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A study on the AI-based online triage model for hospitals in sustainable smart city

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ABSTRACT

An in-depth analysis of the artificial intelligence online triage of hospitals in sustainable smart city is conducted, and a model of factors influencing patients' choice of medical institutions is constructed based on the theory of planned behavior and Anderson's health service utilization model. Based on the questionnaire and the model, a structural equation model is constructed to explore and analyze patients' intention to seek medical treatment at the primary level and that at large hospitals respectively, revealing the mechanism of different influencing factors on patients' intention to seek medical treatment at the primary level and that at large hospitals, and providing a reference for guiding patients to seek medical treatment at the primary level and choosing medical institutions nationally. (1) This paper reveals the influencing mechanism of patients' medical treatment behavior, proposes a patient-centered medical institution selection method, and explores the strategic choices affecting patients' primary care, which provides an important reference for establishing a scientific and reasonable hierarchical diagnosis and treatment model. (2) Meanwhile, how to provide precise medical services to patients by acquiring and fusing multi-source and multi-modal mass data will become one of the principles guarantees of a harmonious society in the future. (3) Compared with other studies, the accuracy and efficiency of the research results of the online hierarchical diagnosis and treatment model in this paper are greatly improved. The current results are also fully applicable to practical applications. In the future, we will conduct in-depth research on the general testability of the model. analysis.

1. Introduction

A sustainable smart city is a result of the new generation of the information technology revolution; its basic theoretical research is not yet perfect, and various problems surface as the research and exploration continue to deepen [1,2]. Based on the actual situation, the basic concepts, main connotations, specific features, and problems in construction and exploration of related countermeasures are discussed in detail, and the exploration based on practice contributes to an in-depth academic discussion of the problems in the construction of smart cities [3–5]. Wisdom construction of many cities is in the fumbling stage, and the planning and design by the government mostly have the problems of not being systematic, holistic, and comprehensive enough [6]. On the one hand, due to the maturity of the theory of wisdom city construction is short; on the other hand, the lack of experience in the practice of wisdom city construction and the short construction period have failed to form a universally applicable experience [7]. The result that emerges is that the realistic needs of sustainable smart city construction cannot be met, and a detailed discussion from a realistic perspective, with thinking triggered by the problems, can enrich the basic theory in construction planning and other aspects [8]. However, along with urbanization, aging, and other socio-economic transformation processes, the basic health needs of residents are growing rapidly and diversifying [9]. Various factors such as insufficient quality medical resources and uneven distribution of medical and health resources have brought certain challenges to the improvement of the basic medical and health service system [10]. First, with the rapid development of the economy and society, the material wealth of the residents is increasing, and the residents are paying increased attention to their health, and the demand for health has increased rapidly in recent years [11].

To further solve the problem of "difficult and expensive medical care", many scholars have conducted in-depth analysis from different perspectives, focusing on how to improve the traditional medical service model, optimize the original unreasonable medical resource supply structure, and make up for the current shortage of quality medical resources, to enhance the overall effectiveness of the medical service system. The study focuses on these aspects to better implement the hierarchical medical

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system and more comprehensively meet the health needs of the residents [12]. From the perspective of supply and demand, the current research focuses on the supply side, analyzing the role assumed by the government, hospitals, and other medical service providers, and looking for corresponding solutions [13]. However, the problems of "difficult and expensive medical care" are not only related to hospitals and other supply factors but also closely related to patients and other demand factors. New technologies represented by a new generation of information technology have gradually broken through the limitations of time, space, concepts, and systems to expand into the field of medical and health care, and the service model of intelligent medical care has emerged to guide the development of medical and health care in a new direction.

The theoretical significance of this paper is reflected in the following three aspects: firstly, it establishes a model of factors influencing patients' choice of medical care based on the theory of planned behavior, extends the field of application of the theory of planned behavior, identifies the factors influencing patients' choice of medical institutions, explores the mechanism of different factors influencing patients' choice of medical institutions, and provides a research paradigm from the perspective of patients' medical care behavior. Secondly, individual patients' choice of medical institutions is influenced by the superposition of numerous factors, and the asymmetry of information causes patients to face various kinds of uncertain information. The research on the method of choosing medical institutions considering multiple sources of uncertain information and patients' preferences enriches the theory and method system of decision making under uncertain environment and has certain theoretical value in the decision-making process and method for multiple sources of information aggregation.

2. Related work

Globally, there is a greater emphasis on social engagement, early prediction, personalization, and early treatment, leading to a greater focus on the grassroots community and the individual family, which is driving the outreach and interaction of health services [14]. According to Wiig, attracting and retaining talent is a challenge, as diverse cities are competing to capture the best professionals for development [15]. Hashem et al. believe that managing big data of smart cities is the importance direction of future business models [16]. The evaluation of smart cities is based on the TOP100 index of global innovative cities, but his evaluation data is not primary data, so there is some uncertainty in the accuracy of the data [17]. Also, in the process of data analysis, additional research data may have the problem of incomplete objectivity, which may make the results differ from the actual situation [18]. Because of high streaming demand in medical systems, security methods are to help solving this via light-weight Cryptography as well as fast public key cryptography. Some results have been developed and some mathematical models have been applied in this field [19,20]. In order to avoid hackers' attack, Hureib and Gutub [21] investigated ways in which information can be encrypted and hidden to improve the security of healthcare data. Alassaf et al. [22] proposed a lightweight encryption algorithm based on Simon for the setup of IoT drivers. It seems that foreign sustainable smart city evaluation systems mainly focus on the construction of hardware facilities and the personal experience of the public, and the construction and later effects are evaluated comprehensively, with a strong result orientation, but there are more or fewer difficulties in data collection, and the research data have problems such as not being direct information, not ensuring true objectivity, and not being timely, which eventually affect the evaluation of the results [23–25].

Third, based on the assumption of limited rationality in patients' choice of medical institutions, an evolutionary game model of patients' choice of medical institutions is constructed based on evolutionary game theory, and the dynamic evolutionary process of patient groups and hospitals under different behavioral strategies is analyzed, which provides a theoretical reference for the study of patients' choice of medical institutions. The study of residents' medical care behavior and institutional choice under the information asymmetry environment can help patients choose medical institutions and enjoy medical services scientifically and reasonably, reduce the cost of medical care for patients, reduce the burden of medical services for patients, improve the overall efficiency of medical and health services in society, and help establish a fair and efficient medical and health service system. The choice of medical institutions is a choice made by residents under the influence of socio-cultural, political, and economic environments, weighing their conditions and external factors and continuously interacting with related groups. Studying the interaction process of patients' group decision making can help us discover the dynamic evolution trend of people facing internal and external constraints in the process of healthcare reform, and discover logical patterns and room for improvement, which can provide effective policy suggestions for the government to continue and improve the policy of graded diagnosis and treatment and promote stable social development.

3. Analysis of the AI-based online triage model for hospitals in sustainable smart city

3.1. Design analysis of hospitals in sustainable smart city

The new generation of smart cities is more intelligent as the name implies so that advanced information technology is fully used in the city's government system, traffic, and travel, medical resources, education information, tourism conditions, etc. It can be said that information technology has entered every corner of life, every move of the city, every building, every detail is under the monitoring and watch of data, big data collects all the information of the city. With the Internet information technology as the carrier, every seemingly ordinary data contains deep value behind it, and the city becomes observable, perceptible, visible, measurable, and quantifiable. People's different needs can also be met through intelligent applications, and these responses are usually very humane and more satisfying to the subject of the demand, through data storage, processing, and the synthesis of different analysis results to arrive at the best solution to achieve information cloud processing, for example, to take public transportation, citizens no longer need paper money, but through Alipay, a card and other mobile applications to achieve service demand, more convenient and efficient than the traditional way. The main body of sustainable smart city construction is people, the ultimate service object is also people, "people" as the center is the core feature of sustainable smart city construction. From the point of view of system design, the pluralism of participating subjects and the different people who express their interests and demands make the sustainable smart city fundamentally guarantee the people-oriented. If democratic participation provides a guarantee for intelligent human-centeredness, information technology provides a technical guarantee for people to play the main role in the city, and the technical design with people as the starting point has a positive effect on enhancing people's happiness and sense of access to life. Different sustainable smart city construction projects are all based on the realization of human survival and development as the starting point, and the development of technology, infrastructure construction, and livelihood applications is all designed to meet the multiple needs of people.

