Findings About Patient Preferences for Medical Care Based on a Decision Tree Method Study Design for Influencing Factors

Yu Li, MD[1,#], Wen Li, MD[2,#], Zhihui Wu, MD[2,#], Jianhui Yuang, PHD[2,3], Yanling Wei, MD[1], Chao Huang, MD[1], and Daizheng Huang, PHD[1,2,3]

Abstract

Aim: This study aimed to investigate the influencing factors of the medical-seeking behavior of patients in a hospital in Nanning and descriptively analyze the main factors to further improve the medical system and optimize the allocation of health resources. **Subject and methods:** The willingness to seek medical treatment questionnaire survey was conducted on patients who were in the outpatient clinic of a hospital in Nanning from Jun 2018 to Aug 2019. The patients' basic information was analyzed descriptively using the SPSS 23.0 software package, and the influencing factors of the willingness to seek medical treatment were analyzed by univariate analysis method. In addition, the importance of influencing factors in patient preference to seek medical treatment was explored by constructing a decision tree model. **Results:** A total of 3428 questionnaires were valid and the effective rate was 93.78%. Region, age, occupation, educational level, monthly income, insurance type, and disease type demonstrated diverse influences on the medical expenses of patients. In addition, differences were found between occupation and patient insurance situation, personal willingness to seek medical treatment, reasons for visiting the hospital, medical selection standard, preferred medical treatment location for common diseases, waiting time, treatment time, and manner of understanding the disease. **Conclusion:** Increasing attention has been paid on the patients' preference for medical treatment and their satisfaction with medical services. Medical institutions should reasonably allocate the proportion of medical insurance reimbursement and diversify the registration and appointment methods. Patients should be treated in different periods and properly allocated to improve the service mechanism of primary medical institutions. In addition, it is necessary to improve the medical publicity model and the efficiency of medical services according to the needs of patients, so as to relieve the pressure of medical treatment in large general hospitals.

Keywords
patient preference, health resources, decision trees, surveys and questionnaires

[1]School of Information and Management, Guangxi Medical University, Nanning, China
[2]School of Basic Medical Sciences, Guangxi Medical University, Nanning, China
[3]The Laboratory of Biomedical Photonics and Engineering, Guangxi Medical University, Nanning, China

[#]These authors contributed equally to this work

Corresponding Authors:
Chao Huang, School of Information and Management, Guangxi Medical University, No. 22, Shuangyong Road, Nanning City, Guangxi Province 530021, China.
Email: 652927993@qq.com

Daizheng Huang, Guangxi Medical University, No. 22, Shuangyong Road, Nanning City, Guangxi Province 530021, China.
Email: huangdaizheng@gxmu.edu.cn

What do we already know about this topic?
Patients' willingness to seek medical treatment in hospital is affected by many factors, but the key role of which factor is not very clear.

How does your research contribute to the field?
We investigate the influencing factors of the medical-seeking behavior of patients in a hospital in Nanning and descriptively analyze the main factors to further improve the medical system and optimize the allocation of health resources.

What are your research's implications toward theory, practice, or policy?
We find patients should be treated in different periods and properly allocated to improve the service mechanism of primary medical institutions. In addition, the medical publicity mode and efficiency of medical services should be improved and the pressure of medical treatment in large general hospitals must be relieved in accordance with the needs of patients in China.

Introduction

The development of medical industry is the basic premise to meet the good life for people and it is closely linked to their health and wellbeing. With the implementation and deepening of the healthcare reform policy, China's health services have achieved remarkable results. However, the country's health and medical system is facing new challenges in the new era and many profound problems need to be solved. For instance, the medical management system lacks professional management talents and the management methods are outdated. The quality of medical service in public hospitals is not optimistic; there are problems such as high medical expenses and long waiting times. In addition, there are tensions in the doctor–patient relationship in the hospital environment.[1-3] Therefore, the hospital medical management system and the quality of medical services need to be perfected, the hospital environmental problems need to be resolved, and an intelligent medical model needs to be promoted.

