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METHOD OF ANALYSIS OF HIERARCHIES IN DECISION MAKING IN MEDICINE

Н.В. Манічева, Н.В. Тітова, І.В. Прокопович, С.В. Касян. **Використання метода аналізу ієрархій при прийнятті рішень в медицині.** У повсякденній практиці медичні працівники стикаються з багатьма проблемами в прийнятті етичних і професійних рішень. Наразі мало відомо про етичні та професійні міркування та зважування переваг та ризиків у щоденній практиці додаткової та альтернативної медицини. Поряд з розвитком мета-аналізу як інструменту для узагальнення дослідницької та наукової літератури, відновився інтерес до ширших форм кількісного аналізу, який спрямований на поєднання доказів з різних планів досліджень або доказів щодо кількох параметрів. Вони були запропоновані під різними заголовками: метод профілю довіри, перехресний синтез, ієрархічні моделі аналізу та узагальнений синтез доказів. Моделі, які використовуються в оцінці технологій охорони здоров'я, також називаються синтезом доказів у математичній структурі. Проблематика досліджуваної теми досить актуальна, адже прийняття тяжких та «правильних» рішень в медичній галузі досить гостро стоїть на порядку денному в зв'язку з постійним виникненням нових захворювань чи мутації вже відомих інфекцій. Тому вчені постійно вдосконалюють свої напрацювання, навички та знання у всіх сферах. Процес аналітичної ієрархії, один із найкорисніших багатокритеріальних методів прийняття рішень, він може дозволити лікарям, та й самим хворим, чи людям котрі не йдуть в медичну установу, а обирають шлях самолікування більш детально пояснити фармацевту свій стан для уникнення ще гірших проблем та тяжкого стану. Він приє прийняттю рішень шляхом структурування ієрархічних елементів рішень і критеріїв зважування, які беруть участь у проблемі прийняття рішення. Для того щоб вибрати найкращу профілактичну політику для зниження захворюваності на будь-яку хворобу. У цій статті розглянемо доцільність та ефективність використання методу аналізу ієрархій при прийнятті рішень для лікування та покращення стану хворого, також підсумуємо кількісні та якісні показники результативності використання даного методу.

Ключові слова: метод аналізу ієрархій, аналітична ієрархія, процес прийняття рішень, прийняття рішень в медицині, медичні рішення, ієрархічний аналіз, процес аналітичної ієрархії Томаса Сааті

N. Manicheva, N. Titova, I. Prokopovych, S. Kasian. **Method of analysis of hierarchies in decision making in medicine.** In everyday practice, health professionals face many challenges in making ethical and professional decisions. So far, little is known about ethical and professional reasoning and weighing the benefits and risks in the daily practice of complementary and alternative medicine. Along with the development of meta-analysis as a tool for summarizing research and scientific literature, there has been renewed interest in broader forms of quantitative analysis, which aims to combine evidence from different research plans or evidence from several parameters. They have been proposed under different headings: the trust profile method, cross-synthesis, hierarchical analysis models, and generalized evidence synthesis. The models used to evaluate health technologies are also called the synthesis of evidence in mathematical structure. The issues of the studied topic are quite relevant, because making difficult and "correct" decisions in the medical industry is quite acute on the agenda due to the constant emergence of new diseases or mutations in already known infections. Therefore, scientists are constantly improving their work, skills and knowledge in all areas. The process of analytical hierarchy, one of the most useful multicriteria methods of decision-making. It can allow doctors, patients themselves, and people who do not go to the medical institution, but choose the path of self-medication to explain their condition to the pharmacist in more detail to avoid even worse problems and serious conditions. He makes decisions by structuring the hierarchical elements of decisions and weighing criteria involved in the decision-making problem. To choose the best prevention policy to reduce the incidence of any disease. In this article we will consider the feasibility and effectiveness of using the method of hierarchical analysis in decision-making for the treatment and improvement of the patient, as well as summarize the quantitative and qualitative indicators of the effectiveness of this method.