A service-oriented government is a government that takes service as its administrative spirit, provides public services, and creates maximum public value as its core, and makes the best public space, and protects maximum public rights from a "people-oriented" perspective. A service-oriented government changes its traditional role as a managerial authority and becomes a service provider for the public, society, and social organizations, providing public goods and services to them. The government no longer interferes too much in market competition and economic operation directly, but by creating a competitive platform of service, legality, fairness, and science, it allows all organizations to freely and fairly realize resource acquisition and value distribution, more scientifically and equally protects the unity of individual and public interests, and effectively realizes the value balance between the government and market forces, private organizations and social needs under the socialist market economy system. It is conducive to the maximization of efficiency and equity. By relying on modern information technology, the government can explore the value of the massive data through processing and analysis, serves as a solid basis for decision-making, and achieve scientific, effective, and relevant decision-making. The smart government also provides a channel for universal citizen participation. The public can enjoy the public services provided by the government through mobile data terminals and computers, and score the experience of the service process and give feedback to government departments to provide direction for the improvement of public service quality. The government can accurately analyze the public's needs by collecting citizens' daily behaviors, such as travel information, and very often the results from data analysis are more suitable and better quality than the choices decided by my perceptual thinking, which facilitates refined and precise services and solves the energy consumption and resource waste caused by inaccurate positioning, as shown in Fig. 1.

It has completed the government affairs network, video monitoring special network, key enterprise supervision special network, completed the government information technology cloud computing center, key enterprise supervision special network, government information technology cloud computing center, information technology application and emergency command center, comprehensive video monitoring platform, GIS geographic information system, comprehensive information mobile collection system six basic resource system construction, formed a systematic basic framework of the sustainable smart city; to comprehensive emergency command center as the basis for the initial formation of the emergency response system for enterprise production safety accidents, play the role of the comprehensive command center in mobilization, coordination, decision-making command and risk prediction and early warning; start the key informatization comprehensive management platform, enterprises and institutions fire safety independent management platform, pollution source online monitoring system, governmental collaborative work platform, urban management comprehensive law enforcement platform five wisdom application system platform construction, the initial formation of wisdom city application system; 600 new video monitoring points, to further enrich the video monitoring resources. It has completed the construction of the five wisdom application system, and the construction of the working mechanism to go with it; the initial formation of intelligent police, intelligent transportation, and intelligent government, play the role of information technology in the police, traffic, government work; it has launched a pilot project of intelligent tourism, and explored the operation of the intelligent tourism market and business model.

The Internet, especially the mobile Internet, can make medical services online and complete the integration of online and offline so that patients can get services most conveniently and doctors

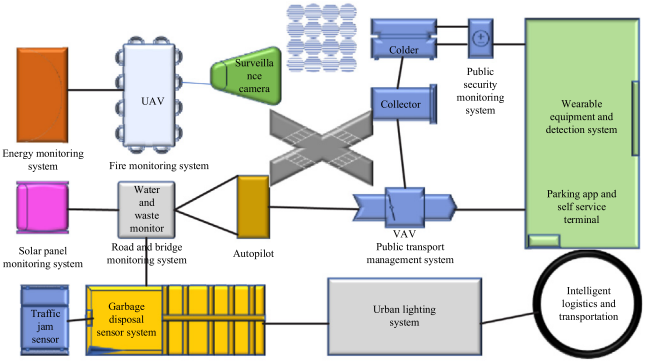

Fig. 1. Sustainable smart city construction architecture.

can find patients at any time; wearable devices and biochips can synchronize the data of patients' health signs to the network in real-time, and the integration of audio and video technology and virtual reality technology can make doctors and patients immersion and communicate efficiently. The use of big data and genetic technology allows doctors to fully grasp patients' health data and make an efficient diagnosis; artificial intelligence technology can provide intelligent auxiliary decision support in the three aspects of the examination, diagnosis, and treatment, reducing medical errors and improving efficiency. The Internet can change the way of service, and "Internet plus" will certainly give birth to innovative service models. In the future, new medical service models such as online consultation, online payment, video consultation, remote consultation, online drug purchase, pre-hospital emergency guidance, and post-hospital rehabilitation guidance will gradually become widespread. The innovative service models will also put forward higher requirements for the innovation of business models. It is foreseeable that patients will occupy a more active position in the future medical services, and they will also put forward higher requirements for medical services, such as appointment-based treatment, personalized treatment, and on-demand medical treatment is an inevitable trend. For medical institutions, they can take advantage of the communication convenience brought by the Internet to cover all the places that can be achieved by the network, breaking the traditional hospital walls and covering a wider area with quality medical resources. These are much like the boost and impact that e-commerce brings to traditional business. Internet healthcare will flourish, integrating and supporting medical institutions and innovating service models, which is an inevitable requirement for economic and social development, as well as for industrial development, as shown in Fig. 2.

As some hospitals, especially new hospitals, tend to electronic medical records and other clinical medical information technology construction as a sub-procurement of the overall hospital construction, to the implementation of the general contractor, including the hospital's weak electrical systems, equipment procurement. Such general contractors generally do not have clinical medical information technology business capabilities. Therefore, the company uses the form of a joint operation with the general contractor to obtain such business, and the company designs clinical informatization solutions for the general contractor, participates in the design of the entire information system construction program, and communicates with the hospital.

After the general contractor wins the bid, it purchases clinical medical information systems or services from the company according to the overall construction bidding plan of the hospital. Such business is contracted by the company and the general contractor in the form of product sales or project implementation.

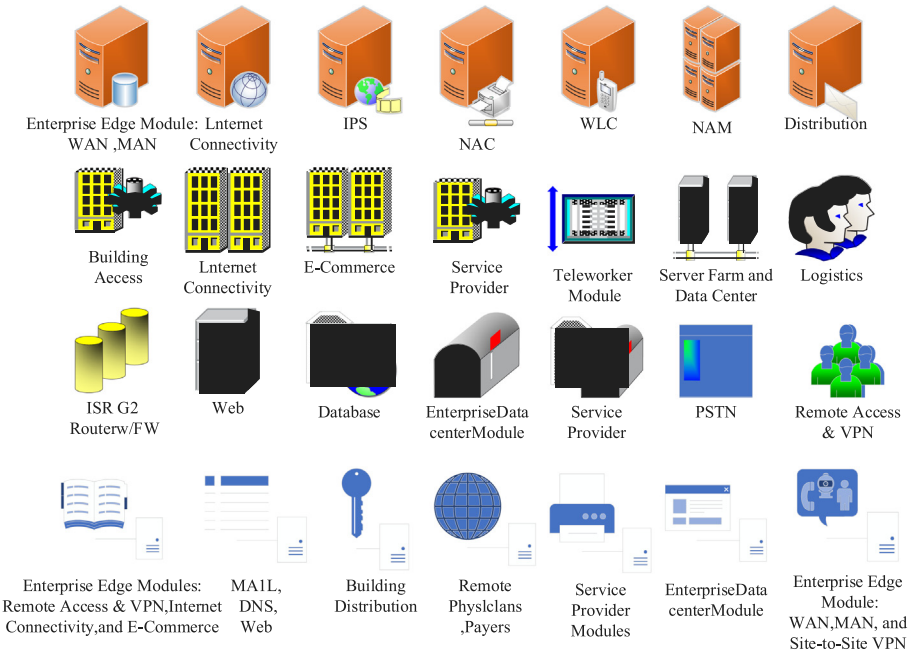

Fig. 2. Network structure diagram.

