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ALLOCATION METHOD OF RURAL INTELLIGENT MEDICAL AND HEALTH RESOURCES BASED ON MULTI-OBJECTIVE OPTIMIZATION ALGORITHM

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Abstract: This paper studies the current unreasonable allocation of rural medical and health resources. In order to better achieve the goal of building a well-off society in an all-round way, this paper analyzes the development of medical and health in rural areas, constructs the health resource allocation management platform combined with multi-objective optimization algorithm and big data intelligent technology, and optimizes the information management function of the platform, The multi-objective optimization algorithm is used to optimize the rural intelligent medical and health resource allocation algorithm. Finally, the simulation experiment shows that the rural intelligent medical and health resource allocation method based on the multi-objective optimization algorithm can better promote the healthy and long-term development of serfs' medical and health undertakings and promote the development process of an all-round well-off society.
Keywords: multi-objective optimization; Rural areas; medical and health work; Resource allocation;

0 Introduction

The continuous growth of medical services demand, rapid development of science and technology, the advent of the Internet plus era and the strong support of government policies have greatly improved the feasibility of rural self-help medical care. Rural self-help medical care as a supplementary part of the medical insurance system, promoting the implementation of rural self-help medical care is beneficial to alleviate the serious shortage of medical resources in rural areas[1]. The situation of blowout growth in medical demand. The feasibility study of rural self-help medical treatment is an important content in the field of medical insurance research in China. The study of the feasibility of rural self-help medical treatment is of great significance to the reform and improvement of China's medical insurance system. Rural areas are the weak areas in the implementation of China's medical insurance system, which seriously affects the medical level and the health status of residents[2]. Paying attention to the construction of rural supplementary medical insurance is not only an important content to improve China's medical insurance system, but also an important content to deepen the reform of medical and health system. As a supplement to basic medical insurance, supplementary medical insurance is also an important part of China's multi-level medical security system, including self-help medical insurance, community medical insurance, commercial medical insurance and enterprise supplementary medical insurance[3]. Due to the limited medical level and lack of medical resources in rural areas, community medical care has not yet met the medical needs of rural residents; Rural residents generally have low education level, low educational level, more migrant workers and unstable economic income. Therefore, they have low recognition of commercial insurance and less coverage of enterprise supplementary insurance. Using the Internet plus medical and big data + medical technology, self-help medical care has obvious advantages compared with traditional medical treatment mode, which is convenient and flexible, and is conducive to easing the current situation of "difficult to see a doctor and expensive medical treatment" in rural areas. Therefore, in contrast, self-help medical care is more suitable as a supplementary insurance than rural medical insurance[4]. So far, multi-objective optimization has not only achieved many important results in theory, but also has a wider range of applications. As a tool, multi-objective decision-making has increasingly shown its strong vitality in solving many problems in engineering technology, economy, management, military and system engineering. Through the construction of urban and rural health information platform, we can realize the sharing of medical resources between urban and rural areas, narrow the gap between urban and rural medical level, and build an urban-rural integrated medical security system.

1 Allocation method of rural intelligent medical and health resources

1.1 Rural intelligent medical and health resource information management platform

Rural medical and health care is a key area of health care in China. The implementation of self-help medical care is related to the development of rural health care in China. Promoting the implementation of rural self-help medical care is an important issue that can not be avoided in rural medical and health care in China. Health care reform is related to people's livelihood, which is actually the foundation of benefiting the country and the people. The solution supported by mobile technology can make up for this shortcoming and realize real-time and fast door-to-door medical services; Real time monitoring of primary medical information[5]. Full access to effective medical information; Flexible and convenient remote medical resource scheduling; Real time remote diagnosis and treatment technology exchange; Secure and convenient wireless remote payment function. Based on the construction of a real-time and efficient wireless data collection and medical interaction platform, the intelligent medical system supported by mobile technology is rich in rich and fast statistical report functions, easy to operate software interface, convenient extended standard interface, efficient remote terminal management, effective customer customization development and so on[6]. In the background, a large-scale relational database is used to realize the medical data interaction and data sharing of county, township and village medical institutions, and obtain information from others; At the same time, integrated with GPS and GIS, users can understand and manage various information of doctor visits and drug sales outlets in real time on the map interface. Furthermore, hospitals and health authorities can directly interact with the terminal, issue various information and obtain various feedback information[7]. Doctors can log in to the background database directly on the terminal, query the patient's past medical history, therapeutic drugs and other data, and print the treatment plan; Farmers can directly brush medical insurance or bank card at the terminal to facilitate payment and query. The specific functional structure is shown in the figure 1.