Help-seeking behavior (HSB) is the human behavior of keeping healthy and seeking treatment for symptoms.[4] There are differences in resources for medical care in different regions in China nowadays. For example, citizens in urban areas have access to ample medical resources,[5] while rural or township resources for medical care are relatively scarce, which largely leads to inappropriate HSB.[6,7] To a certain extent, the patient's behavior of seeking medical treatment can reflect the current allocation of health resources and health policy issues.[8] Previous studies have shown that the patient's behavior of seeking medical treatment is affected by factors such as the severity of the disease, education level, family income, hospital distance, and the form of medical insurance.[9-11] Guangxi is a relatively slow-developing province. Although the total amount of health resources in Guangxi is increasing, the inequity in the allocation of some health resources is still severe.[12] Nanning City is the capital city of Guangxi province, China.

The purpose of this study was to understand the willingness of outpatients in a tertiary hospital in Nanning to seek medical treatment, and to analyze the influencing factors of the medical-seeking behavior. To further improve the effectiveness of patients' access to medical services, and provide an objective scientific basis for hospital management, we use decision tree model to process the data and explore the importance of various factors in patients' medical behavior.

Investigation Objects and Methods

A random sampling survey was used in this study. Randomly selected patients who visited the outpatient clinic of a tertiary hospital in Nanning from June 2018 to August 2019 for questionnaire survey. All respondents were voluntary participants. The research has been approved by the National Natural Science Foundation of China (No.81860604) and the Guangxi Natural Science Foundation (No.2018GXNS-FAA281133). All the respondents were informed by oral about the research, including the purpose of the research and the publication form of the research results. In addition, we used anonymous polls and only involved statistical analysis of the data, so there was no Institutional Review Board/Ethics Committee requirement for this study.

The questionnaire was designed by the research group. After reviewing the literature[13-16] and comprehensively considering the local actual situation, the content of the questionnaire mainly includes the patient's personal objective information, such as age; occupation; education level; monthly income; social insurance; medical services (including doctors and hospitals), such as doctor's title, attitudes, hospital equipment, and hospital hours; cognition and understanding of the hospital and patient satisfaction. The questionnaires were filled out anonymously by the respondents themselves or with the help of accompanying family members. The questionnaires were collected on the spot.

Manual data entry on MS Excel. Delete missing and duplicate data to ensure validity. SPSS 23.0 was used for statistical analysis of the data. The enumeration data were described by frequency and composition ratio, and the univariate analysis method was used to describe the influence of

Table 1. Basic Information of Questionnaire Survey Results.

Content	Label	Classification	Number	Ratio (%)
Where are the people come from?	1	Nanning City	915	26.69
	2	Affiliated counties of Nanning City	912	26.61
	3	Other places in Guangxi except Nanning City	1149	33.52
	4	Provinces excluding Guangxi province	452	13.18
Occupations	1	Farmer	424	12.37
	2	Civil servants	730	21.30
	3	Institutional staff	803	23.42
	4	Businessman	578	16.86
	5	Student	659	19.22
	6	Other	234	6.83
Education Situation	1	Bachelor degree	1801	52.54
	2	High school degree	603	17.59
	3	Primary school education	257	7.50
	4	Vocational Education	564	16.45
	5	Master Degree or Doctor degree	203	5.92
Monthly Income (¥)	1	Below 3000	1043	30.43
	2	Between 3000 and 5000	1550	45.22
	3	Between 5000 and 10000	718	20.95
	4	Over 10000	117	3.41
Social Insurance	1	The basic medical insurance for urban residents	1134	33.08
	2	The basic medical insurance for urban workers	924	26.95
	3	New rural cooperative medical insurance	670	19.54
	4	Commercial medical insurance	360	10.50
	5	Other social insurance	244	7.12
	6	No social insurance	209	6.10
Age	1	Below 18 years old	223	6.51
	2	Between 19 and 34 years old	1819	53.06
	3	Between 35 and 49 years old	1096	31.97
	4	Between 50 and 60 years old	224	6.53
	5	Over 60 years old	66	1.93
Disease Type	1	Common illnesses	1547	45.13
	2	Chronic illnesses	820	23.92
	3	Serious illness	282	8.23
	4	Others	779	22.72

Note. In this study, we calculated the monthly income in the survey data, and obtained the average value of 4091.89; then, we used the quartile algorithm to verify the monthly income level. The final result is: among the sample population in the survey, 3000-5000 yuan/month belongs to the middle-income level.

patients' personal conditions on medical expenses and factors related to occupation. $P < .05$ was considered to be statistically significant. In addition, R software version 4.05 was used to conduct general descriptive statistics on the data. A decision tree model was built to predict the patient's medical preference, to find out the key factors of the medical-seeking behavior, and to show the importance of the influencing factors.