Table 1
The meaning of the symbols of all formulas.

Symbol	Meaning
X	Learning sample
C	Cycles
SSE	The total intra-group sum of squares
P	Probability
Z	Copious amounts of high-quality data
Y	Doctor resources

3.2. Artificial intelligence algorithms

The meaning of the symbols of all formulas is shown in Table 1.

The idea of artificial intelligence is inspired by the deep RBM algorithm integrating parameter adaptive tuning and implicit layer noise reduction, in which the parameter adaptive tuning concept is employed in this study for a suboptimal Boltzmann machine network combining pre-classification and fine classification. Let the learning sample X of the deep Boltzmann machine compose of two parts.

$$X|_C = \left\{X_i|_{C_i}\right\}, \quad i = 1, \ldots, n \tag{1}$$

During the company's daily sales process, large and medium-sized medical institutions are the main target customers, and the project priority classification is completed through the analysis of potential project opportunities with regional sales staff. Regional sales personnel track potential business opportunities according to the important principle, and regularly sort out sales leads with the person in charge of the marketing center to complete dynamic tracking analysis of potential business opportunities. When the potential business opportunities meet the project establishment criteria, the marketing center initiates the project application and forms a project team with the business center, technical service center, and other support departments to prepare the project bidding plan and determine the bidding price through the procedures of resource feasibility analysis, technical feasibility analysis, and business risk assessment, and then participates in the project bidding or conducts negotiations after reporting to the general manager for approval, as shown in Table 2.

After successful bidding or negotiation, the business center is in charge of contract validation and signing, etc. The marketing center initiates the project implementation process application and enters the project execution phase. Due to the complexity of business processes in medical institutions and the information application-oriented nature of the company's software systems, most of the company's sales revenue is realized in the form of total solution projects, which require personalized development according to customer needs and completion of information linkage debugging within the system and between the system and other software in medical institutions, rather than simple software delivery. The company takes into account the configuration of software products, the difficulty of technology development, the cost of implementing custom development and providing technical services and the cost of operation and management, and other factors, as well as the competitive market situation, to determine the price of project services. During the implementation of some projects, the company provides hardware configurations according to the needs of customers, forming hardware sales revenue, whose pricing is determined mainly considering the procurement cost of hardware products.

$$SSE_i = \lim_{m\to\infty} \sum_{j=1}^{m} \left[\left(x_{ij} - \overline{x_i} + \left(x_{ij} - \overline{x_i}\right)^2\right)^2 + \left(y_{ij} - \overline{y_i} + \left(y_{ij} - \overline{y_i}\right)^2\right)^2 \right] \tag{2}$$

Thus, the total intra-group sum of squares is:

$$SSE = \sum_{i=1}^{N} SSE_i = \lim_{m\to\infty} \sum_{i=1}^{N} \sum_{j=1}^{m} \left[\left(x_{ij} - \overline{x_i} + \left(x_{ij} - \overline{x_i}\right)^2\right)^2 + \left(y_{ij} - \overline{y_i} + \left(y_{ij} - \overline{y_i}\right)^2\right)^2 \right] \tag{3}$$

Users selfishly and strategically maximize their utility, and platforms want to collect large amounts of high-quality data with minimal user overhead. To build a noise map, for example, dense

Table 2
Characteristic connotation of intelligent healthcare.

First-level indicators	Secondary indicators	Third-level indicators
Infrastructure	Information infrastructure public infrastructure educational needs medical needs	Fixed broadband home coverage Fiber to the home rate Next-generation broadcast and television network (NGB) coverage (ten thousand households) Satisfaction of WIFI service in public places
	Traffic demand social security and employment information service cultural and entertainment needs government affairs	Popularization rate of intelligent display screens at bus stops Smart light pole construction level Construction level of intelligent induction screen in subway station Intersection TV monitoring points (a)
Public service	Government management secondary indicators	Convenience and richness of obtaining educational resources online The rationality of the price of online platform learning resources
	Information infrastructure public infrastructure	Satisfaction of online appointment and electronic medical record popularization Self-service network platform to pay medical expenses satisfaction
	Educational needs medical needs traffic demand social security and Employment Information Service	Satisfaction of online car information service Accuracy of real-time traffic information Satisfaction of convenient payment Status of online processing of social security services
	Cultural and entertainment needs government affairs secondary indicators	Opening rate of self-service for social security in streets and communities Satisfaction of handling social security services in different places Satisfaction of pushing employment information service Cinema and library reservation and information inquiry satisfaction
Infrastructure	Information infrastructure public infrastructure	Abundance of free learning resources One-stop satisfaction
	Educational needs	Satisfaction with the urban citizen hotline Satisfaction of diversified service channels

and unbiased noise data best shows the city noise situation and is what the platform wants to collect most. Assuming that the platform wants to collect perceptual data with quantity no less than chemical and quality no less than 2, and considering minimizing user overhead, we construct the overhead minimization problem (CMQN) under quantity and quality constraints as follows.

$$\min \sum_{g_i}^{W_g} C_i^g \geq N \tag{4}$$

The information construction of grassroots hospitals is backward, and teleconsultation often adopts the way of paper documents plus remote "hard video", which cannot realize the complete and real-time transmission of patients' medical records; telemedicine mostly requires the construction of fixed consultation rooms, and experts on the consultation side and doctors on the application side must go to designated consultation points to participate in the consultation, which increases the cost of consultation and reduces the efficiency of consultation. This increases the cost of the consultation, reduces the efficiency of consultation, and affects the enthusiasm of experts to participate in the consultation. Family physicians and the "three divisions" (referring to specialists in large hospitals, primary care physicians, and health managers) lack platform support and family physicians cannot quickly and dynamically obtain medical records and health management information of management subjects, and it is difficult for family physicians and specialists or higher-level hospital physicians to efficiently carry out professional guidance.

$$\begin{cases} \chi_0(\mathrm{m}) = \hat{\mathrm{x}}(\mathrm{m}) + \widetilde{\mathrm{x}}(\mathrm{m}) \\ \chi_i(\mathrm{m}) = \hat{\mathrm{x}}(\mathrm{m}) + \sqrt{1+\dfrac{k_i}{n}}\,\widetilde{\mathrm{x}}(\mathrm{m}) \\ \chi_{i+j}(\mathrm{m}) = \hat{\mathrm{x}}(\mathrm{m}) - \sqrt{1+\dfrac{k_j}{n}}\,\widetilde{\mathrm{x}}(\mathrm{m}) \end{cases} \tag{5}$$

The corresponding weights are:

$$w_i^m = \begin{cases} \dfrac{n-5}{2i(n+k+5)}, i = 0 \\ \dfrac{n}{2i(n+k+5)}, i = others \end{cases} \tag{6}$$

In the symmetric sampling strategy, there is a central point among the odd sampling points, and the distribution of the positions of the remaining sampling points is symmetric and has the same distance to the central point and the same weight, i.e., has the same importance, so the sampling strategy is called symmetric sampling. The odd central moments in this selection strategy are zero except for the first order, which can promote accuracy in the approximation of any nonlinear distribution up to the Taylor expansion 2nd order truncation. Due to the symmetry of the Gaussian distribution states, the central moments of the odd time in the Taylor expansion of the Gaussian nonlinear system are zero, so symmetric sampling can achieve the Taylor expansion 3rd order truncation, as shown in Fig. 3.