Keywords: method of analysis of hierarchies (AHP), analytical hierarchy, decision-making process, decision-making in medicine, medical decisions, hierarchical analysis, process of analytical hierarchy Thomas Saati

Introduction

The method of analytical hierarchy (AHP) is one of the multi-criteria methods of decision-making, which was originally developed by Professor Thomas Saati. In the 1980s, the scientist worked with Ernest Foreman to develop a selection of experts, which later gave impetus to the continuous improvement and study of AHP. In short, AHP is a method of deriving the scale of relations from pairwise comparisons. Input data can be obtained from actual measurements, such as price, weight, etc., or from subjective opinion, such as feelings and well-being. AHP admits some slight inconsistencies in

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judgments, as people are not always consistent. The scales of relations are derived from the basic eigenvectors, and the consistency index – from the basic eigenvalue.

AHP has a special niche in its application for group decision-making, is widely used worldwide in a wide range of decision-making cases in areas such as business, government, shipbuilding, industry, health and education.

Instead, in order to determine the "right" solution, AHP helps decision makers to find it, to choose the one that best meets the criteria of the ultimate goal and their understanding of the problem. This method provides a comprehensive and rational basis for structuring the problem of decision making.

People who use AHP first break down their problem into a hierarchical table of easier-to-understand subproblems, each of which can be independently analyzed. The components of the hierarchy can relate to any range of decision-making problems – whether tangible or intangible, measured in detail or generally evaluated, well or poorly understood – anything related to the decision.

Subsequently, as the hierarchy is built, those who make complex decisions systematically evaluate its various segments, comparing them in pairs with each other, in terms of their impact on the segment above them in the hierarchy. When making comparisons, individuals or teams may use specific data about the elements, but they usually apply their vision of the relative importance of each element.

The essence of AHP is that human judgments can be used in assessments, not just basic information.

The method of hierarchy analysis converts estimates into numerical values that can already be processed and compared throughout the problem. Numerical weight or priority is displayed for each segment of the hierarchy, which allows you to compare completely different and often incomparable segments in a rational and consistent way. This feature distinguishes AHP from other methods of complex decision-making.

At the final stage of the process, numerical priorities are calculated for each of the alternative solutions. These figures reflect the relative ability of the alternative to achieve the goal of decision-making. Therefore, they provide an opportunity to directly consider different areas of action.

In medicine, AHP has a special application, as evidenced by numerous experiments, surveys and scientific papers, articles in well-known international scientific journals.

Analysis of literature data and problem statement

By 1988, very few articles had been published, and since 1997 the activity rate has risen to about three articles per year. Summarizing research articles and research can be structured into the following categories: diagnosis, patient participation, therapy / treatment, organ transplantation, project and technology evaluation, human resource selection and planning, and health evaluation and policy. The largest number of articles was found in the category of evaluation and selection of projects and technologies with significant activity in patient participation, therapy / treatment, and evaluation and health policy.

AHP is a promising support tool for patient-physician decision-making, evaluation and choice of treatment and therapy, and evaluation of health technologies and policies.

The purpose and objectives of the study

The aim of the study is to consider the possibility of using the method of hierarchy analysis for sound decision-making in many areas of medicine and to show its feasibility as an effective tool to reduce subjectivity and uncertainty of goals in medical decision-making.

The purpose of this study is to clarify the use and combination of the method of analysis of hierarchies in making difficult decisions in the medical field. Summarizing quantitative and qualitative indicators of the effectiveness of this method and the need for its use by managers, doctors and other employees of medical institutions to a balanced scientifically sound approach to decision-making on which people's lives depend.

Materials and methods of research

The use and combination of AHP in solving problems of the medical field and medicine in general are as follows:

1. Using the approach of cognitive engineering to conduct a hierarchical analysis of tasks to understand the complex decisions of older people when choosing over-the-counter drugs [1].

Adults aged 65+ (elderly people) disproportionately consume 30% of over-the-counter (OTC) medicines and are largely responsible for making over-the-counter treatment decisions because providers are unaware of their consumption. These treatment decisions are complex: older people need to focus on age / cognitive changes in the body, developed comorbidities, and complex treatment regi-

mens when choosing the right over-the-counter medication. However, little is known about how older people make such decisions.

This study characterizes the cognitive decision-making process of older people when they try to self-medicate over-the-counter drugs at their public pharmacy, and demonstrates how hierarchical task analysis (HTA) can be used to assess the impact of pharmacy intervention on decision-making.

The pre-/post-implementation approach, using an outspoken reflection process, was conducted with older adults in a community pharmacy when they completed a hypothetical scenario for treating pain, sleep, or cough / cold / allergy symptoms. HTA has developed a conceptualization of older adult decision-making on the selection and use of OTC before / after the implementation of the senior section.

