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Preferences for healthcare services among hypertension patients in China: a discrete choice experiment

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ABSTRACT

Objectives

Our study aimed to support evidence-informed policy-making on patient-centered care by investigating preferences for healthcare services among hypertension patients.

Design

We identified six attributes of healthcare services for a discrete choice experiment (DCE), and applied Bayesian-efficient design with blocking techniques to generate choice sets. After conducting the DCE, we used a mixed logit regression model to investigate patients' preferences for each attribute and analyzed the heterogeneities in preferences. Estimates of willingness to pay were derived from regression coefficients.

Setting

The DCE was conducted in Jiangsu province and Shanghai municipality in China.

Participants

Patients aged 18 years or older with a history of hypertension for at least two years and who took medications regularly were recruited.

Results

Patients highly valued healthcare services that produced good treatment effects (β=4.502, $p<0.05$), followed by travel time to healthcare facilities within 1 hour (β=1.285, $p<0.001$), and the effective physician-patient communication (β=0.771, $p<0.001$). Continuity of care and minimal waiting time were also positive predictors ($p<0.001$). However, the out-of-pocket cost was a negative predictor of patients' choice (β= -0.168, $p<0.001$). Older adults, patients with good health-related quality of life, had comorbidities, and who were likely to visit secondary and tertiary hospitals cared more about favorable effects ($p<0.05$). Patients were willing to pay CNY 2,489 (95% CI 2,013-2,965) as long as the clinical benefits gained were substantial.

Conclusions

Our findings highlight the importance of effective, convenient, efficient, coordinated, and patient-centered care for chronic diseases like hypertension. Policymakers and healthcare providers are suggested to work on aligning the service provision with patients' preferences.

Keywords: patients' preferences, healthcare services, discrete choice experiment, hypertension

Strengths and limitations of this study

- Our study provides valuable information regarding patients' preferences for healthcare services in China.
- The in-depth understanding of patients' preferences will inform policymakers to bridge the gap between the optimal models for patient-centered service delivery and patients' healthcare needs.
- The discrete choice experiment is a rigorous method that enables us to measure patients' preferences.
- Comorbidities, past healthcare experience, and health-related quality of life were used as variables of preference heterogeneity to address the evidence gap.
- While this study explored the preferences among hypertension patients, future studies need to examine other types of chronic diseases.

INTRODUCTION

Hypertension, also known as high blood pressure, is a condition in which the blood vessels have raised pressure persistently. Hypertension can damage the brain, heart, kidney, and arterial blood vessels. It is ranked as the leading cause of cardiovascular disease and premature death worldwide.[1] The prevalence of hypertension is high and continues to be rising in China in recent years. Among Chinese adults aged over 15 years, 18.14% have hypertension.[2] Despite huge efforts, the awareness, treatment, and control rate of hypertension remained extremely low, which were associated with substantial unnecessary disease burden and significant excess mortality.[3-5] Moreover, many hypertension patients have multiple comorbidities, which is associated with increased utilization of healthcare services and great financial burden to individuals and the health system.[6 7]

To optimize the allocation of healthcare resources and reach the goal of delivering high-standard healthcare services, since 2009, the Chinese government has vigorously promoted the implementation of the hierarchical medical system. Primary healthcare facilities like community health service centers are expected to offer affordable first-contact care, while secondary and tertiary healthcare facilities provide specialist referral services. In the past decade, advances have been made by the Chinese government in achieving universal health coverage and providing financial protection for its citizens.[8] However, primary healthcare was underutilized, and the referral system was still practiced with poor effectiveness.[9]

Many patients would like to get healthcare services directly from specialists in tertiary hospitals. In 2019, there were 3842.4 billion patient visits to hospitals in China, 53.53% of which were visits to tertiary hospitals.[10] A study showed that only 21.95% of outpatients from tertiary hospitals were willing to choose a general practitioner in a primary care setting as their first-contact physician.[11] Likewise, 50.27% of respondents in a survey never heard of general practitioners.[12] Moreover, individuals with better socioeconomic status and greater healthcare needs seemed to

be less likely to utilize primary healthcare.[13]

Understanding patients' preferences are particularly worthwhile when patient decisions are preference-sensitive, like the choice in healthcare services. Eliciting patients' preferences is a key element of patient-centered care. Discrete choice experiment (DCE) is a well-established quantitative approach to elicit stated preferences. Despite several DCEs[14-22] were carried out to investigate public preferences for healthcare services, none of them involved patients with hypertension, one of the most common types of chronic diseases.