$$\begin{cases} \hat{\mathrm{x}}(0) = \mathrm{E}(\mathrm{x}_0) \\ P(0) = \mathrm{E}(\mathrm{x}_0 - \hat{\mathrm{x}}(0))\mathrm{E}(\mathrm{x}_0 - \hat{\mathrm{x}}(0))^T \end{cases} \tag{7}$$

Information construction has the characteristics of high investment and high risk. Depending on the survey, the lack of financial support has become the primary reason for limiting the construction of intelligent medical care. According to the relevant comrades of the Municipal Health and Planning Commission, the municipal second-and third-level hospital funds for the construction of intelligent medical mainly from the hospital's financing, and the medical institutions on the economic return on capital investment expectations vary, coupled with the "zero price difference for drugs" and another direct impact on the income of medical institutions, to a certain extent, affect and restrict some of the medical institutions capital investment the enthusiasm and initiative of some medical institutions. The community health service center is subject to the financial strength of the district where it is located, and the residents' electronic health records and public health information system are facing financial difficulties,

which makes it difficult to update and share information in the existing facilities, and the management application value is not enough, even the basic information data is difficult to complete. It is difficult to make reasonable health care consultation suggestions for the residents, causing the electronic health records of the residents to continue to form "new dead files" after the paper files, and the effectiveness of the electronic health records of the residents and the "family health doctor" work of the residents is affected and questioned. The effectiveness of the residents' electronic health records and the residents' "family health doctor" has been affected and questioned, and some systems have been reflected by the community health service centers as having major information security risks and loopholes.

Hospitals must also break the barriers and embrace the Internet. From the perspective of potential user demand, hospitals have the drive to become bigger and stronger, and "touching the Internet" is their inevitable choice; government departments need to provide better services for the people in the region, promote the development of graded diagnosis and treatment, promote medical reform, develop the health service industry, and better allocate and coordinate resources under the premise of stock resources to achieve the most effective use of medical and health resources. Other parties involved in health care have the demand to maximize their interests.

$$P\left(X^M \left| Z^N \right.\right) = \lim_{N\to\infty} \frac{1}{M} \sum_{n=1}^{N} \frac{1-\alpha}{1+\alpha}(X^M - X_n^M) \tag{8}$$

In the integration of key resources, we should form a differentiation from our main competitors, rely on the original hospital customers, take the doctor's end as a breakthrough to obtain a large number of doctor resources, hold on to the main body of medical and health services, downward, we can expand health management services for individuals; upward, we can expand the price negotiation mechanism for hospitals, medicine, and health insurance to form a profit point. Partners should be able to provide customers with services that companies cannot provide. From this perspective, large medical institutions can provide medical technical help to small and medium-sized medical institutions; health service institutions can undertake the work of treating untreated diseases, rehabilitation, and chronic disease management, which medical institutions are not good at; medical equipment manufacturers are providers of production materials for medical services; together they build a partner network that can better promote the efficient operation of this business model. Finding these target customers can be achieved through secondary marketing of existing large hospital client, and also requires making full use of various industry forums and conferences to actively articulate the company's philosophy and programs and enhance attention. It can also be achieved through cooperation with governments at all levels to promote government policy guidance and exert influence on medical institutions in the region.

3.3. Analysis and design of online triage model

In the medical equipment management system, the client mainly involves seven parts: login module, query module, registration record module, a network communication module, scan code quick identification module, data offline cache module, system setting module, and the corresponding functional test for the characteristics of the above seven modules and the initial design, monitoring data mainly involves boot time statistics, room temperature, and humidity measurement, data transmission and preservation, etc. There are many medical devices in the hospital, covering a wide range of areas, with different shapes and structural principles, and complex use environments [26]. The formation of an in-hospital medical equipment IoT through the deployment of a monitoring network can centralize the management of equipment scattered in various places and save the time cost of management departments and is also a way to meet the emergency needs of medical equipment. This monitoring function requires the support of an intelligent hospital information system, with individual therapeutic devices as the base unit. Each unit is equipped with one or more monitoring modules, and the monitoring modules uniformly transmit data wirelessly to the web server of the management system, and the information stored in the database can be accessed and displayed by the Android client of the management system, and the platform framework is shown in Fig. 4.

The equipment that needs to be monitored in the platform is equipped with monitoring modules according to the actual conditions. For example, excessive dust causes the loss of respirator filters; the water to the power supply of infusion pumps leads to power-tripping; magnetic resonance shielding leakage leads to image distortion, etc. Various equipment failure caused by changes in environmental conditions can be monitored by the monitoring module, which brings convenience to the installation, repair, and maintenance of departmental staff. Medical equipment is distributed in all corners; it is difficult to have all wired network transmission interface; to overcome this difficulty, the monitoring module automatically transmits data to the server through a wireless network, unified by the server for data processing, and the user can access the database of the web server with the android client to get data when using. To determine whether a piece of equipment is worthwhile, the start-up rate is one of the very important parameters; to achieve accurate start-up running time records, it can effectively calculate the economic benefits of the equipment. The operating environment parameters mainly include temperature and humidity, which can make a corresponding prediction on the operation of the equipment and the preventive maintenance work.

In the process of remote diagnosis and treatment services, the elderly can be first consulted in the community health service center (station) and accomplish the basic physiological parameter acquisition. When the condition of the elderly requires upward referral to, the intelligent medical and health care service platform instantly transmits medical images and related data to the higher-level hospital, and the geriatrician obtains the physiological parameters and electronic medical records of the ailing elderly from the intelligent terminal. The geriatrician gets the physiological parameters and electronic medical records from the smart terminal. Through the remote video screen, he/she observes the sick old man up close, performs the face-to-face treatment, communicates with the general practitioner of the community health service center, and guides him/her to conduct relevant examinations. After a comprehensive analysis of the elderly's condition and test reports, the diagnosis results and electronic medical advice are transmitted back to the community health service center. Also, elderly people who need medication can directly pick up medication at the community health service center (station), and those who need inpatient treatment can make outpatient appointments and green channel referrals through the intelligent medical and health care service platform. Remote diagnosis and treatment not only simplify the consultation process for the elderly but also significantly improves the accuracy and efficiency of diagnosis and treatment, as shown in Fig. 5.