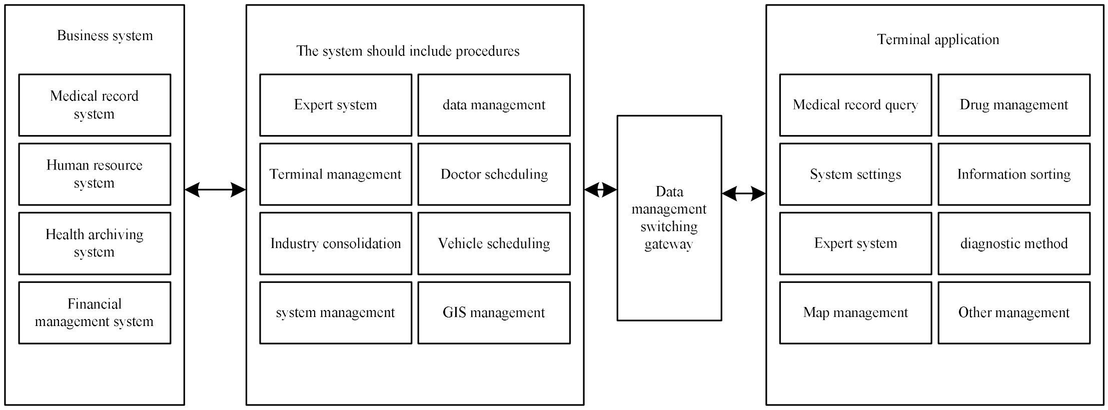

Fig.1 Function diagram of rural medical mobile informatization solution

The supply side reform of medical and health care is mainly aimed at the contradiction between medical and health supply and demand, starting from the supply side, focusing on improving the social productivity of medical and health care, meeting social needs, reforming the structural problems of medical and health supply, including system reform, structural adjustment and factor upgrading, so as to expand the supply coverage, improve supply efficiency and quality to better meet the health needs of the masses, and make contributions to realizing the healthy China strategy and building China into a prosperous, strong, democratic and civilized socialist modern power[8]. The medical and health supply side includes governments at all levels and relevant administrative departments, various medical and health institutions at all levels, medical and health personnel, medical insurance agencies, manufacturers and suppliers of medical devices and pharmaceutical consumables, and the medical demand side includes the majority of patients and all people with medical and health care needs. The supply side and demand side of medical and health care form the supply and demand structure of the whole medical and health care industry. In this supply-demand structure, if the supply exceeds the demand, there will be competition on the supply side, and the demand side can choose services relatively freely, which is beneficial to patients; If supply is less than demand, there will be competition on the demand side, which is conducive to relevant factors such as medical and health institutions[9]. Rural intelligent medical and health resource allocation management is a service management to provide users with basic use materials of various drugs and drug circulation materials. The administrator's login account and password will be given by default, and the administrator will manage large and small affairs and authority allocation. Internal and external users can directly log in to inquire about the basic information and use information of relevant drugs. The administrator will allocate the database with corresponding authority according to different identity users, manufacturers suppliers and primary medical institutions can directly enter the corresponding account and password according to their own identity to log in and perform some operations with corresponding permissions, or log in as tourists[10]. However, tourists can only browse relevant drug information and cannot perform any data modification operations. The databases of all users are uniformly managed by the administrator. Component intelligent medical and health resource allocation management model, and optimize its functional structure, as follows figure 2:

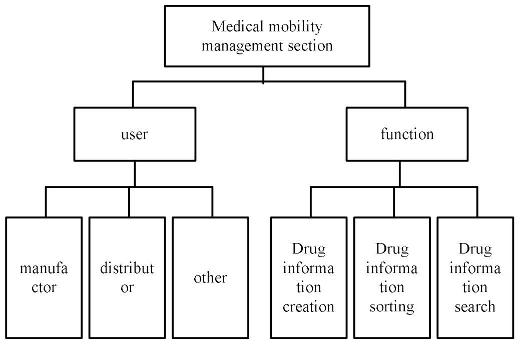

Fig. 2 Functional structure of intelligent medical and health resource allocation management model

Mobile informatization is an important part of rural medical modernization. It is an important means to improve hospital work efficiency, improve medical quality, service level and innovate medical service mode[11]. Truly realize the real-time, informatization and mobility of rural medical treatment, improve the business processing speed of grass-roots doctors and improve their business and technical level; Strengthen the management and control of grass-roots doctors through intelligent terminals, and eliminate the existence of falsely prescribing medical prescriptions and increasing the burden on patients; Through the real-time tracking and dispatching system of vehicles and grass-roots doctors, speed up the speed and accuracy of rescue, eliminate the problems such as slow rescue response, and speed up the operation efficiency of rescue[12]. Improve the diagnosis and treatment accuracy of grass-roots doctors through self-service medical inquiry system; Remote diagnosis and treatment of patients through on-line experts to improve the utilization efficiency of medical resources; Real time and accurate collection of patient information to provide accurate data information for diagnosis and treatment conclusions; Intuitive and accurate data analysis provides scientific reference for medical management. Real time and efficient payment to improve the utilization efficiency of medical insurance[13]. Through medical information sharing, we can achieve treatment and rest at home and reduce the pressure of large medical facilities.

1.2 Medical and health resource allocation algorithm based on multi-objective optimization

Medical and health service resource system is composed of resource input system and output system. Each subsystem needs to be reflected by a certain number of indicators. The established evaluation index system of medical resource allocation efficiency needs to contain sufficient information and fully reflect the characteristics of medical and health service resource allocation. Multiple objectives are as best as possible in a given region at the same time. The solution of multi-objective optimization is usually a set of equilibrium solutions, that is, a set of optimal solutions composed of many Pareto optimal solutions[14]. Each element in the set is called Pareto optimal solution or non inferior optimal solution. Therefore, on the one hand, it is necessary to deeply understand the research objectives and select the indicators comprehensively without repeating the selection of indicators; On the other hand, we need to select the main indicators that can reflect the essential characteristics of the evaluation object. The technical efficiency calculated by multi-objective optimization algorithm includes scale efficiency, which can be used to judge whether the decision-making unit is technically effective or whether it is scale effective[15]. At this time, the obtained technical efficiency is usually called comprehensive technical efficiency:

