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Research Paper

Application of the Analytical Hierarchy Method of Decision-Making in Patient Treatment

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Abstract
On the basis of the existing literature conducted in the paper, we determined that the analytical hierarchy method is a promising auxiliary tool for supporting joint decision-making, as well as for the evaluation and selection of treatment methods in the field of health care. A decision-making support model based on the analytical hierarchy method has been developed for the selection of safer medicaments for the patient, which will allow us to take into account the characteristics of the patient as an individual. It is concluded that, if the results of the study are used, the doctor will be given the opportunity to evaluate and make an objective decision when selecting a safer medicament.

Keywords: *decision making, analytical hierarchy method, decision support mode.*

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I. Introduction

The activities of the management of the organization are constantly related to decision-making of various types and complexity, taking into account a large number of economic, social, political, legal and moral factors, which leads to the setting of a multi-criteria optimization task by experts in the relevant field or decision-making persons (DMP). In order to increase the objectivity and quality of decision-making, it is advisable to take into account the opinion of the group of experts. Therefore, justified conclusions can be obtained through the group decision-making method [1],[2], [3].

When using subjective information in the decision-making process, which can be presented in the form of quantitative or qualitative assessment, creates a condition of uncertainty. The causes of uncertainty are: DMP incomplete knowledge about the properties of the object, DMP's lack of confidence in the correctness of the expert assessment, lack of clarity of the presented information and inconsistency of knowledge. Therefore, in order to realize the tasks of decision-making in the conditions of uncertainty, it is necessary to ensure the comparison of non-quantitative factors, or quantitative and qualitative characteristics. One of the tools for solving such tasks is the Analytical Hierarchy Method (AHP). AHP is one of the multi-criteria decision-making methods that divides a complex decision problem into different hierarchical levels. The weights of each criterion and alternative are evaluated in pairwise comparisons and priorities are calculated by the eigenvector method [4],[5].

Today, medicament safety is one of the main problems in clinical practice. The pharmacological market is developing intensively, the number of medicinal products is constantly increasing. Doctors must systematically read medical articles to obtain active information, for which they can spend a significant part of their working hours. In this regard, it is adequate to evaluate the safety of medicaments for a specific patient and recommend the safest one, which is the most difficult task for a doctor. Consequently, clinical decision-making becomes difficult, the risk of clinical error and the number of unreasonably prescribed medicaments increase [6], [7].

The use of the analytical hierarchy method for multi-criteria decision-making in the safe selection of medicaments for a specific patient is very relevant in the conditions of the computerized society and medical practice.

The paper presents the possibility of using the analytic hierarchy process for forecasting demands in logistics and offers an analysis method for estimating the values of individual parameters [8].

The paper suggests that AHP can be used to make group decisions about adjunctive therapy for patients with type 2 diabetes. AHP represents a possible tool to improve patient-centered care by incorporating information about all aspects of decision-making and including the preference for treatment-related outcomes [9].

The paper presents the possibility of using the analytical hierarchy method to evaluate the effectiveness of medicaments in medicine, for wine tasting and tea production, for the selection of team members in sports, its use is forecast in the industrial sector, services and trade. Each presented application involves qualitative and quantitative determination of information. However, this work is very old and is not useful for assessing the present-day status of the presented topic [10].

The paper aims to develop a decision support tool to improve the planning of water distribution networks (WDN) rehabilitation, using the analytic hierarchy process [11].

The problem is presented in the paper considering 6 main and 38 sub-criteria criteria for purchasing construction equipment as a multi-criteria optimization task. Using the Analytic Hierarchy Process (AHP) created a sustainable procurement index with consistent analysis results. The procurement index proposed in the paper will assist decision makers in the process of purchasing sustainable construction equipment [12].

Based on the analysis of the literature review on the presented topic, we determined that AHP is a promising auxiliary tool for supporting joint decision-making, as well as for the evaluation and selection of treatment methods in the field of health care. In our opinion, AHP research will remain an important component of health care and medical research for a long time, including for the selection of more safe medicinal medicaments for the patient, which represents the scientific novelty of the research paper.

The aim of the paper's research is to analyze the current state of the analytical hierarchy methodology in the field of health care and the possibility of its increasingly consistent use in the selection of medicaments that are safer than the patient.

Main Part

Medical decision-making has traditionally been associated with the search and associated selection of treatment options, which can be thought of as:

- Description of the patient's condition (analyses, diagnosis);
- Analysis of restrictions (presence of allergens in the component of the medicament, impaired kidney function, etc.);
- Selection of recovery method/selection of therapeutic medicament;
- Prediction of treatment outcome options (medicament safety assessment, possibility of unwanted side reaction).