Remote monitoring service mainly monitors the health condition of the sick elderly remotely through intelligent sensing technology and medical imaging equipment and implements 24-hour vital signs tracking for the elderly after surgery or during

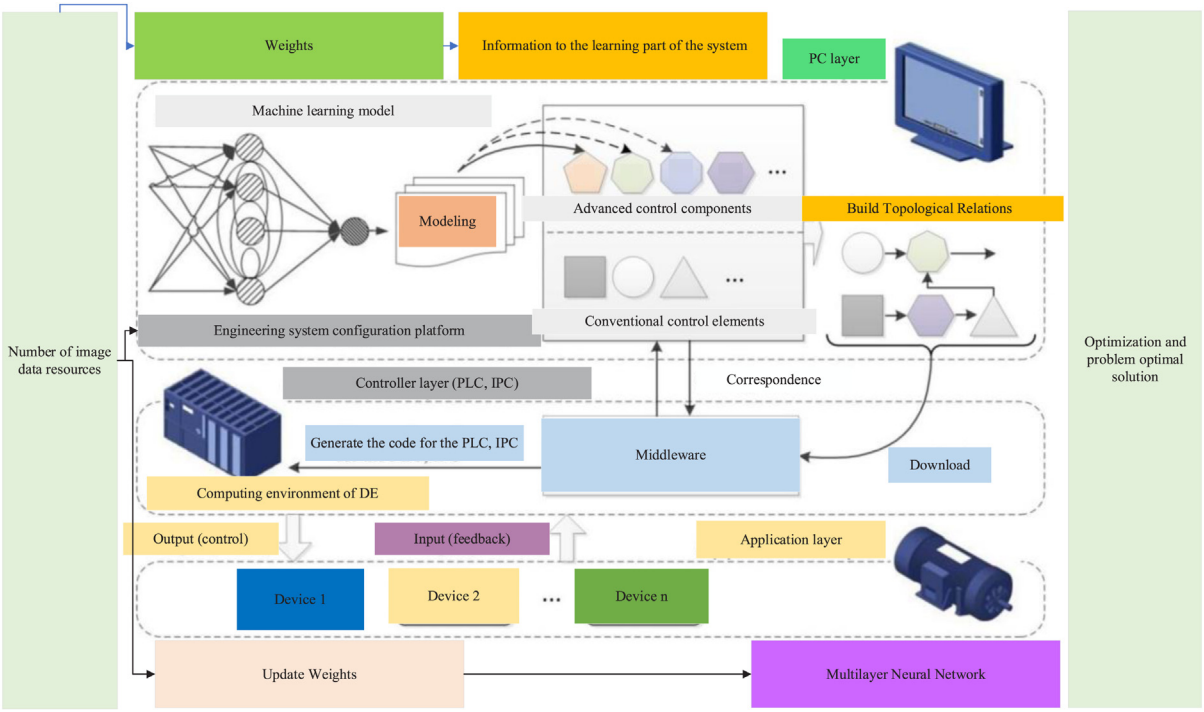

Fig. 3. Improved artificial intelligence algorithm model.

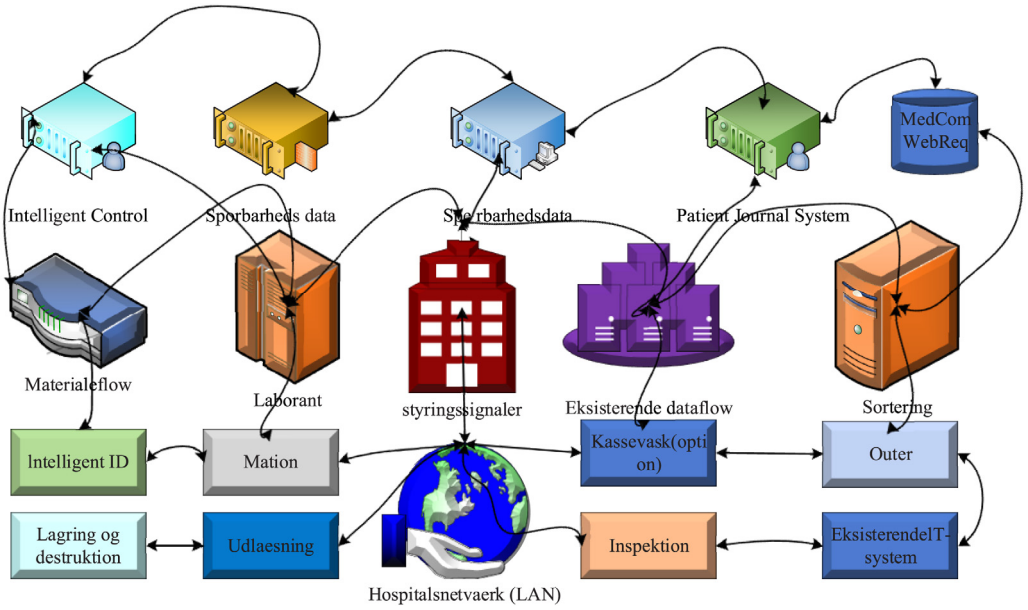

Fig. 4. Online medical device monitoring framework.

rehabilitation. According to the specific abnormal index data and the disease situation, the intelligent medical and health care service platform instantly uploads the physiological parameters of the sick elderly to the community health service center (station) or the higher-level hospital, and the medical and nursing staff will diagnose and give the specific diagnosis and treatment plans to them. Also, medical personnel can take the initiative to retrieve the real-time vital signs of the sick elderly through the intelligent medical and health care service platform. The remote monitoring service not only reduces the hospitalization time of the sick elderly and saves valuable medical resources, but also gives the elderly a safe health guarantee.

In the tele-education service, the elderly can receive health education from expert doctors through remote video and voice, and receive guidance through daily health care information pushed by the intelligent medical and health care integration service platform. In this process, elderly people's health management awareness and health care skills are continuously improved, which can effectively improve the quality of life. Also, public hospitals at all levels in the network medical and health care consortium communicate remotely through the intelligent medical and health care integration service platform, and community health service centers (stations) receive medical training from expert doctors and nurses of higher-level hospitals through the intelligent medical and health care integration service platform to standardize

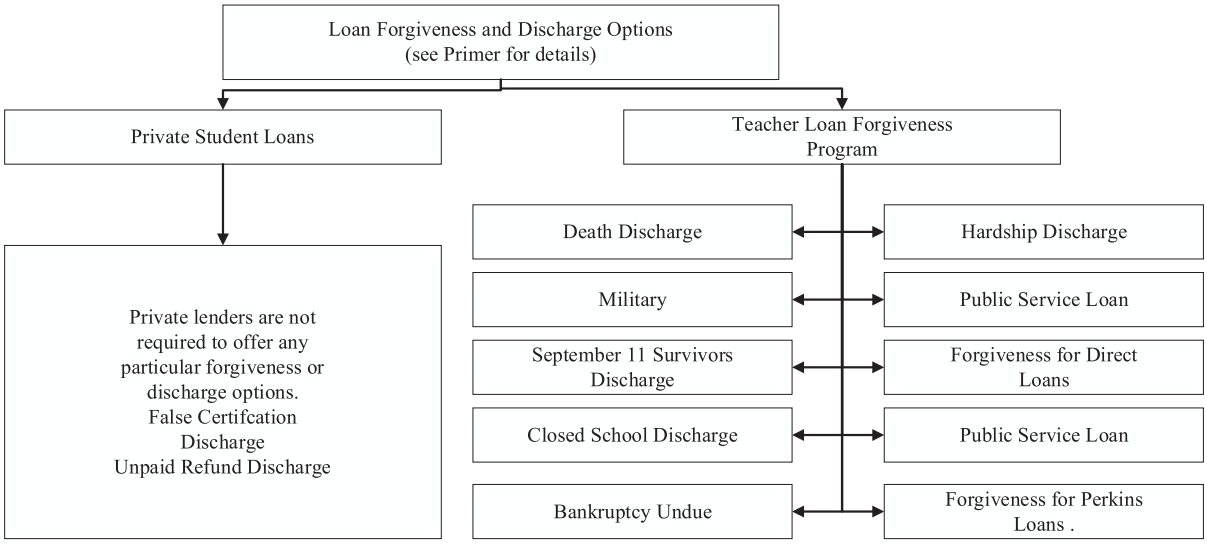

Fig. 5. Remote diagnosis and treatment process.

medical and nursing operations and improve medical and nursing technology. In the process of diagnosis and treatment of difficult and serious diseases, expert consultation can be carried out through remote video to improve the accuracy of diagnostic results and treatment plans.