The HTA consists of 12 purposefully selected interviews (before $n = 9$ / after $n = 3$), consisting of 8 goals / 15 sub-goals. When choosing an over-the-counter drug, the elderly took into account the quantity, cost, form, regimen, safety, strength, safety compliance of the over-the-counter drug, overall / brand name, past experience, and ingredients. The intervention halved the number of factors considered.

Older adult decision-making is more difficult than simply choosing over-the-counter medications from a pharmacy shelf. HTA-informed decision profiles can give pharmacists an important idea of safety issues that older people may not take into account (such as factors related to the safety, potency, or suitability of over-the-counter symptoms) so that pharmacists can support their decisions.

2. Combining and using the Utrecht method and the process of analytical hierarchy to promote professional and ethical discussion and decision-making in complementary and alternative medicine: a practical example of a stakeholder group [2].

In everyday clinical practice, there are many cases when pregnant women and health professionals are reluctant to use conventional drugs, especially in the first trimester of pregnancy [3]. In these cases, women and / or their health care providers may choose some complementary or alternative medicine methods, such as using ginger to treat toxicosis. [4]. Medicinal plants have evolved as one of the most commonly used modalities of alternative medicine. In many cases, medicinal plants are considered safe [4]. Probably, this idea arose from the advertising of medicinal plants as safe and gentle [5]. Moreover, some health professionals have helped perpetuate this myth by recommending herbs as “natural” medicines that are always safer than conventional medicines [6, 7]. Contrary to many patients’ beliefs, medicinal plants contain many chemical components that may be identical to those present in conventional medicines. In this case, these components may act by the same pharmacological mechanisms and, therefore, have a similar potential to cause unwanted side effects, like other conventional drugs. Therefore, like conventional medicines, herbs should be prescribed according to certain indications, in many cases they should be used with caution and they can cause unwanted side effects. Therefore, medicinal plants should be recommended for the right patients, at the right time, in the right dose, with the right frequency and the right route of administration [4, 6].

Deciding on specific therapeutic options, where alternatives are available, requires weighing their potential benefits and potential risks. The therapeutic option is often chosen when its potential benefits outweigh the potential risks. Today, terms such as choice, self-management, coherence, and informed decision-making are key words used to treat a variety of health-related conditions [8, 9]. Today, the results reported by the patient are extremely important, as improving the patient’s quality of life is the ultimate goal of any treatment option. Recognition of these principles has changed the philosophy and practice of health care.

As a result, patients are increasingly involved in weighing the potential benefits and potential risks of available treatments, and patients and their health care providers are more likely to make joint decisions.

In everyday clinical practice, deciding on therapeutic alternatives can be difficult, especially in the presence of other comorbidities. Although some patients may delegate the decision-making process to their healthcare professionals, many prefer a more collaborative approach to collaborative decision-making. In both cases, the patient should be informed of the process of weighing the benefits and risks of the treatment option.

It can be argued that well-informed patients may have fewer misconceptions about treatment and expected outcomes, be aware of potential benefits, better cope with unwanted side effects, and feel in control of their lives [8, 10, 11, 12, 13, 14]. CAM is no exception, and healthcare providers often face

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decision-making problems in their daily practice. Although ethical aspects of professional practice are either explicitly mentioned or at least suggested, professional guidelines do not offer tools for professional and ethical discussions and weighing of potential benefits and potential risks in daily practice [15].

In general, little is said in the literature about ethical and professional considerations in everyday practice when choosing traditional or alternative medicine treatment options. The Dutch Center for Bioethics and Health Law has developed a method known as the Utrecht Method, which can be used in ethical and professional discussions [16, 17, 18]. This method is often used in teaching. Given the difficulty of weighing the potential benefits and risks of decision-making, using a combination of qualitative and quantitative approaches that combine potential benefits and risks and rank certain benefits / risks should be useful to support decision-making [19]. Various approaches to multicriteria decision analysis (MCDA) have been reported in the literature to support decisions under uncertainty, especially when many treatment-related goals were available [20]. Among these approaches, the Analytical Hierarchy Process (AHP) has become one of the most commonly used. AHP provides a means of explicitly incorporating the benefits and risks of treatment and combines the importance of differences in the priorities of treatment outcomes [21]. Unlike standard decision-making processes, in which the importance of each component of the decision is not clearly expressed, AHP provides a transparent decision-making process in which stakeholders can understand and demonstrate the basics of their decisions [21].