Results

Basic Information

A total of 3655 questionnaires were collected, 3428 were valid and the effective recovery rate was 93.78%. Most of the respondents live in Nanning city (53.3%) and aged 19-49 years (85.03%). The majority of them have professional or undergraduate education (52.54%). The proportion of civil servants and public institution staff was nearly half (44.72%). Their income was mainly concentrated to 3000-5000yuan/month (42.4%). The details are shown in Table 1

Influencing Factors of Medical-Seeking Behavior

Influence of Objective Factors on the Choice of Medical Treatment. Patients have various choices in the process of medical treatment. Amongst these choices, external objective factors are the key factors influencing their decision to seek medical treatment. The results of the survey showed that patients have their own selection criteria of hospitals and doctors, as shown in Figure1.

In terms of hospital selection, patients chose to go to hospital mainly because of convenient transportation (41.07%) and good medical environment (37.87%). Hospital reputation (31.68%), advanced medical equipment (28.48%), and relatively complete drug categories
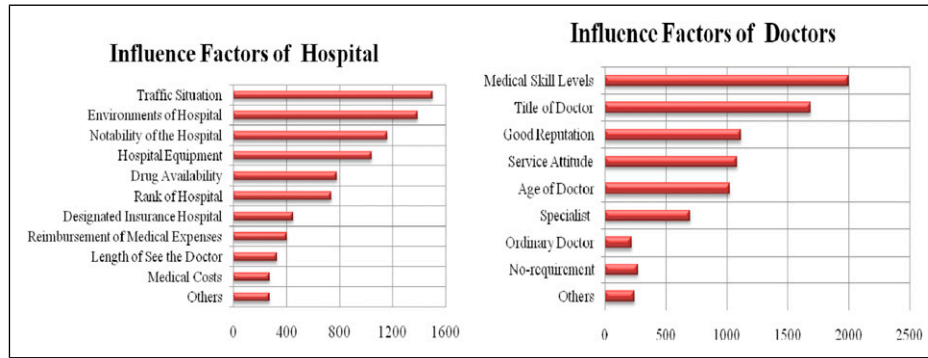
Figure 1. Influence of two objective factors on the choice of medical treatment.
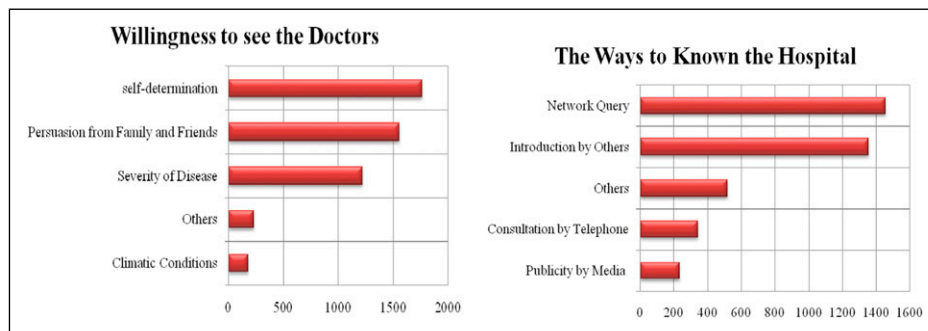
Figure 2. Influence of subjective factors on the choice of medical treatment.

(21.42%) were also the concerns of patients. The selection criteria for doctors indicated that patients tended to choose doctors with high medical level (54.69%) and high professional title (46.10%). Good reputation, good service attitude, and long medical experience were also the preferred standards of patients in the process of medical treatment.