The Smart Medical and Health Care Center wears a smart bracelet for each elderly person admitted to the hospital, and medical and nursing staff can identify basic information, electronic medical advice, medication dosage, and nursing records of the elderly through the patient's bracelet ID during the nursing process, and check the medication of the elderly to reduce nursing errors and accidents. The intelligent medical care service platform uploads the daily care records of the elderly to the higher-level hospital, and the responsible doctor is responsible for supervising their care services to effectively improve the quality of care. For the elderly admitted with normal bodily behavior, but with memory loss or Alzheimer's disease, prevention of wandering is a basic measure to ensure their life safety. Each activity area of the Smart Medical and Health Care Center is equipped with the function of real-time sensing the movement trajectory of the elderly, and when the elderly are identified to be out of the specified activity range, the Smart Medical and Health Care Service Platform will push the alarm information to the terminal of the nursing staff and display the specific location and safety status of the elderly in the terminal. The nursing staff of the intelligent medical and health care center stores the medication of all the elderly in the area in the intelligent medication dispenser every week. When dispensing medication for the elderly, the intelligent medical and health care service platform transmits the medication information of the elderly to the intelligent medication dispenser and automatically exports the required medication and dosage at the time the elderly take medication. When there is not sufficient medication left in the smart dispenser, the system automatically pushes the supplemental medication information to the children and caregivers of the elderly.

4. Results and discussions

4.1. Analysis of the results of artificial intelligence hospital of smart city

The efficient operation of the wisdom medical and health care combination model in public hospitals requires a relatively comprehensive medical and health care service platform. The Shaanxi provincial government should accelerate the construction of a medical and health care information platform, fully relying on the e-government network and the unified data sharing and exchange platform, and accelerate the improvement of existing facilities and equipment. Build a medical and health care information platform across provincial, municipal, and county levels to strengthen information collection, integration, and business collaboration of applied information systems (such as elderly care services, drug supply, and comprehensive management). The government should encourage public hospitals at all levels and all types of elderly service institutions to strengthen the collection and storage of large-scale medical data, enhance technical support for application and operation and maintenance, and open up channels for sharing data resources. The government should accelerate the construction and improvement of basic databases with electronic medical records for the elderly, health records, and electronic prescriptions as the core. It should eliminate data barriers, open data-sharing channels between departments and institutions, and explore sharing mechanisms for medical and health data. It should regulate the use of data resources generated by wearable devices, smart health products, and health care mobile applications in the medical and health care information platform. It also should establish a national directory of medical and health care data resources systems for the elderly, develop policy specifications for the open application of medical and health care data in a graded, classified, and zoned manner, and steadily promote the opening of medical and health care data. Community-based health care institutions are the frontier closest to the elderly, and the information construction of community-level institutions directly affects the vital interests of the elderly; therefore, it is imperative to promote the information construction of community-based health care institutions, and it is recommended to increase the financial investment in community-based health care institutions, as shown in Fig. 6.

Performance testing is a basic test other than functional testing, mainly including CPU usage, memory usage, network transmission time consumption, traffic usage, etc. It is an important evaluation tool for whether the client design is reasonable, and the performance of the client is also directly related to the user's operating experience. This project uses Android monitor to test the memory, CPU, and network of the Android client. The CPU call test focuses on the number of threads being called by the software system and the CPU usage rate. When the program is not operating, the threads are dormant and do not occupy any

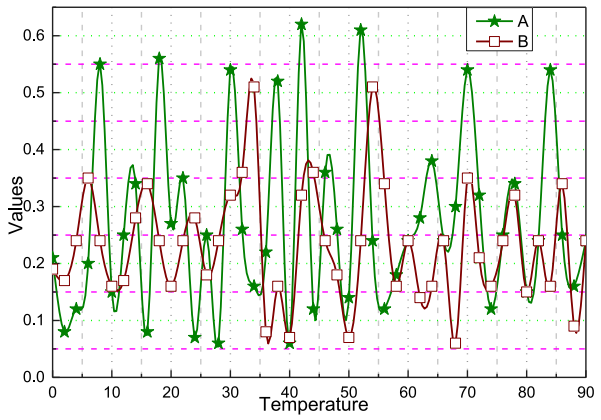

Fig. 6. Temperature and humidity monitoring effect diagram, A represents the actual temperature, and B represents the humidity.

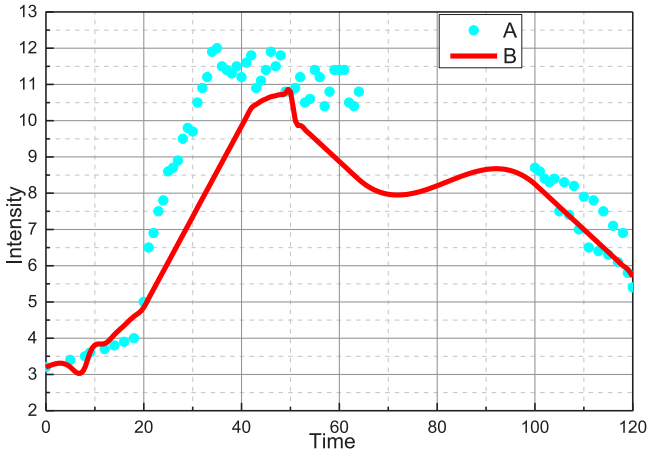

Fig. 7. CPU test, A represents actual CPU consumption, B represents simulated consumption.

CPU, which is shown in gray. When the program is operated, the CPU usage is indicated in green when the software is active, as shown in Fig. 7. Maximum CPU usage during normal use of the program does not exceed 21%, which meets the performance test requirements.

The network test is to analyze the time and traffic required for the client to access the server and obtain the data. The system is configured to read the offline storage function when the network situation is not ideal, and this part of the test mainly focuses on the system response when the network signal is strong. The specific test results of each network access situation are shown in Fig. 8. The amount of data used for network access is trivial, and the response is timely and meets the performance test requirements. The Internet hospital platform provides basic public services and data services. The broadcast service provides basic services such as security, payment, and messaging; the data service integrates all health data of patients and authorizes access among the Internet hospital participants. The platform builds a unified clinical data center and constructs the management of patient-centered monolithic clinical-related data. Through the Enterprise Master Patient Index (EMPI) mechanism, it realizes automatic identification of patient identity in the whole Internet hospital service system. Through the platform, medical experts can participate in Internet hospital activities through doctors' workstations, tablet PCs, and smart phones to enhance the efficiency of the Internet hospital and fully mobilize the participation of all parties.

Along with institutional reform and administrative approval system reform, government functions have been transformed, from the past emphasis on approval light supervision to now pay more attention to strengthen the supervision after the event; the law does not prohibit can be lenient and strict management of the administrative approach. Like most cities, it is currently in the stage of exploring how to strengthen after-the-fact supervision; the established knowledge is no longer used; the new technical means to grasp is not in place; the quality of personnel and related security follow-up is not timely; the specific measures of supervision is not in place; some districts and counties, departments have inadequate information sharing, the departmental linkage is not timely; joint enforcement of violations is not in place; disciplinary action is not strong and other issues, regulatory synergy needs further strengthen; by the past obsession with rights, confused by the practice of responsibility, the original emphasis on administrative approval, ignoring the problem of supervision that has not been fundamentally changed, and part of the administrative approval matters after the abolition decentralize the corresponding post-event supervision without supporting measures. Administrative approval matters have been transferred to the Administrative Approval Bureau, and most of the matters transfer through the e-government platform to achieve online processing, and through the original unit to retain the responsibility for supervision, and no approval authority, the supervision after the fact without the original means and strength, relying only on limited administrative means; many times it is difficult to effectively monitor the behavior of market entities. At the same time, some information of "audit and management interactive platform" is too simple, there are blind spots in supervision. Administrative approval matters after the fact of supervision in the context of sustainable smart city construction, need more basic data accumulation and the corresponding integrity system construction.