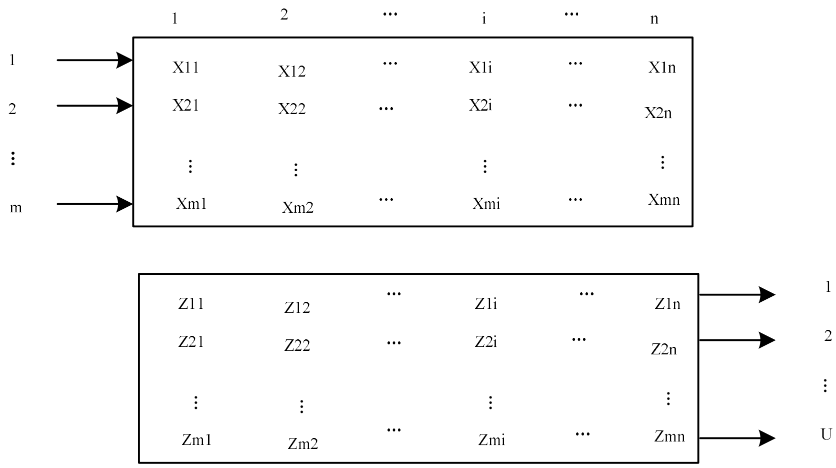

Fig. 3 Input and output of resource allocation decision unit

If x is the input quantity of type m input. v_j is the output of the j-th output. $y > 0$ is a measure of input; Ur is a measure of the r-th output, then:

$$\begin{cases} \mathbf{X}_j = \left(x_{1j}, x_{2j}, \cdots, x_{mj}\right)^T \\ \mathbf{Y}_j = \left(y_{1j}, y_{2j}, \cdots, y_{sj}\right)^T \end{cases} \quad (1)$$

Then the efficiency evaluation index of the decision-making unit is:

$$h_j = \frac{u^T \mathbf{Y}_j}{v^T \mathbf{X}_j} \quad (2)$$

The weight coefficients V and u can always be properly selected so that $h_j \leq 1, j = 1, 2, \ldots, n$,then:

$$\begin{cases} t = \dfrac{1}{v^T X_0} \\ \omega = tv \\ \mu = tu \end{cases} \quad (3)$$

In the above algorithm, t is the time-consuming situation of resource allocation, ω is the resource allocation path, μ is the number of configurable resources. Its linear programming model is:

$$\left(P_{C^2R}\right) \left\{ \begin{array}{c} \max \mu^T Y_0 = V_P \\ \text{s.t. } \omega^T X_j - \mu^T Y_j \geq 0, j = 1, 2, \ldots, n \\ \omega^T X_0 = 1 \\ \omega \geq 0, \mu \geq 0 \end{array} \right\} \quad (4)$$

It is further assumed that the input and output data corresponding to n decision-making units delete the evaluated multi-objective optimization path from the reference set. Therefore, the efficiency of the evaluated multi-objective optimization is proposed by referring to the frontier composed of other decision-making units[16]. In the super efficiency model, the efficiency value of effective decision-making unit is generally greater than 1, so this characteristic can be used to rank the efficiency value of decision-making unit. The planning model is:

$$\mathrm{s_n}=\begin{cases}\sum_{j=1,j\neq k}^{n}\lambda_j x_{ij}\leq\theta x_{ik}\\ \sum_{j=1,j\neq k}^{n}\lambda_j y_{rj}\geq y_{rk}\\ \sum_{j=1,j\neq k}^{n}\lambda_j=1\\ \lambda\geq 0\\ i=1,2,\cdots m;r=1,2,\cdots q;j=1,2,\cdots n(j\neq k)\end{cases} \quad (5)$$

Further, according to the model, the process of health resource allocation can be expressed as the relationship between two production stages, which belong to the upstream and downstream relationship. When all outputs in the first stage can be used as inputs in the next stage or all become intermediate variables, and some input of the second stage production process needs to be composed of all or part of the output of the first stage production process. At this time, it can be called vertical integration[17]. The multi-objective optimization model of chain structure provides an efficiency measurement and analysis method for this vertical integration production process. The calculation formula is as follows: the first stage: the input is $x_1,x\in E_1,x_1>0$, and the output is $x_2,x_2\in \mathrm{E},x_2>0$. $f(x_2)$ is the production function of the first stage. In the second stage, the inputs are all the outputs of the first stage $x_2,x_2\in E1,x_2>0$, and the outputs are $x_3,x_3\in E_1,x_3>0$ is the production function of stage. Both $f_1(x_2)$ and $f_2(x_2)$ are first-order homogeneous functions, that is, for any $a\geq 0$, there are:

$$f_i\left(a^{x^i}\right)=\alpha f_i\left(x^i\right)-\mathrm{s_n} \quad (6)$$

Based on the above algorithm, according to the research of relevant experts and scholars, combined with the design principles and design ideas of the index system in this study, firstly, find the relevant indicators that can reflect the input and output of provincial medical and health services as comprehensively as possible, and preliminarily construct the evaluation index system of medical and health service resource allocation efficiency considering the influence of population factors in different regions, It includes two primary indicators of medical and health service input and medical and health service output[18]. The input indicators include three secondary indicators of expenditure, institution construction and employees. The output indicators include three secondary indicators of outpatient service, inpatient service and health service, a total of 6 secondary indicators and a total of 30 tertiary indicators, as shown in the table 1.