The Utrecht method was originally developed as a reflective tool for discussion with special emphasis on professional and / or ethical dilemmas faced by health professionals in everyday practice [18]. Discussions often begin with guiding questions, such as “what should I do?”, Which will finally lead to concrete advice. Decisions are justified by professional or ethical decisions that require transparency. This method takes into account the different normative points of view that healthcare professionals as well as patients can follow in practice, which can be taken into account during the discussion.

The use of the Utrecht method can be attractive because it corresponds to daily professional practice and the limited number of questions that arise during the discussion process. There are eight questions in this method, which were as follows: first, what is the professional and / or ethical issue in this case? Second, what are the alternative potential solutions in this case? Third, is there a lack of relevant information? Or what are the potential benefits and potential risks of using ginger in this case? Fourth, what are the views of stakeholders on this case? Fifth, what are the pros and cons of alternative potential solutions? Sixth, how strong are these arguments in this case? Seventh, which alternative solution should be preferred based on the arguments considered in this case? And finally, the eighth, how to implement the solution desired for this case?

This study was approved by the Institutional Revision Board (IRB) of An-Naja National University. Ten participants gave oral consent before participating in this study.

Research results

To investigate how strong the arguments in this case (the decision to use ginger to treat toxicosis), AHP was used. At AHP, panellists use pairwise comparisons to weigh alternatives and facilitate decision-making. In this way, we will be able to determine the relative weight of the benefits to assess the therapeutic effect and avoid side effects and risks to the continuity of pregnancy and the integrity of the developing fetus. The participants of the discussion were provided with a summary containing information on the safety and effectiveness of ginger in toxicosis. Data on the safety and efficacy of ginger were summarized from the Comprehensive Database of Natural Medicines [22], the Cochrane Database of Systematic Reviews [23] and from the summary of relevant systematic reviews and scientific papers [24, 25, 26, 27, 28, 29, 30, 31, 32], [33, 34, 35, 36, 37, 38, 39, 40]. Participants in the discussion were provided with full copies of the documents when requested. Participants in the discussion were asked to make pairwise comparisons on a 9-point scale. The higher the numerical value given to an item (benefit, side effect, or risk), the higher the relative weight of the item compared to the other item being compared. Discussion participants were asked to consider the likelihood of each benefit, side effect, or risk associated with the present case in a pairwise comparison. The comparison was performed in 4 stages. In the first stage, participants were asked to assess the weight of potential benefits. At this stage, 12 potential benefits were compared in pairs. These benefits included relieving toxicosis, relieving cough, relieving flu, increasing milk production, reducing appetite, lowering choles-

terol, lowering blood pressure, lowering blood sugar, relieving dyspepsia, improving sleep, improving skin health, and reducing joint pain. In the second stage, participants were asked to evaluate 15 potential side effects in the pair. These side effects included the risk of bleeding, heart arrhythmia, irritable bowel syndrome, duodenal ulcers, heartburn, hypotension, hypoglycemia, itchy skin, dehydration, belching, thirst, sweating, fever, headache and diarrhea. In the third stage, the experts assessed 3 potential risks to the continuity of pregnancy and the integrity of the developing fetus in the pair. Participants were asked to evaluate 15 potential side effects in the pair. These side effects included the risk of bleeding, heart arrhythmia, irritable bowel syndrome, duodenal ulcers, heartburn, hypotension, hypoglycemia, itchy skin, dehydration, belching, thirst, sweating, fever, headache and diarrhea. In the third stage, the experts assessed 3 potential risks to the continuity of pregnancy and the integrity of the developing fetus in the pair. Participants were asked to evaluate 15 potential side effects in the pair. These side effects included the risk of bleeding, heart arrhythmia, irritable bowel syndrome, duodenal ulcers, heartburn, hypotension, hypoglycemia, itchy skin, dehydration, belching, thirst, sweating, fever, headache and diarrhea. In the third stage, experts assessed 3 potential risks to the continuity of pregnancy and the integrity of the developing fetus in pairs [24, 25, 26, 27, 28, 29, 30, 31, 32, 33, 34, 35, 36, 37, 38, 39, 40]. Such risks were the risk of miscarriage, the risk of fetal developmental disorders and the risk of fetal hypoglycaemia. At the last stage, the potential benefits, side effects and risks were compared in pairwise comparisons. Individual estimates of each expert were used to calculate comparison matrices in Excel spreadsheets [38]. Relative weight scores, as well as their consistency ratios, were calculated using mathematical formulas originally developed by Saati [41].