4.2. Analysis of online graded diagnosis and treatment results

The path coefficient between Exp and Att was positive and statistically significant, which supported hypothesis 1 and indicated that patients' previous experience had a significant positive effect on their attitudes toward health care. The path coefficient between disease cognitive ability Cogn and behavioral attitude Att was positive and statistically significant, which supports hypothesis 2 and indicates that patients' disease cognitive ability has a significant positive influence on patients' behavioral attitude toward medical care. The path coefficient between disease cognitive ability Cogn and perceived behavioral control PBC was positive and statistically significant, and a result that supports hypothesis 3, indicating that patients' disease cognitive ability has a significant positive effect on perceived behavioral control. The path coefficient between access to care Acc and perceived behavioral control PBC was positive and statistically significant; a result that supports hypothesis 4, indicating that patients' access to care has a significant positive effect on perceived behavioral control. The path coefficient between perceived Cost and perceived behavioral control PBC was negative and statistically significant; a result that supports hypothesis 5, indicating that patient perception of the cost of access to care has a significant negative effect on perceived behavioral control. The path coefficient between online medical media Onl and perceived behavioral control PBC was positive and statistically significant, a result that supports hypothesis 6, indicating that online medical media has a significant positive impact on perceived behavioral control, as shown in Fig. 9.

From the above analysis, it is clear that patients' good experience in primary care, correct knowledge of their diseases, high accessibility, online medical media, patients' behavioral attitudes, perceived behavioral control, and hierarchical diagnosis

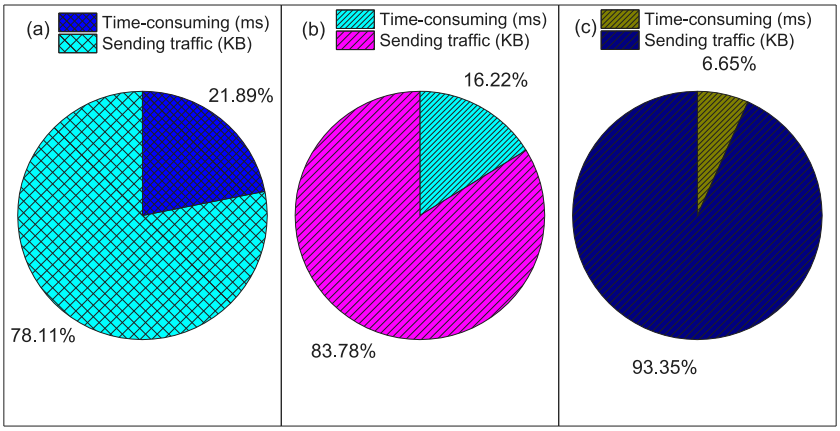

Fig. 8. Network time consumption, traffic usage.

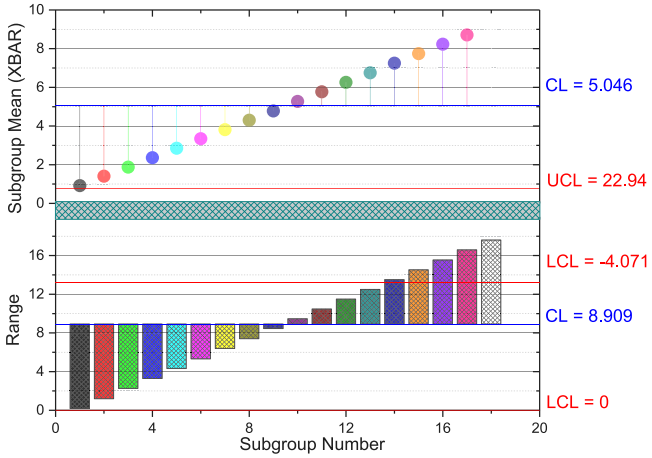

Fig. 9. Research hypothesis testing results.

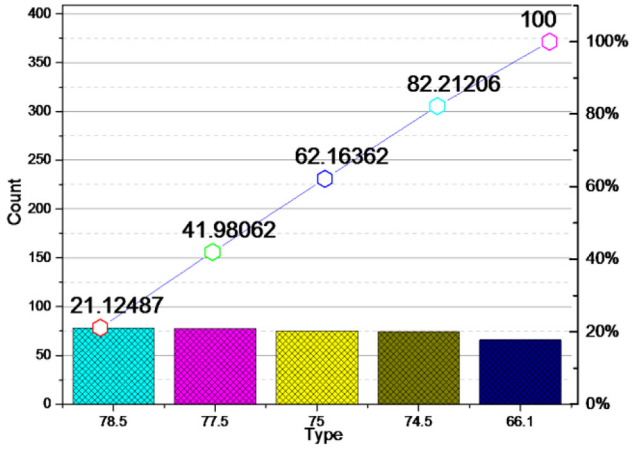

Fig. 11. Expected utility values and program ranking of providers.

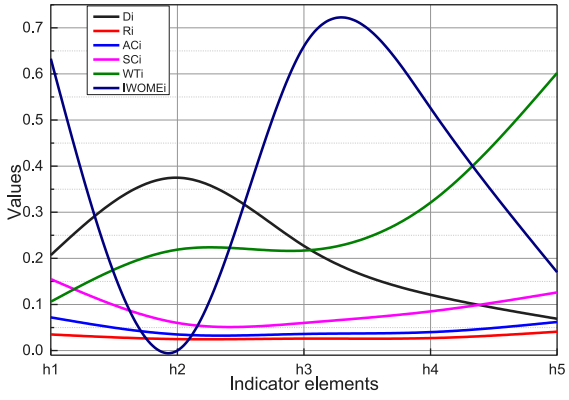

Fig. 10. Normalized results of medical institutions.

and treatment policies all have significant positive effects on patients' intention to choose primary care; the higher the cost of primary care, the weaker patients' intention to seek medical treatment, so patients' perception of the cost of medical treatment has a negative and significant effect on the intention to seek medical treatment. The higher the cost of primary care, the weaker the patients' intention to seek medical treatment, as shown in Fig. 10.

After the alternative medical institutions are determined, the medical service platform analyzes the criteria and collects information related to the decision criteria based on the influencing factors of patients' choice of medical institutions analyzed in the previous section, to prepare for the next decision. From the above model analysis, it can be seen that the criteria information to be collected includes patient location, medical institution location, medical institution ranking, medical institution authority ranking, average outpatient cost of medical institutions, medical insurance reimbursement policy under the graded treatment policy, the average number of doctors visiting medical institutions per day, the average number of registered numbers per doctor per day in medical institutions, waiting time and online reviews. The search and analysis of Internet data revealed that some of the information were uncertain, not directly available, or could not be described with precise data. Therefore, we need to preprocess the raw data to make it into the type of data that can be recognized by the decision model, as shown in Fig. 11.