Table 1 Preliminary construction of evaluation index system for resource allocation efficiency of medical and health services

Primary index	Secondary index	Tertiary indicators
Health service investment	Expenditure	Total health expenditure per capita
		Proportion of total health expenses
		Per capita health organization assets
		Total medical and health assets per capita
	Organization establishment	Number of medical and health institutions per 1000 people
		Number of beds in medical organizations per 1000 people
		Number of professional health organizations per 1000 people
	Employed persons	Number of health personnel per thousand people
		Number of CDC personnel per thousand people
		Number of medical personnel per thousand

According to the principle of establishing the evaluation index system of health resource allocation efficiency mentioned above, based on the index system of multi-objective optimization model, select more comprehensive and representative indicators into BPANN model to reflect the real efficiency of resource allocation. Combined with the relevant literature at home and abroad, a total of 16 indicators were selected as the input layer of artificial neural network to finally evaluate the efficiency of health resource allocation in China[19]. Based on the selection of indicators of the multi-objective optimization model, in addition to the indicators of health funds, health facilities, health manpower and medical services, in order to more comprehensively and accurately calculate the efficiency of health resource allocation, relevant data on economic and population status, people's health level and nutrition status are also added.

1.3 Realization of rural intelligent medical and health resource allocation

In the allocation of rural smart medical and health resources, the selected indicators are the percentage of total health expenditure in GDP, the proportion of government health expenditure in total health expenditure, the proportion of social health expenditure in total health expenditure, the proportion of personal health expenditure in total health expenditure, and the total health expenditure per capita, which are compared with the total health expenditure selected by the multi-objective optimization model, It can reflect the investment of health funds in various regions and the attention of the government and society to residents' health and health. In the health facilities, the number of beds in medical and health institutions per 1000 population is selected considering the permanent population in various places. In terms of health manpower, the number of practicing (Assistant) doctors and registered nurses per 1000 population included in the permanent population shall also be considered. Select the average length of stay and bed utilization rate that can reflect the work efficiency and medical service quality of medical and health institutions[20]. The allocation standard of health resources is affected by factors such as economy, population and residents' health level. Therefore, the model also includes relevant evaluation indicators such as per capita disposable income, proportion of urban population and maternal mortality. Specific indicators and related meanings are shown in the table 2.

Table 2 Evaluation index system of health resource allocation efficiency based on BPANN model

Indicator type	Primary index	Secondary index	Index significance	Number
Input variable	Economy and population	Total population	Annual population statistics	M1
		Proportion of township population	Proportion of township population in total population	M2
	Sanitary equipment	Number of beds in Medical and Health Organization	Number of beds / population ×1000	M3
	Health expenditure	Social expenditure as a percentage of total expenditure	Ratio of expenditure to GDP in the same period	M4
		Total per capita health expenditure	Ratio of total health expenditure to average population in the same period	M5
	Medical service	Use of hospital bed	Total number of beds actually occupied / total number of beds actually occupied × 100%	M6
Output variable	-	Network DEA efficiency value	-	N1

The total health expenditure is selected as the overall investment in the allocation of health resources, which reflects the total amount of funds consumed by each region for medical and health services in a certain period of time. The number of medical institutions, the number of beds in medical institutions, the number of practicing (Assistant) doctors and the number of registered nurses are the most direct output after the total health expenditure is invested, and also reflects the investment level of human and material resources in the health system, The number of doctors and nurses, the number of discharged patients and the number of health checkups are selected as the final output of medical services. The index system is shown in the table 3.

Table 3 Evaluation index system of health resource allocation efficiency based on Network DEA

Node	Variable	Index significance	Category

Node 1	Total health expenditure	The total amount of money paid by society for health service activities.	Investment
	Health Organization	Including hospitals, clinics, etc	Intermediate variable
Node 1 - node 2	Number of beds	Number of fixed beds	Intermediate variable
	Medical practitioner	Obtain personnel engaged in medical undertakings, excluding management doctors	Intermediate variable
Node 2	Discharge quantity	Number of discharges after hospitalization	Produce
	Number of health checks	Number of all health checks	Produce

Aiming at the common problems of low efficiency and error in the current grid resource allocation management process, a grid resource allocation management method based on optimized multi-objective decision-making is proposed. Firstly, the multi-objective decision-making algorithm is poured into the grid computing process, which is optimized combined with the resource allocation strategy of fuzzy multi-objective decision-making. Through the component of multi-objective decision-making model, the characteristics of task objective parameters are extracted, so as to effectively screen and allocate resources and improve the success rate and accuracy of resource allocation.

