis.

2. Problem statement (detection and definition of its source elements and relations between them) – forecast of the treatment results (taking into account accompanying conditions, the patient's personality and facilities of the clinic).

3. Search for the problem solving – choosing the tactics of the treatment process (treatment and rehabilitation plans, choosing the drugs, techniques, method of control).

The stages of problem solving were described with some modifications by many authors. The most popular among them are the following:

Stages of problem solving in theories by O. Selz [17], K. Duncker [18], Greeno [19]

O. Zelz	K. Duncker	Greeno
1. Forming a complex that includes: a) characteristics of the known and b) known-unknown relation determining c) the place of the unknown in the complex. Incompleteness of this complex is the essence of the problem	1. Going deeply into the problem situation – understanding its internal relations, perceiving it as a whole containing some conflict	1. Constructing a cognitive network made of the elements of the known (datum) and unknown (relation between the elements of the known and unknown has not been established yet)
2. Launch of intellectual operations: recollection or making a decision	2. Finding a *functional value* of the decision. 3. Implementation of the functional value in a concrete decision	2. Constructing connections (relations) between the elements, modifying the network with additional information from the memory

The most acceptable for **clinical** problems is K. Duncker's theory, as it corresponds to the structure of a medical "triad": knowledge – assessment – activity. Though application of these theories in their pure form is hardly possible maybe because it is a particular person with his/her own emotions, ideals, experience, everyday problems, who learns, assesses and acts in the clinic. Hence, personality in decision making is one of the most important conditions of their success/failure. In fact, the process of problem solving (in science in particular) and successful solving of it is affected by the following factors:

1. **Attitude.** Attempt to repeat what was successful in the past. The level of attitude is proportional to the level of difficulty of the problem. A previously applied method is difficult to use in a different way.

2. **Characteristics of an emotional (motivational) state.** Efficiency of a decision is proportionally affected by a previous success/failure. The higher or weaker is the motivation, the worse is the outcome of problem solving – the most efficient is a medium intensity of motivation.

3. **Knowledge.** It may influence problem solving both positively and negatively depending on its depth.

4. **Intellect.** Low intellect intensifies dependence on attitude, high intellect makes the dependence lower.

5. **Personality.** At the personal level the success of problem solving depends on a] flexibility, b] initiative, c] confidence, d] nonconformity, e] ability to restrain activity.

Conclusion. Thus, subjective probabilities are so important in medicine that they give special characteristics to decision making. Expected value and expected utility should be integrated in the process. But it is not just a man who makes a decision - it is a medical doctor who is limited by the requirements of his/her social role. Consequently, parameters of this role will also be parameters of decision making. What are they determined by? By a normative regulation of the medical profession, in other words – by the norms of bioethics. For this reason, a bioethical regulation determines both the process and outcome of decision making in medicine.

Hence, in respect of development and application of "human enhancement" technologies in medicine decision making will be successful only if decisions are based on a] data of fundamental sciences and b] data of humanitarian expert examination, a bioethical one in the first line.

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