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ALGORITHM FOR MAKING DECISIONS BASED ON FUZZY NETWORK MODELS IN PROBLEMS OF MEDICAL DIAGNOSTICS AND FORECASTING

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The vague nature of the descriptions in the formulation of the tasks necessary for the adoption medical decision-making and in the preferences of experts when choosing a treatment method leads to the need to apply the methods of Fuzzy Set Theory and fuzzy mathematical programming. Studies show that a significant increase in the effectiveness of treatment procedures for various diseases can be expected through the use of various methods of therapy, which are controlled by modern information technologies, in particular, expert systems and decision support systems. This approach allows, in reality (in practice), to significantly increase the speed of decisions made in conditions of limited, subjective, blurred and inaccurate information. The information on the basis of which a decision-maker (DM), for example a doctor or medical personnel, has to make decisions is heterogeneous due to both the object itself and the external environment[*]. As a result, the most common methods used in medical diagnostics and in choosing solutions in the process of treating a patient are methods of Mathematical Logic, Probability Theory and Game Theory, methods of Fuzzy Set Theory, Fuzzy Logic and Artificial Neural Networks.

The purpose of this study is to formulate a physical setting of a multi-criteria fuzzy decision-making problem when choosing drug therapy for a patient, taking into account the various forms of severity of the disease, and to provide an algorithm for its solution. The statement of the decision-making problem is as follows: let there be mathematical models for predicting changes in the patient's condition as a result of the use of drug therapy, which, with the required accuracy, describe the effect of the prescribed set of dosages of drugs $x = (x_1,..., x_m)$ (vector of control parameters), on the vector of output parameters $y = (y_1,..., y_n)$, which characterizes the effectiveness of the prescribed treatment, taking into account the varying severity of the course of the disease $y_i = f_i(x_1,..., x_n; a_i)$, $i = 1,..., m$, where a_i are fuzzy parameters characterizing the severity of the disease. Taking into account the constraints imposed on the components of the vectors x and y, which determine their admissible measurement areas, we obtain that the partial objective functions of the ratio $y_i = f_i(x_1,..., x_n; a_i)$, $i = 1,..., m$, constitute a vector function f and differ in their coefficients of relative importance, the values of which can change. Having found a control vector that will provide the best approximation to the desired values of local criteria, we will get an equation that will take into account fuzzy local criteria, the values of which are calculated by neural models; ideal values of local criteria set by the decision maker; restrictions imposed on vectors of control parameters, etc. As an example, consider the Algorithm for deciding on the appointment of antibiotic therapy for suspected community-

[*] Батюк Л. В. Вибір по ROC-кривим вирішувальних правил для діагностичних тестів. *Вісн. Харк. нац. ун-ту. Сер. Біофізичний вісник.* 2015. № 33 (1). С. 68–72. ISSN 2075-3810.

acquired pneumonia in patients with COVID-19 in the provision of primary health care on an outpatient basis. The development of a transient state of bronchial obstruction occurs in the course of the disease, due to the physiological characteristics of the body against the background of viral infections. Recurrent obstructive syndrome is the main risk factor for a decrease in pulmonary function, which creates conditions for the implementation of a generalized reaction and increased sensitivity. A set of dosages of drugs prescribed by basic and inhalation therapy acts as a vector of control parameters. As a basic therapy, antibiotic therapy and anti-inflammatory drugs can be prescribed. Fuzzy parameters a_i can be specified in the form of a linguistic variable that will characterize the severity of the disease, for example, the variable a_i can consist of three that will characterize the mild, moderate and severe form of the disease. The effectiveness of treatment is assessed according to the following criteria: the severity of the main symptoms (f_1), the improvement of the patient's condition in the analysis of the follow-up (f_2), the effect of the therapy (f_3), which make up the vector function f and differ in the weights (j_1, j_2, j_3). The decision maker should assign reference values of local criteria and calculate minimax (guaranteed) options for solving the problem for various forms of severity of the disease. The decision maker must choose from the obtained set of solutions to the problem the most acceptable option, taking into account the existing severity of the course of the disease. If the option is not selected, then the decision maker must correct the reference values of the local criteria and re-calculate the minimax options for solving the problem. The iterative procedure of sequential minimization of the maximum deviation of the values of local criteria from the standards is repeated until the decision maker is satisfied with the current results. This algorithm will make it more likely to diagnose the addition of secondary bacterial pneumonia and to prescribe antibiotic therapy in a timely manner. In severe patients being treated in the intensive care unit, it is sometimes difficult to assess the effectiveness of antibiotic therapy only by the dynamics of clinical symptoms. In such situations, the assessment of the effectiveness of antibiotic therapy should be carried out according to surrogate indicators, such as respiratory coefficient (PaO_2/FiO_2), severity of multiple organ failure, using integral patient assessment scales (SOFA). The proposed algorithm for solving the problem can be used for the problem of decision making, in which the values of local criteria are characterized by blur.