1.4 Introduction of multi task target feature path decision algorithm

In the multi task objective decision algorithm, if the characteristic function of the task objective is, the decision feature of the allocation path of grid resources is v, the value range of the characteristic function of the target resource is between (x,y) and the characteristic data range of the resource is within (i,j), then the task resources in the above range can be used as the object of grid resource allocation, By collecting and filtering the characteristic attributes $h(h_i,h_j)$ of resources within the scope, the resource information that meets the allocation characteristic standard is managed, it is represented by t_n. On the contrary, resources that do not meet the resource allocation standards are represented by t_m. In the process of resource provisioning, set the parameter t_i^m that affects the allocation accuracy. Based on the above data, you can first obtain the accurate grid area of resource provisioning distance. The calculation formula is as follows.

$$S_{i+j}^{j} = t_i^m (v_y + v_x) + \frac{1}{2}\left[\frac{(t_n+1)^2}{h_i} - \frac{t_i^m (t_m-1)^2}{h_j}\right] \quad (7)$$

Let G and E be the tasks to be assigned in the grid feature hierarchy space, which are the constraints of the allocation decision, the resource allocation path decision P is the common feature parameter in the grid feature hierarchy space, and U is defined as the intersection. Then, combined with the above algorithm, the effectiveness range of multi task target resources can be obtained. The algorithm is as follows:

$$f(x,y)=\frac{S_{i+j}^{j}}{GE}\sum_{i=1}^{j}zip\sqrt{\frac{a(v_y+v_x)^{\mathrm{m}-n}}{2PU}} \quad (8)$$

In the actual process of grid resource allocation and management, the actual process of data resource allocation and management is affected by many factors. Therefore, generally, the effect of grid resource allocation and management is difficult to maintain stability. Therefore, it is necessary to simplify the steps of grid resource allocation when making decisions on multi task objectives. However, due to the decline of accuracy and other problems in the simplification process, in order to make up for the impact on the accuracy of decision-making after the simplification of task target allocation management process, the error judgment matrix is listed as follows:

$$\lambda=\begin{bmatrix} h_1^{\,j} \\ h_2^j \\ h_3^j \\ . \\ . \\ . \\ h_i^j \end{bmatrix}=\begin{bmatrix} t_1^m v_j S_{1+i}^j & \dots & t_1^m v_j S_{1+(i-1)+m}^j \\ t_2^m v_1 S_{2+i}^j & \dots & t_2^m v_j S_{2+(i-1)+m}^j \\ t_3^m v_1 S_{3+i}^j & \dots & t_3{}^m v_j S_{3+(i-1)+m}^j \\ \dots & \dots & \dots \\ \dots & \dots & \dots \\ \dots & \dots & \dots \\ t_i^m v_1 S_{i+j}^j & \dots & t_i^m v_j S_{m+(i-1)+m}^j \end{bmatrix} (9)$$

Combined with the above matrix, the decision-making error after the simplification of the task target rejection allocation management process can be effectively avoided, the potential ways of resource allocation can be judged in time, the possibility of potential resource allocation error can be analyzed, and the decision-making recommended parameters of resource allocation management can be calculated. The calculation method is as follows:

$$d=2.2f(x,y)+\log_2\lambda[h_ih_j-\frac{1}{2}S(n)] \quad (10)$$

If r is a multidimensional variable of resource parameters in multi-objective decision resources with limited number of decision schemes, α is the total number of schemes, then combined with the above algorithms, the target space algorithm can be obtained as follows:

$$K=f(x,y)\exp[r+\alpha]^n-\lambda \,(11)$$

When the value range of the characteristic function a of the grid structure is controlled at (0,1), the range of d is:

$$\mathrm{d}=\begin{cases}1,\sqrt{\mathrm{x}^2+y^2}\le A/2 \\ 0,\sqrt{x^2-y^2}>A/2\end{cases} \qquad (12)$$

Combined with the above algorithm, if the range of multi task objective decision-making is between 0.5 and 1.5, the objective decision-making algorithm can be expressed as:

$$z=\sqrt{\frac{K}{d^2-\lambda}}-\exp(\alpha-\frac{x^2+y^2}{K-1}) \quad (13)$$

Combined with the above algorithms, the grid resource allocation management algorithm can be effectively optimized. Generally, in the process of grid resource allocation management for decision-making on multi task objectives, its own local management organization will be used for allocation processing. In this case, grid resources have a certain self-healing ability, but there is still some insecurity in the case of relatively many tasks. Therefore, it is necessary to optimize the local grid structure. In order to analyze the spatial agglomeration of China's health care information industry, when using the spatial autocorrelation analysis method for statistical analysis, it is necessary to express the spatial location information of different rural areas in the form of numerical values. In the field of geography research, constructing spatial weight matrix is the most direct and effective way to establish the relationship between spatial targets. Therefore, in the spatial autocorrelation analysis, the binary weight matrix (*W*) can be used to represent the relationship between different spatial targets, and its expression is.

$$\begin{vmatrix} W_{11} & W_{12} & \cdots & W_{1n} \\ W_{21} & W_{22} & \cdots & W_{2n} \\ \dots & \cdots & \cdots & \dots \\ W_{n1} & W_{n2} & \cdots & W_{nn} \end{vmatrix} \quad (14)$$

Among them, the diagonal elements in the binary weight matrix represent the correlation between the spatial targets themselves. Therefore, the element values of the diagonal are 0: W, indicating the correlation between the spatial target I and the spatial target J. In spatial correlation analysis, the spatial weight matrix is generally divided into adjacency matrix and adjacency matrix. The adjacency matrix indicates that when the distance value of spatial target I and spatial target J in geospatial is within a given threshold range, it is considered that the two spatial targets are adjacent to each other, and the element {WNN} value in the corresponding spatial weight matrix is 1, otherwise it is 0. When conducting empirical analysis on the basis of proximity matrix, it is necessary to carry out special processing on all kinds of point, line, surface spatial data or other types of spatial data, so as to convert non-point data into point data, so as to prepare for the construction of proximity matrix. During data conversion, the centroid of line and surface data or administrative division center is generally selected as the final data result for analysis. The specific calculation formula is:

$$W_{ij}(d)=\begin{cases}1 & \sqrt{\left(x_i-x_j\right)^2+\left(y_i-y_j\right)^2}<d \\ 0 & \text{other}\end{cases} \quad (15)$$