Influence of Subjective Factors on the Choice of Medical Treatment. The selection of hospital by patients for treatment depends on a series of subjective factors. They comprehensively consider various factors, such as hospital conditions and disease types and severity, to determine the best choice of medical treatment. The results are shown in Figure 2.

As the picture shows, nearly half of the patients subjectively decided by themselves (48.18%), whilst some followed the advice of their relatives and friends (42.49%) or decided to seek medical treatment in accordance with disease severity (33.3%). Most patients also used network query (39.86%) or obtained medical information through the introduction of family and friends (37.07%) when understanding the disease and medical institutions.

Effect of Waiting Time on Patient Satisfaction. With the increase in the demand for health and medical services, the forms of medical services tend to be diversified. How a hospital occupies a key position in the competitive medical system largely depends on patient satisfaction. Bar Dayan et al.[17] found that the length of waiting time remarkably affects the overall satisfaction of patients and it is one of the key factors to evaluate the level of patient satisfaction.[18] In this study, the waiting time of patients and the time taken to see a doctor were evaluated to understand the overall situation of the time spent in the process of seeking medical treatment. The survey results are shown in Figure 3.

The data showed that the waiting time of most patients from registration was approximately 30-60 minutes (50%). The time spent by doctors to see a patient was approximately 10 minutes.

Influence of patient's personal condition on the choice of medical treatment. The results of univariate analysis showed that among patients in different regions, 40.1% believed that the effect of medical expenses is minimal and 33.8% perceived the effect as general. The availability of insurance also affected the patients' perception of medical expenses. The statistical data showed that the patients (38.5%) who participated in the new rural cooperative medical system (NCMS) and those (8.4%) who did not have any insurance considered the cost of medical treatment to have a substantial effect. The patients with serious diseases considered that the medical expenses had a considerable effect (17.6%), whereas
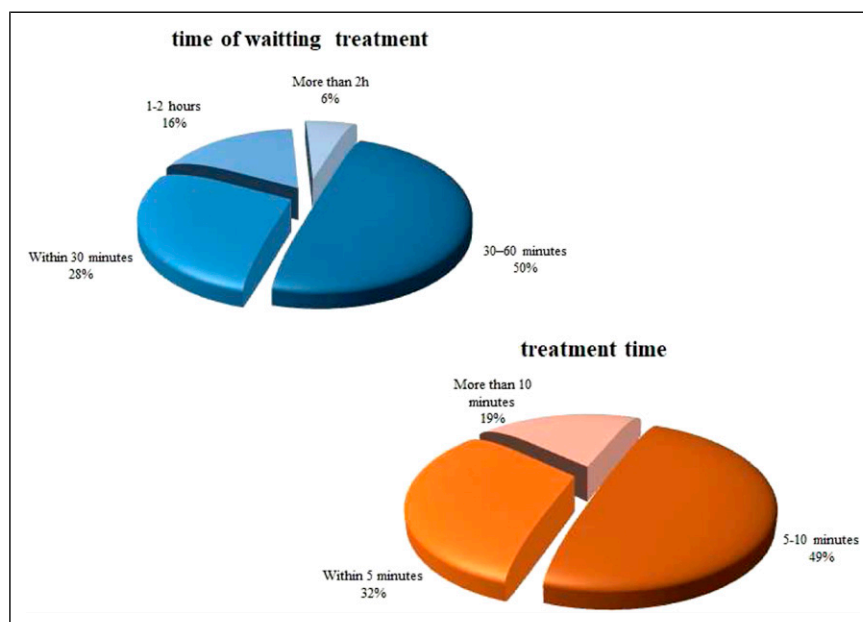
Figure 3. Time of waiting treatment and treatment time.

those with general diseases indicated a slight effect (59.4%). In addition, the patients with heavy medical burden included those with a monthly income of less than 3000 yuan (51.9%). The burden on civil servants and public institutions was minimal. The patient's household registration, age, occupation, education level, monthly income, type of insurance, and type of disease for medical treatment all had statistical significance on the medical expenses of patients (P<.05).