Grades were received from 10 participants (share of answers = 100%). Two gynecologists-women have more than 10 years of experience and often meet with pregnant women and advise them on the safe use of medicinal plants, including ginger, to treat toxicosis. The three pharmacists were two women and one man. They also had more than 10 years of experience in public pharmacies. They often give medicines to pregnant women and often discuss the safety of medicinal plants with pregnant women. All three herbalists were men with more than 15 years of experience. They often sell medicinal plants to pregnant women and instruct them on how to prepare them. Two pregnant women had more than 3 previous pregnancies. One of them had a history of miscarriage. Treatment priority analysis was based on an analysis of the benefits of ginger for this case, potential side effects and risks to the fetus and pregnancy. Analysis of the benefits of ginger in this case showed that the relief of symptoms of toxicosis has the highest weight (30.7% ± 16.6%), and one-way analysis of variance (ANOVA) with multiple comparisons Bonferroni showed that this assessment was significantly higher, than others. weight points (p_1-value < 0.001). Thus, the relief of symptoms of toxicosis was evaluated. Multiple comparisons showed a statistically significant difference in estimates of the severity of dyspepsia relief compared to all other benefits (p-values < 0.001), except for cough relief (p-values = 1.000) and influenza (p-values = 0.890). Estimates for the relief of cough and influenza symptoms did not differ significantly (p-value > 0.05), while they were statistically different from the reduction of joint pain (p-value < 0.05) and the improvement of skin health (p-value <0 05). 0.01). Detailed estimates of the weight of potential benefits are shown in Fig. 1.

Analysis of side effect estimates showed that the risk of bleeding was significantly higher (p-values < 0.001) than others (24.7% ± 13.5%) and was assessed. Estimates of cardiac arrhythmia and dehydration were not statistically significant (p-values > 0.05). Heartburn rates (14.8% ± 6.6%) were significantly higher than all other potential side effects (p-values < 0.01), except for duodenal ulcers (p-values = 0.145) and irritable bowel syndrome (p-value = 1,000). Detailed estimates of the severity of potential undesirable side effects are shown in Fig. 2.

Estimates of the risk of miscarriage (45.8% ± 3.8%) and the risk of fetal developmental disorders (41.6% ± 3.6%) were significantly higher (p-values < 0.001) than fetal hypoglycaemia. Detailed estimates of the weight of potential risks to the fetus and pregnancy are shown in Fig. 3.

When the benefits were compared with the side effects and risks to the fetus and pregnancy, the former had a significantly higher (p-value < 0.001) weight (72.3% ± 5.2%). Details of weight estimation are shown in Fig. 4.

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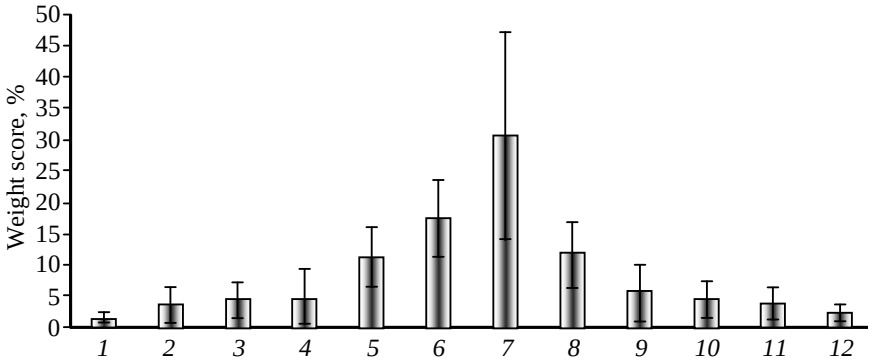

Fig. 1. Evaluation of the benefits of using ginger during pregnancy: *1* – improve skin health; *2* – reduce blood pressure; *3* – decrease appetite; *4* – improve sleep; *5* – alleviate flu; *6* – alleviate dyspepsia; *7* – alleviate NVP; *8* – alleviate cough; *9* – increase milk production; *10* – decrease cholesterol levels; *11* – reduce blood sugar levels; *12* – reduce joint pain