Where, (x_i,y_i), (x_j,y_j) are the spatial positions of spatial target *i* and spatial target *j*, and table *d* is the distance threshold of the two spatial targets. When constructing the proximity matrix, the distance threshold d must meet the requirement that it is not less than the minimum distance between spatial targets. In the framework of exploratory spatial data analysis (ESDA), global spatial autocorrelation analysis indicators mainly include Moran's I index, gear index and gear ratio. Since Moran's I index is less likely to be affected by deviation from normal distribution, Moran'sl index is mostly used for global autocorrelation analysis in most applications. The calculation formula of Moran's I index is:

$$I=\frac{\sum_{i=1}^{n}\sum_{j=1}^{n}W_{ij}\left(x_i-\overline{x}\right)\left(x_j-\overline{x}\right)}{S^2\sum_{i=1}^{n}\sum_{j=1}^{n}W_{ij}(d)} \quad (16)$$

Where: s is the global spatial autocorrelation coefficient and W_{ij} is the spatial weight matrix.

$$S^2=\sum_{i=1}^{n}\left(x_i-\overline{x}\right)^2/n \quad (17)$$

$$\overline{x}=\frac{1}{n}\sum_{i=1}^{n}\left(x_i\right) \quad (18)$$

With the acceleration of the integration of health care services and information technology, it is urgent to further measure the coordination between the development of health care information resource allocation and economic development based on the measurement of the development level of health care information resource allocation, so as to promote the development of health care information resource allocation and give birth to new momentum of economic development, Promote the coordination between the construction of health and medical informatization and the economic development in the same period: on the other hand, establish the direction of economic development for the foundation and key support of health and medical informatization, promote the agglomeration of health and medical information resources at a high level, promote higher quality, and promote the innovation of health industry, It is necessary to conduct quantitative and qualitative investigation and analysis on the balanced development and coordination degree of the two through certain tools and methods. Unilateral, rapid or lagging development will undoubtedly have a certain negative effect on China's health and medical services, which is not conducive to the sustainable development of China's society and economy. On the contrary, the coordinated development of China's health care informatization and social economy will promote China's society and economy to a more advanced and scientific direction to a great extent. The higher the degree of coordination between the two, the better the balanced development of China's society and economy, and vice versa. Using the mature coordination analysis model for reference, this paper will build a coordination analysis model suitable for the allocation and development of health care information resources and social and economic development in China.

$$C=(4f(x)\times g(y))^2/(f(x)+g(y))^4 \quad (19)$$

Among them, $f(x)$ and $g(y)$ are the comprehensive evaluation values of economic output value and the development level of health and medical information resource allocation respectively; C represents the coordination degree between health care information resource allocation and social economy. The value range of C is 0 to 1. When C reaches the maximum value of 1, that is, $f(x) = g(y)$, it means that the coordination degree between socio-economic and health care information resource allocation reaches the highest. On the contrary, when C is close to 0, it means that the coordination degree between socio-economic and health care information resource allocation is poor, and the more uncoordinated they are. In order to increase the scientificity of the research process of coordination degree, this section will follow the principle of operability, select the per capita GDP index data to represent China's socio-economic development level, and select the calculation results in the previous section as the index data of China's health and medical information resource allocation level. Due to the dimensional difference between socio-economic index data and health care information resource allocation index data, the above data need to be dimensionless before coordination analysis. The variation coefficient method is used to dimensionless process the socio-economic index data and health medical information resource allocation index data to obtain the final comprehensive evaluation value of socio-economic and health medical information resource allocation:

$$\begin{cases} f(x) = \sum_{i=1}^{m} a_i x_i \\ g(x) = \sum_{j=1}^{n} b_j y_j \end{cases} \tag{20}$$

Where, x and y are the indicators for evaluating the allocation of socio-economic and health medical information resources respectively, and a and b represent the weights of various indicators reflecting the socio-economic development and the allocation of health medical information resources respectively, which are calculated by the coefficient of variation method. The scale of public hospitals in China has expanded too rapidly, and the scale of some hospital units is too large. There are problems of extensive development such as pursuing bed scale, purchasing large equipment, ignoring hospital internal management and mechanism construction, which has increased the unreasonable growth of medical expenses and squeezed the development space of grass-roots medical and health institutions and non-public hospitals, It is also not conducive to improving the service quality and management level of hospitals. The establishment of medical institutions should adhere to the principles of overall planning, scientific layout and coordinated development. According to the needs of medical services, adhere to the principle of public hospitals as the main body, clarify the scope and number of government run hospitals, strictly control the number and scale of public hospitals, promote the balanced layout of tertiary general hospitals and specialized hospitals, and promote rehabilitation Nursing and other service industries are growing rapidly, promote the integration of hospitals and grass-roots medical institutions, strengthen the cooperation between public medical institutions and social run medical institutions, integrate the chain of prevention, medical treatment and rehabilitation nursing services: take health needs as the guide, effectively give play to the role of government regulation and market regulation, and clarify the functional positioning of various medical institutions at all levels, scientifically and reasonably determine the number, scale and layout of various medical institutions at all levels, so as to maximize the allocation efficiency of medical resources and improve the overall efficiency of medical and health resources.