This study also explored career-related factors. The results of single-factor statistics revealed that the main type of insurance for farmers was the NCMS (55.3%). The main groups of urban employees with medical insurance were civil servants (44.2%) and public institution employees (47.8%). The main groups of urban residents with medical insurance were individual business households (35.0%) and students (40.6%). The factors that attracted patients with different occupations to go to a particular hospital were its reputation (12.1%), the high level of doctors (20.9%), its good environment (14.4%), the complete equipment (10.9%), and the short distance (15.7%). For most common diseases, farmers tended to choose better tertiary hospitals (35.6%). The groups that preferred community hospitals were civil servants (46.2%), public institutions staff (38.4%), and individual business households (39.3%). Most of the students chose clinics for treatment (39.8%). Most of the patients with different occupations chose the introduction of relatives and friends (34.7%) and network inquiry (37.4%) to understand the diseases and the hospitals. Farmers are mainly introduced by relatives and friends (43.1%) and the occupational groups (44.2%) who mostly searched information through the Internet were civil servants

(42.6%). In addition, the patient's participation in insurance, personal willingness to seek medical treatment, reasons for visiting the hospital this time, medical selection criteria, preferred medical treatment location for common diseases, waiting time for medical treatment, medical treatment time and the way of understanding the disease are all statistically significant among patients with different occupations The difference was statistically significant (P<.05).