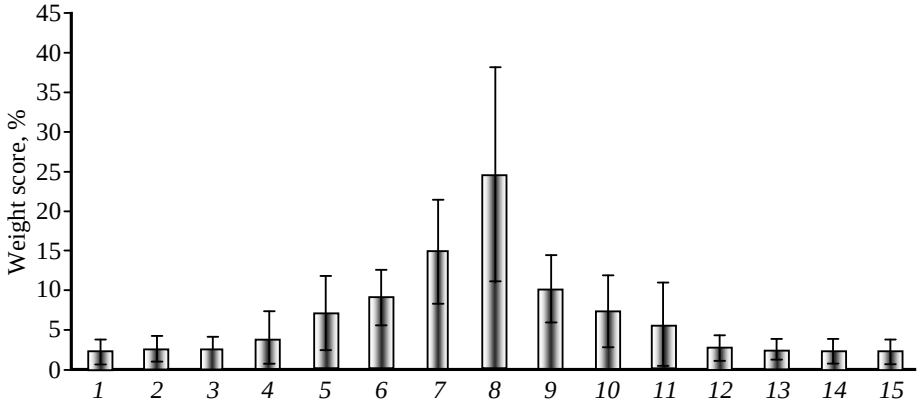

Fig. 2. Evaluation of side effects from the use of ginger by pregnant women: *1* – headache; *2* – diarrhea; *3* – fever; *4* – skin itching; *5* – cardiac arrhythmia; *6* – duodenal ulcer; *7* – heartburns; *8* – risk of bleeding; *9* – irritable bowel syndrome; *10* – dehydration; *11* – belching; *12* – hypoglycemia; *13* – hypotension; *14* – sweating; *15* – thirst

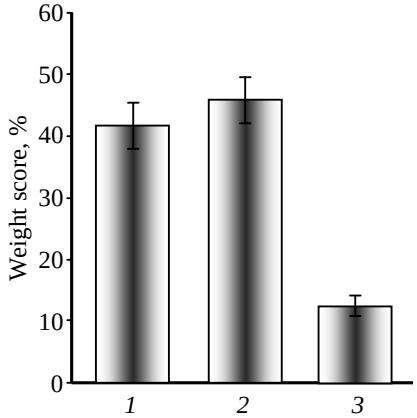

Fig. 3. Assessing the risks of using ginger for the fetus and pregnancy: *1* – risk of impairment of fetal development; *2* – risk of spontaneous abortion; *3* – risk of fetal hypoglycemia

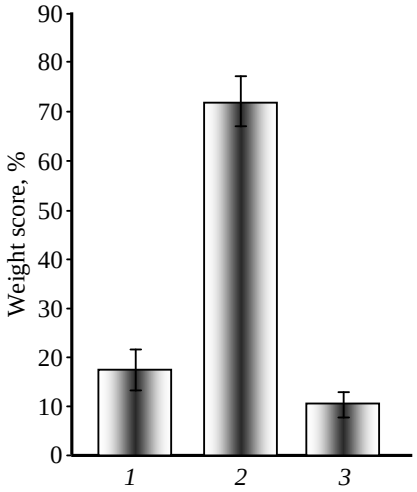

Fig. 4. Assess the benefits, side effects and risks of using ginger during pregnancy: *1* – risk to the fetus and pregnancy; *2* – benefits; *3* – side effects

In conclusion, this study demonstrates that the Utrecht method and AHP can be combined and used to facilitate a common solution in the practice of alternative medicine.

Conclusions

The study and analysis of the above factors convincingly showed the feasibility of using the method of analysis of hierarchies for difficult medical or managerial decisions in the medical field. This method is well used and has very positive results because it allows you to clearly trace the available alternatives and in uncertainty to choose the most promising methods and tools that need to be used at this time. However, in the process of making any decisions, there is always an element of subjectivity that is related to the human factor, and therefore the use of the method of analysis of hierarchies allows you to make the decision-making process completely transparent. The versatility of the basic method of hierarchy analysis and the ability to combine it with other methods of analysis provides even better results in making "correct" important decisions and the maximum exclusion of dangerous factors in decision-making in the medical field.

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