2 Analysis of experimental results

The global autocorrelation coefficient of the allocation and development of rural health and medical information resources in China in recent years is calculated and statistically tested. Among them, the moran'si index ranges from - 1 to 1. When the moran'si index is close to 0, it shows that there is no obvious spatial correlation in the application and development of health and medical information in China; When moran'si index is close to 1, it shows that there is an obvious positive correlation in the allocation of health and medical information resources in rural China; On the contrary, when moran'si index is negative and gradually approaches - 1, it shows that there is an obvious spatial negative correlation in the allocation of health and medical information resources in various rural areas in China. In the significance test of moran'si index, it is usually assumed that there is a normal distribution between statistical variables, so the spatial correlation of health and medical information resource allocation in rural China can be tested by Z statistics of standard normal distribution. Through the autocorrelation analysis of China's health and medical information resource allocation during the investigation period and its effectiveness test, the calculation results are shown in the table 4.

Table 4 Moran's I coefficient and significance test statistics of medical information resource allocation

Particular year	Moran’s I	E(I)	Var(I)	Z(I)	P(I)
2016	0.265482	-0.0333	0.012213	2.634282	0.002542
2017	0.264883	-0.0333	0.012153	2.852462	0.003215
2018	0.289944	-0.0333	0.012322	2.913463	0.008423
2019	0.306741	-0.0333	0.012415	2.941485	0.003458
2020	0.320685	-0.0333	0.012686	3.063415	0.002168

In the empirical analysis of the evaluation of health resource allocation efficiency constructed above, according to the research purpose and model needs, this paper takes rural areas as the research unit. Firstly, the neural network training sample data set is established through various evaluation indexes in each region. Because different evaluation indexes have different dimensions and dimensional units, strange sample data is easy to appear. It will affect the analysis results in the actual analysis, so it is necessary to normalize the data to eliminate the dimensional influence between indicators and make the data comparable. The common normalization methods include function transformation, Z-score standardization and maximum minimum standardization. In this paper, the maximum minimum standardization is selected for linear transformation of the original data. The formula is as follows:

$$x' = \frac{\chi - \min A}{\max A - \min A} \quad (21)$$

Where $\min A$ and $\max A$ are the minimum and maximum values of attribute a respectively, χ is an original value of a, through the maximum and minimum standardization processing, χ is the data after normalization processing, and the value interval is [0,1]. Based on the above global spatial autocorrelation analysis results, in order to further analyze the internal development of the allocation of health and medical information resources in various rural areas in China, as well as the balanced development of the allocation of health and medical information resources in different regions, and provide a scientific basis for formulating the development policy of regional health and medical information resources allocation, This section will explore and mine the possible local significant associations in the allocation of health care information resources in China based on the analysis method of global autocorrelation and local pattern. According to the above description, the spatial autocorrelation analysis tool of local mode mainly Moran scatter diagram. Select the medical and health resource allocation in a rural area for a two-year study, compare the average level of medical and health resource allocation in other rural areas in China, and analyze the practical application of rural intelligent medical and health resource allocation method based on Moran scatter diagram and multi-objective optimization algorithm, as shown in Figure 4.

Fig. 4 Local Moran scatter diagram of spatial agglomeration application of health care information resources in China

It can be seen from the figure that the rural areas with high development level of health and medical information resource allocation in China tend to be concentrated and distributed, and this trend of agglomeration and distribution is gradually strengthening. Further, take the research results as training samples and bring them into the multi-objective optimal allocation established by neurosolutions for repeated training to obtain the training results of health resource allocation efficiency for analysis, The specific experimental results are shown in Figure 5:

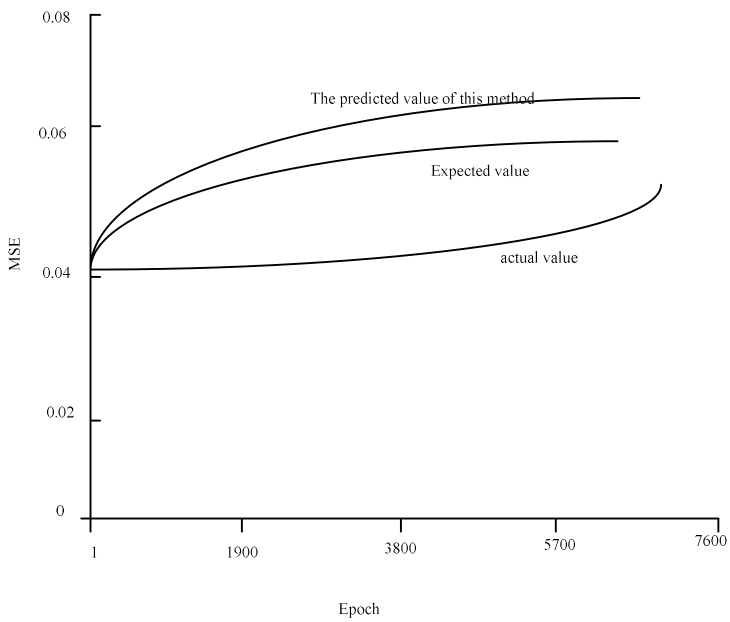

Fig. 5 Training results of health resource allocation efficiency

Based on the analysis of the detection results in Figure 4 and figure 5, it can be seen that the performance of the proposed rural intelligent medical and health resource allocation method based on multi-objective optimization algorithm is completely higher than the expected level in the process of practical application, which can better realize the effective allocation of rural medical and health resources.