Decision Trees. Studies have shown that factors such as occupation, education level, monthly income, age, type of disease, treatment time, waiting time for treatment, and expenses are all influencing factors for patients to choose the type of medical service.[19-21] Decision tree algorithm is a widely used classification algorithm. Decision trees are easy to understand and implement. In the process of learning, people can directly reflect the characteristics of the data without knowing a lot of background knowledge.[22] For the construction of the decision tree model, there is no need for too complicated steps to process the raw data. In addition, decision tree models are capable of producing feasible and effective results on large data sources in a short period of time. According to the characteristics of the data types, a decision tree model is considered to analyze the factors involved in the questionnaire. After the data is preprocessed, the data set is divided according to the minimum error eigenvalue. Since the selected features are independent and have the same probability of occurrence, we set the parameter to .5. The data goes through an iterative process to generate a model. The bar chart represents the proportion of
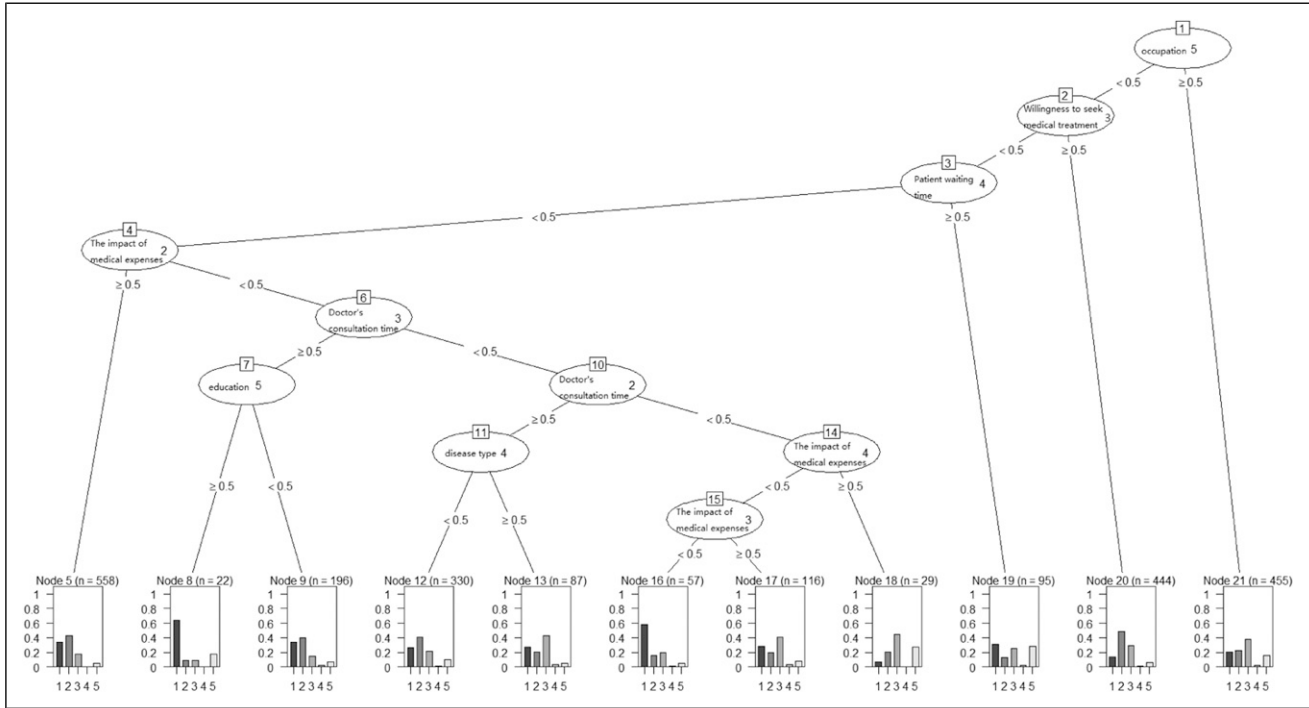
Figure 4. Decision trees of influencing factors of the patient's choice for medical treatment.
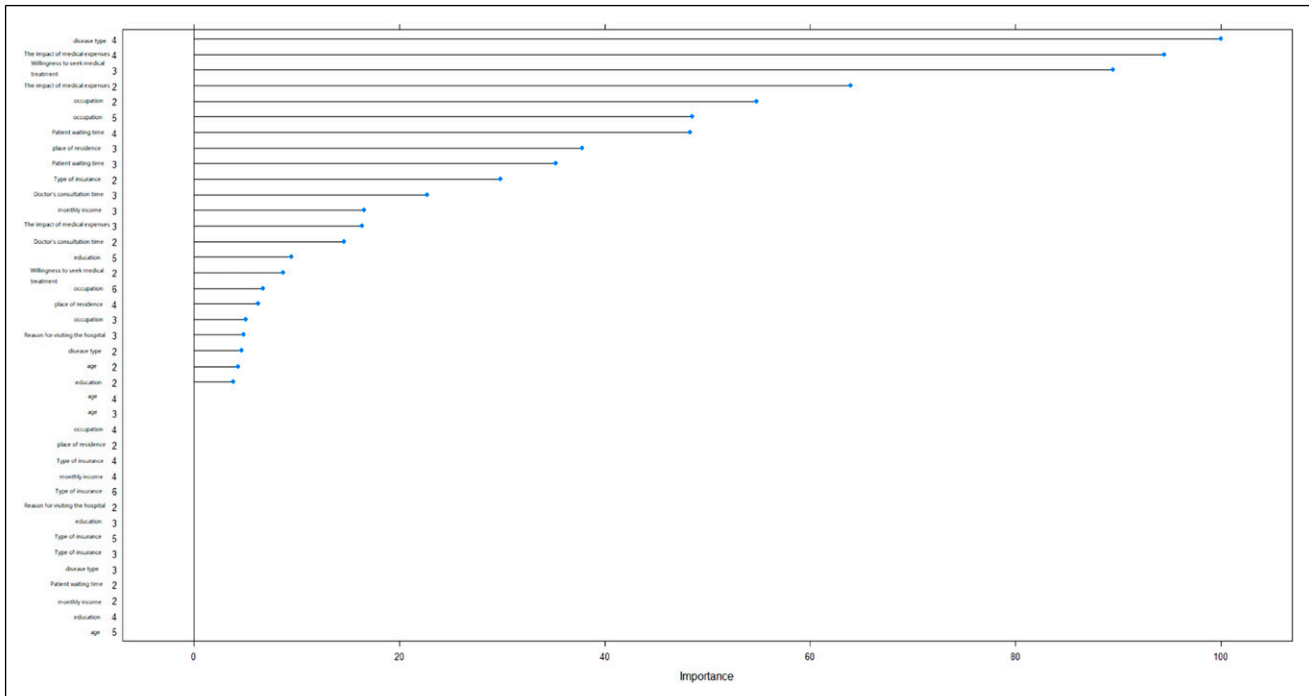

Figure 5. Decision trees of influencing factors of the patient's choice for medical treatment.

different medical service types under the conditional division, as shown in Figure 4. We further discussed the importance of each factor in the patient's medical selection process, and the results are shown in Figure 5.