The computed alternative providers' expected utility values are interval numbers, and here we introduce a method for comparing interval numbers to obtain the ranking of alternative providers. To rank the full range of providers, we first compare each hi with all the remaining hj. Most elderly and pediatric patients focus on the distance factor when choosing a provider due to their physical condition and lack of energy, as well as their vulnerability to emergencies. Therefore, in the context of patients' distance preference, we analyze the ranking of the obtained alternative medical institutions, and h8 is the best choice for patients

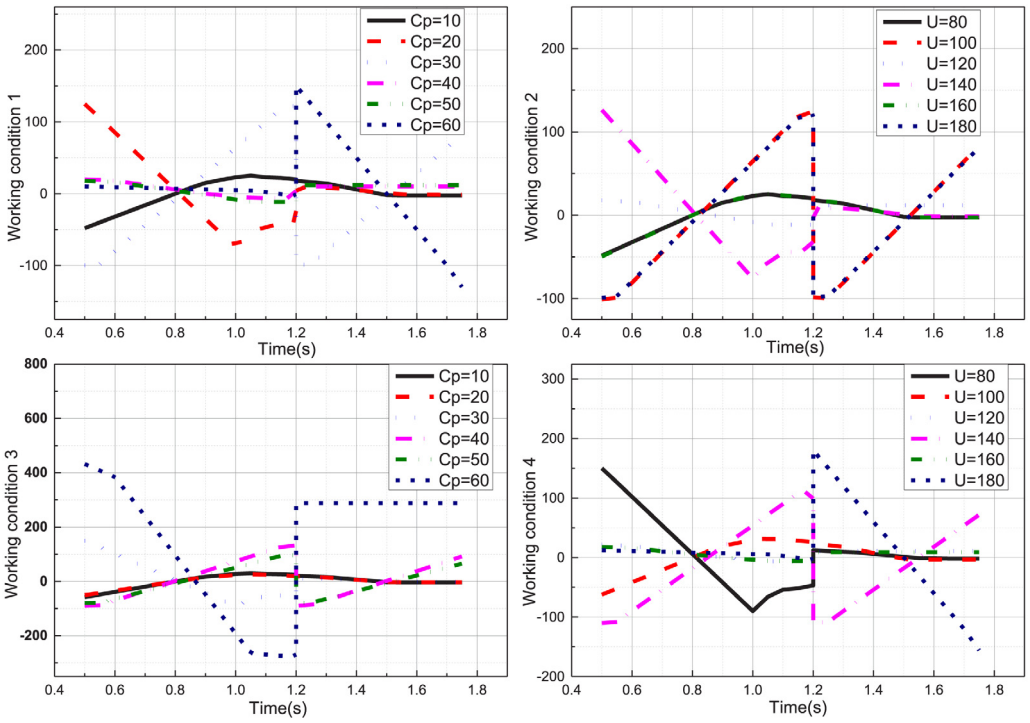

Fig. 12. Effect of increased utility gained and cost paid by patients with tiered care on evolutionary outcomes.

with distance preference, which has obvious geographical advantages and helps patients choose medical institutions scientifically and guides them to seek medical treatment reasonably.

4.3. System performance analysis

When patients choose primary care, on the one hand, the increase of reimbursement ratio of primary care insurance, priority registration right of famous specialists in higher-level hospitals, fast referral channel and a series of other measures make the efficiency of patient's consultation improved and the utility of patient's consultation increased; on the other hand, patients also need additional costs, such as the cost of contracting family doctors and other services. Under the hierarchical treatment model, the increased utility and cost of patients directly affect their choice of medical institutions. Therefore, we explore the impact of patients' increased utility and cost of evolutionary outcomes, as shown in Fig. 12.

As shown in Fig. 12, when patients are willing to cooperate with the implementation of the graded diagnosis and treatment policy, i.e., Cp = 10,20,30,40,50,60, U = 80,100,120,140,160,180, choose primary care, they will change from the initial strategy of choosing primary care to the strategy of choosing to go directly to large hospitals as the cost increases. Also, the increase of utility brought by graded diagnosis and treatment to patients will cause a change in patients' choice of medical institutions. As the increase of utility brought by graded diagnosis and treatment to patients becomes larger, patients will change from the initial choice of going directly to large hospitals to the choice of primary care, and as the increase of utility becomes larger, patients' choice of medical institutions will converge to the strategy of primary care more quickly, as shown in Fig. 12. It can be seen from Fig. 12 that the main trends of the results are consistent, so it is acceptable to explain this issue in detail in a more realistic analysis.

In this section of objective index evaluation analysis experiments, a total of 45 image pairs are purposely selected from TNO and INO world public datasets, and objective index evaluation analysis is performed using the nine fusion indexes introduced in this subsection, to obtain more experimental image pairs scenes. The final fused image results were obtained through extensive experimental training, and subsequently, the average values of the nine objective evaluation metrics for the 45 experimental image pairs were calculated through extensive statistics and presented as shown in Fig. 13.

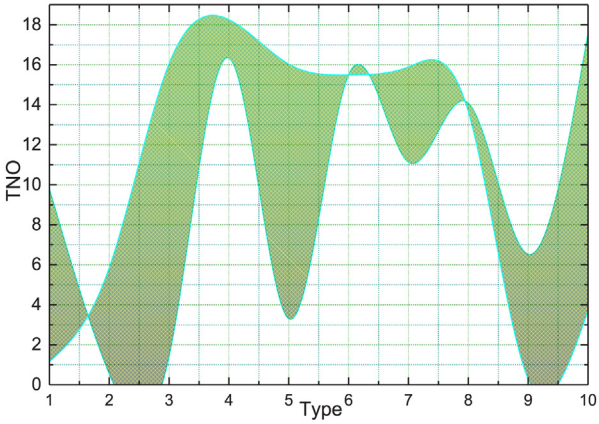

Fig. 13. Objective evaluation of data fusion.

Fig. 13 compares the impact of differentiated and equalized pricing strategies on the total revenue of the resource providers. As can be seen from the figure, the overall gain of the resource provider under the homogenized pricing strategy is constant as the number of task owners increases. This is because from the perspective of the overall gain of the resource provider, the problem of resource allocation is transformed into solving problem P2 regarding the maximum value of the resource allocation decision variables, which degenerates into a linear programming problem where each task owner receives the same resource at a uniform

unit resource price, and thus problem P2 has the equal total gain for different numbers of task owners. In contrast, the overall gain of resource providers under the differentiated pricing strategy tends to increase gradually with the number of task providers. In the case of a relatively small number of task owners, the current supply of resources is greater than the demand, so it leads to the inability of resource providers to trade all resources to task owners, making the current price per unit of resources lower, which leads to lower overall revenue. Our model is more efficient and accurate than other models, and the user experience is better. With further increase in the number of task owners, when the current resource supply is less than the demand, the differentiated pricing strategy will set different unit resource prices and resource supply results based on the real resource supply and demand due to the phenomenon of resource competition among task owners. Our results are simple in the parameter settings involved and the complexity of the model is not high, but the predicted results can meet the actual application. Therefore, our results are more efficient and the model requires configuration. Lower performance means lower cost.

5. Conclusion

A sustainable smart city is an inevitable requirement for adapting to the development of new technologies and new businesses in the city, and it is also the trend of future development of the city. By building sustainable smart cities, municipal management can be improved, people's livelihood service capabilities can be improved, economic and social transformation and upgrading can be promoted, and green and intensive development can be promoted. The performance of the configuration studied in this paper is excellent and meets the performance test requirements. It can help patients choose medical institutions scientifically, guide patients to seek reasonable medical treatment, and have less resource occupation. Patients who have long-term free medical services and their preference directly enter large hospitals. Preference is the main reason that leads to disorderly access to medical services, the overall inefficiency of the medical service system, and the inefficiency of implementation. Hierarchical diagnosis and treatment policies. This article analyzes the mechanism of patients' selection of medical institutions, the methods of individual patients' selection of medical institutions, and the evolution of group patients' selection of medical institutions, and provides decision support for guiding patients to seek medical treatment. Reasonably promote the hierarchical diagnosis and treatment model. This has important theoretical significance and practical value for enriching and developing medical consulting behavior and system selection method system from the perspective of management, and promoting the construction and implementation of hierarchical diagnosis and treatment system.

CRediT authorship contribution statement

Lingqiang Kong: Methodology, Wrote the manuscript.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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