3 Conclusion

The orientation of rural grass-roots medical and health service center is to provide high-quality and low-cost medical and health services. Therefore, in the implementation process of multi-objective optimization technology, it is bound to increase the cost of patients more or less. How to achieve "high quality and low price" under the condition of introducing new technology is an important issue we need to consider. As a high-end latest science and technology, multi-objective optimization technology is not widely used at home and abroad. In its development process, there is no unified standard, and the cost is too high. Despite a series of problems, the development of multi-objective optimization technology itself is a challenge. The application prospect of multi-objective optimization technology in medical treatment has great potential. Whether for the development of the Internet of things or the development of medical and health undertakings, it will inevitably bring about the revolution of multi-objective optimization technology reform.

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Reference

[1] Xia X X , Wang Z Q , Zhou N J . 2020, Working fluid selection of dual-loop organic Rankine cycle using multi-objective optimization and improved grey relational analysis. Applied Thermal Engineering, 171(4):115028.

[2] Chen Z , Guo R , Lin Z . 2020, A Data-Driven Health Monitoring Method Using Multiobjective Optimization and Stacked Autoencoder Based Health Indicator. IEEE Transactions on Industrial Informatics, PP(99):1-1.

[3] Sriniva Sa N B , Venkate Sa N R . 2021, Multi-objective optimization for energy and heat-aware VLSI floorplanning using enhanced firefly optimization. Soft Computing, 25(5):4159-4174.

[4] Cao Y , Fan X , Guo Y . 2020, Multi-objective optimization of injection-molded plastic parts using entropy weight, random forest, and genetic algorithm methods. Journal of Polymer Engineering, 40(4):360-371.

[5] Lv Z , Wang L , Han Z . 2019, Surrogate-Assisted Particle Swarm Optimization Algorithm With Pareto Active Learning for Expensive Multi-Objective Optimization. IEEE/CAA Journal of Automatica Sinica, 6(03):838-849.

[6] Fl A , Zc A , Gm B . 2020, Approaching the cell switch-off problem in 5G ultra-dense networks with dynamic multi-objective optimization. Future Generation Computer Systems, 110(5):876-891.

[7] Zhang Q , Lian B , Cao P . 2020, Multi-Source Medical Data Integration and Mining for Healthcare Services. IEEE Access, 8(10):165010-165017.

[8] Wang F Y . 2020, Parallel Healthcare: Robotic Medical and Health Process Automation for Secured and Smart Social Healthcares. IEEE Transactions on Computational Social Systems, 7(3):581-586.

[9] Liang J , Zheng X , Chen Z . 2019, The Experience and Challenges of Healthcare-reform-driven Medical Consortia and Regional Health Information Technologies in China: A Longitudinal Study. International Journal of Medical Informatics, 131(9):103954.

[10] Abolhassani N , Santos-Eggimann B , Chiolero A . 2019, Readiness to accept health information and communication technologies: A population-based survey of community-dwelling older adults. International journal of medical informatics, 130(Oct.):103950.1-103950.7.
[11] Mardani A , Hooker R E , Ozkul S . 2019, Application of Decision Making and Fuzzy Sets Theory to Evaluate the Healthcare and Medical Problems: A Review of Three Decades of Research with Recent Developments. Expert Systems with Applications, 137(4):202-231.
[12] Shim K A . 2020, Cryptanalysis of Two Signature Schemes for IoT-Based Mobile Payments and Healthcare Wireless Medical Sensor Networks. IEEE Access, 8(4):167203-167208.
[13] Abedin B , Milne D , Erfani E . 2020, Attraction, Selection, and Attrition in Online Health Communities: Initial Conversations and their Association with Subsequent Activity Levels. International Journal of Medical Informatics, 141(8):104216.
[14] Zero M , Easter B , Anderson A . 2020, Multidisciplinary Expertise for Exploration Medical System Design. IEEE Potentials, 39(4):39-45.
[15] Wei K , Zhang L , Guo Y . 2020, Health Monitoring Based on Internet of Medical Things: Architecture, Enabling Technologies, and Applications. IEEE Access, 8(4):27468-27478.
[16] Zghaibeh M , Farooq U , Hasan N U . 2020, SHealth: A Blockchain-Based Health System With Smart Contracts Capabilities. IEEE Access, 8(8):70030-70043.
[17] Nazir S , Khan S , Khan H U . 2020, A Comprehensive Analysis of Healthcare Big Data Management, Analytics and Scientific Programming. IEEE Access, 8(10):95714-95733.
[18] Ahmad R W , Salah K , Jayaraman R . 2021, The Role of Blockchain Technology in Telehealth and Telemedicine. International Journal of Medical Informatics, 148(18):104399.
[19] Velthoven M V , Cordon C , Challagalla G . 2019, Digitization of healthcare organizations: The digital health landscape and information theory. International Journal of Medical Informatics, 124(APR.):49-57.
[20] Abu-Elezz I , Hassan A , Nazeemudeen A. 2020, The benefits and threats of blockchain technology in healthcare: A scoping review. International Journal of Medical Informatics, 142(5):104246.