It can be seen that the patient's disease type, medical expenses, and subjective willingness account for a large proportion (>50%) in the process of patients choosing medical treatment methods.

Discussion

Medical Institutions Should Reasonably Allocate the Proportion of Medical Insurance Reimbursement

"It is difficult and expensive to see a doctor" has been the common problem and challenge since the implementation of the healthcare reform policy and one of the most concerned livelihood issues of residents. A study indicated that the solution to "expensive medical treatment" was mentioned to be mainly solving the problem of compensation.[23] The compensation problem is closely related to the insurance problem. Properly increasing the reimbursement ratio of residents' basic medical insurance could fundamentally reduce the economic burden of residents. There are four main types of medical insurance in China: the basic medical insurance for urban residents, the basic medical insurance for urban workers, new rural cooperative medical insurance, and commercial medical insurance. The basic medical insurance for urban residents, the basic medical insurance for urban workers, and new rural cooperative medical insurance belong to social insurance. Social insurance is a redistributive policy in China whose goal is to ensure material and labor reproduction and social stability. Commercial medical insurance is a supplement to the other three types of insurance, and individuals participate voluntarily. Social insurance and commercial medical insurance jointly play an important role in maintaining social stability and making up for economic losses. The results of this study also showed statistical differences in the type of insurance, monthly income and medical expenses of patients. Whether patients participate in any insurance and the type of insurance they have are factors affecting medical expenses. Therefore, two suggestions were provided for hospitals. First, promoting the basic medical security system and optimizing the rules of security could effectively relieve the pressure of expenditure, improve the security for vulnerable groups, and enable residents to obtain high-quality medical and health services to a greater extent. Second, insurance institutions can allocate medical insurance to each hospital according to the patient's disease type, so as to relieve the pressure on medical and health resources of large hospitals.

Diversification of Registration and Appointment Methods

According to the statistical data, more than half of the waiting time was more than 30 minutes, and 75.75% of the consultation time were less than 10 minutes. The reason may be that the hospital has a large number of patients. Most of the patients felt that the waiting time is long, the time for taking medicine is long, and the doctor's consultation time is short. Patients are sensitive to time when seeking medical treatment and hope to be treated as soon as possible. In addition, due to the healthcare reform, people have high expectations of medical problems. They hope that the reform could take immediate effect. However, it requires a process. If patients wait too long in the process of seeing a doctor, they are more likely to experience anxiety. When patients are not clear about their diseases, they choose to go to a large general hospital for the sake of security. In addition, senior doctors are reluctant to go to primary hospitals due to the worse equipment and environment problems. Given this vicious circle, large hospitals are overcrowded, whilst primary hospitals have less patients, leading to a decline in the total medical quality. In addition, medical resource allocation is difficult to solve. According to statistics, 42.33% of the patients visited the hospital for general diseases, whilst 54.69% went to a tertiary hospital because of the high level of doctor and 46.10% chose doctors with high professional titles. This behavior could cause unnecessary crowding in tertiary hospital. First, for patients with common diseases, the first choice of hospital should be somewhere close or the community hospital for treatment, which could improve the efficiency of medical treatment and properly allocate patients. Second, hospitals should encourage patients to learn to use modern service equipment, such as online booking, WeChat official account reservation platform, telephone booking and self-help registration machine, to shorten the waiting time. Finally, primary hospitals could improve their treatments, mechanism of promotion, and overall hospital level to obtain the trust of patients.