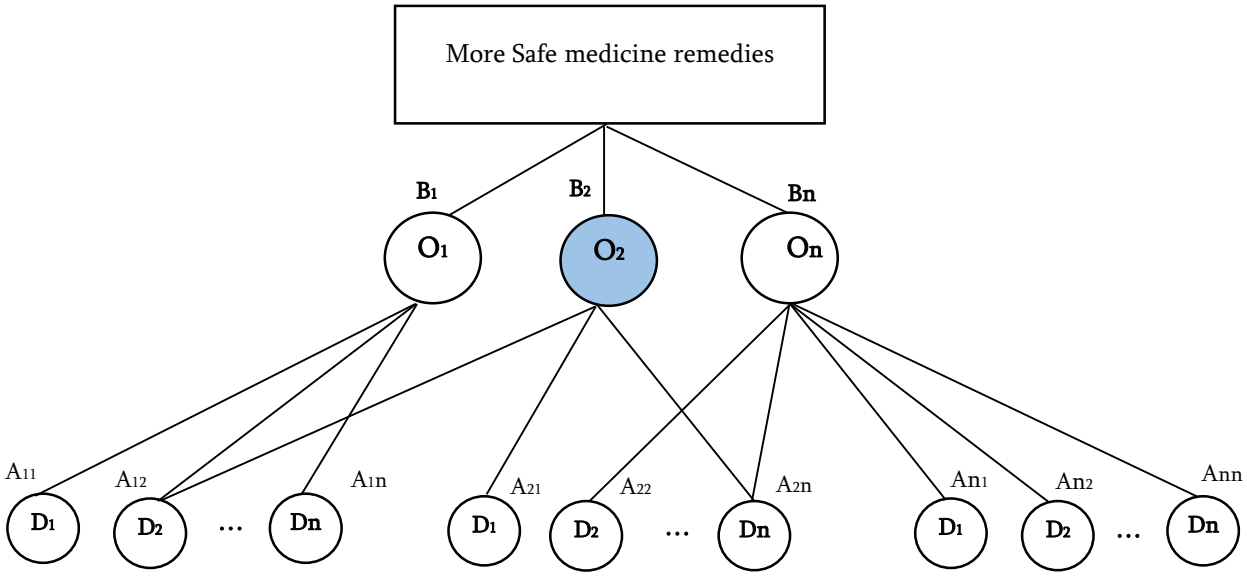
The theoretical decision-making process will be reduced to the selection of sets of criteria and the determination of alternatives, according to the criteria given in the algorithm for the selection of alternatives. The selection of a safe medicament is guided by the following criteria:

- The diagnosis that determines the prescription of the medicament (according to the international classification of diseases);
- Pharmacological group of medicaments;
- The presence of an allergic reaction to the components of the medicaments.

With the given criteria, a subset of alternatives is selected for selecting the most appropriate medicament. In the form of criteria by which the best alternative of medicaments is finally selected, it is proposed to use the probability of unwanted effects on the patient's organ or body system.

These criteria can have different values and their priority is determined by the doctor-expert after conducting appropriate diagnostics for a specific patient. For example, a patient who has impaired kidney and intestinal functions, the corresponding criteria of this system and organ will have the best priority compared to the rest, since even a small damage to the body system due to the use of medicaments is unattainable.

The decision support model was based on the analytic hierarchy method as a means of selecting alternatives with several criteria (with different values). The general scheme of the hierarchy of the decision support task of selecting the safest medicinal medicament is presented in Pic. at 1. The Picture shows that at the first level of the hierarchy is the goal of the decision support task – selection of the safest medicinal medicament, at the second level ($O_1 - O_n$) is the selection of criteria that describe the state of a specific patient's organs and body system.



Pic. 1 General diagram of the safe medicament decision support task hierarchy

Where B_1 – B_n – is the value of these criteria, which depends on the condition of this or that organ. D_1–D_n alternatives are located on the third level; A_{ji} - assessment of the probability of adverse effects of medicaments on body organs and systems (O_1 – O_n), which are determined by experts.

Algorithm for selection of highly safe medicinal medicaments in a general form, based on the analytical hierarchy method of multi-criteria decision-making, with the described model of decision-making support, can be represented by the following stages [4],[6],[7]:

- Assessment of the probability of adverse effects for each medicament A_{ji} - alternatives on each system and organ of the patient's body;
- Arrangement of (O_n) criteria and (B_n) value for each organ and body system of a specific patient;
- Construction of a pairwise comparison matrix for the O_n criterion: columns and rows of the O_n criterion matrix; The value of the ratios of Bn_i/Bn_j criteria – the value of matrix elements;
- For each criterion of the second level O_n, construction of a matrix of pairwise comparisons of alternatives, in which the value A_{ij} for each alternative is compared: columns and rows of the matrix of alternatives D_n; the value of the elements of the An_i/An_j ratio matrix;
- Calculation of the vector of priorities $Q = (W_1, .., Wn)$ for each matrix, where Wi is calculated by the formula: $W_i = q_i/r$ $(q_i = \sqrt[n]{a_{i1} \cdot a_{i2} \cdot \ldots \cdot a_{in}}$ ҫ $r = q_1 + \cdots + q_n$, where a_{in}- is the value of the i-th row of the n-th column of the matrix;

$$S_j = \sum_{i=1}^{n} W_i \cdot V_{ji},$$

where the alternatives are ranked in order of increasing S_j value.

The results of the presented research can be used in the development of an automated system supporting the decision making of medicament selection for the patient.

II. Conclusion

Thus, we evaluate the safety of selecting several medicaments at the same time, taking into account the individual characteristics of the patient, the doctor will be given the opportunity to evaluate and make an objective decision when selecting a safer medicament, which reduces the risk of adverse side reactions from taking the medicament and increases the justification for prescribing medicaments.

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