Improving the Service Mechanism of Primary Medical Institutions According to the Needs of Patients

The results of this study showed that the main reason why patients choose a hospital is because of the high level of doctors. Hospital reputation, hospital environment, service attitude, and advanced equipment are also the key factors affecting the choice of patients. The degree of transportation convenience also accounted for a large proportion in the residents' medical-seeking behavior, which is closely related to the level of urbanization development and the relatively rich health resources of the hospital.[24] The selection criteria of patients for doctors mainly consisted of professional titles (46.10%). Relatively good doctor resources, good medical environment, and advanced medical equipment could increase the trust and comfort of patients to a certain extent. Hospitals could improve the efficiency of their health services and patient satisfaction by increasing the ability and service level of doctors, upgrading the equipment conditions, optimizing the hospital management system and increasing the learning and exchange opportunities between hospitals.

Changing the Mode of Medical Publicity

By establishing a good image, the hospital can attract more patients, relieve the pressure of medical treatment in large

general hospitals, and maximize the benefits of health services for residents. The survey data shows that most patients choose to learn about diseases, hospitals, and doctors through the Internet (39.86%). Statistical differences exist among patients in different occupations in understanding how they seek medical care. Therefore, it is particularly important to build a diversified media promotion platform. First, the hospital should improve the construction of an online platform for medical services, enrich the connotation of the hospital brand through cultural publicity videos, and update hospital policies, equipment, introductions and major medical achievements in real time, so that residents can keep up to date with the latest information and avoid choice blindness. Second, the behavior of seeking medical treatment due to the introduction of relatives and friends also accounted for a considerable proportion (37.07%). Hospitals should improve the readability of propaganda and cultural columns to achieve secondary propaganda. Finally, for areas with low internet penetration, such as rural areas, we can make full use of advertising, television, radio, newspapers, and other media for health education. Therefore, the effective transformation of publicity methods by medical institutions or health service institutions can guide residents to make correct medical decisions to a certain extent.

In the questionnaire, civil servants, public sector workers and business persons are prefer community hospitals. This phenomenon may be related to the time constraints of this group of people for it would take more time to see a doctor in Chinese public tertiary hospitals. In addition, most of the public sector workers and businessmen are between the ages of 23 and 60, and most of who have the diseases are not serious, so they can solve the problem by choosing a community hospital. This phenomenon shows that Chinese policy of developing community hospitals in recent years is correct.

Conclusion

The patient's behavior of seeking medical treatment is the result of the cross-influence of a series of subjective and objective factors. Therefore, exploring the influencing factors of patients' willingness to seek medical treatment can predict the characteristics of the medical treatment behavior of the population in a certain place, and guide the health and medical service institutions to make correct decisions.

Limitation

The research due to the limitations of resources, personnel, and other conditions, we chose one hospitals to complete most of the questionnaires. The study did not estimate the sample size. Although it is more suitable for exploratory research, it leads to a lack of representativeness of the sample. We will refine the data in the follow-up study.

There are still deficiencies in this study. In the survey, younger respondents are more likely to cooperate with the questionnaire, so there are many young people in our sample. However, age does play a role in the type of insurance. For example, it is possible that a 19-year-old people is a student who has no permanent job and no labor insurance. This is the limitation of our research, so the next research is going to enter the community for investigation, which is beneficial to the investigation of people of different age groups.

The influencing factors included in the questionnaire design process are not comprehensive enough. For example, for personal circumstances, the questionnaire only considers the patient's income and education, but does not take into account the patient's marital status and the burden brought by family members. Therefore, the questionnaire limits the investigation of the relationship between individual circumstances and socioeconomic circumstances. Subsequent studies can include more variables that affect patients' willingness to seek medical treatment. In addition, due to factors such as data availability, the survey respondents only selected outpatients from one general hospital. In future research, we can combine multiple regions or multiple types of hospitals for analysis.

Authors' contributions

All authors contributed to the study conception and design. Material preparation, data collection, and analysis were performed by Yu Li, Wen Li, Zhihui Wu, Jianhui Yuang, Yanling Wei, Chao Huang, and Daizheng Huang. The first draft of the manuscript was written by Yu li and Daizheng Huang, and all authors commented on previous versions of the manuscript. All authors read and approved the final manuscript.

Data Availability

Upon request, the authors can send relevant data in order to verify the validity of the results presented. Such requests should be sent to the corresponding author.

ORCID iD

Daizheng Huang   https://orcid.org/0000-0003-0245-6303

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