Although patient-reported outcomes, such as health-related quality of life (HRQoL) are essential measures of health status, whether patients' preferences on healthcare services differ from HRQoL remain unclear. Furthermore, preferences contain a learned component, and past experience might influence an individual's current choice.[23 24] We remain unclear about whether the healthcare facilities that patients usually visited in the past could have an impact on their current preferences for healthcare services.

We aim to fill the gap by measuring preferences of healthcare services for first-contact care among hypertension patients, thus supporting evidence-informed policy-making to address the problems of inappropriate healthcare service utilization. Specifically, we conducted a DCE to test the following hypotheses: (1) attributes regarding health benefits are more important than other attributes for patients' preferences for healthcare services; (2) patients' preferences differ by socio-demographic characteristics, feelings of health status (i.e. HRQoL), the severity of disease (i.e. comorbidities), and the prior experience of healthcare services.

METHODS

Identification of attributes and levels

Our DCE design, implementation, and analysis followed the user guide jointly developed by the World Bank, World Health Organization, and the U.S. Agency for

International Development.[25] First, a literature review was conducted to identify attributes that were often used in DCEs regarding patients' preferences. We found that the most commonly mentioned dimensions were the service provision capabilities (skills and attitudes of medical staff, accessibility of medicines and medical equipment, environment), service efficiency (waiting time for admission or treatment), affordability (out-of-pocket costs for service delivery, consultation, examination or treatment), and convenience (travel time or distance from home to healthcare facilities).

Second, focus group discussions with physicians and hospital managers were carried out to determine the attributes and levels. According to their suggestions, although the expertise of healthcare professionals was found to be an important attribute for patients' preferences, benefits from healthcare were rarely considered. Moreover, continuity of healthcare is correlated with increased patient satisfaction and effective physician-patient communication is a central clinical function. [26 27] Therefore, we considered the above attributes in our research.

Attributes and levels of healthcare services that were used in our DCE were shown in Table 1. Details of the explanation of attributes and levels were listed in Appendix 1. Our research objective was to identify the healthcare service attributes and levels that were preferred by hypertension patients, not the grade of hospitals (i.e. primary, secondary, tertiary). Hence, the scenarios in our DCE were not restricted to a specific grade of hospitals.

Table 1. Attributes and levels of healthcare services in the DCE

Domains	Attributes	Levels	Variables coding
Capabilities	Treatment effects	Good; Moderate; Poor	Categorical
	Physician-patient communication	Good; Moderate; Poor	Categorical
	Continuity of care	Yes; No	Categorical
Efficiency	Waiting time	Within 0.5 hour; 2 hours; 4 hours or longer	Categorical
Affordability	Out-of-pocket costs (if reimbursed)	CNY 150 to 600	Continuous
Convenience	Travel time	Within 1 hour; 3 hours; 6 hours or longer	Categorical

Note: The average exchange rate of US Dollars to Chinese Yuan (CNY) in 2020 was about 6.90. Therefore, CNY 150 was approximately US$21.7 and CNY 600 was about US$87.0.

Experimental design and development of the questionnaire

We used Ngene1.2 software (Choice-Metrics, Sydney, Australia) to conduct the D-efficiency experimental design. After obtaining priors of the attributes and levels from the pilot, the Bayesian-efficient design was used to create the formal choice sets, which comprised 48 pairs of scenarios and were divided into six blocks, with eight pairs in each block. Blocking design boosted response efficiency by reducing the cognitive burden on respondents.[28]

We applied unlabeled DCE, which had been widely used to investigate public preferences for healthcare.[15-17 19 20 22] Respondents in unlabeled DCEs found that they were not subject to the psychological cues of the labels, thus reflecting the real-life choice.[21 29] Also, in our research, we did not investigate patients' preferences for specific types of healthcare facilities. Therefore, the unlabeled DCE was considered appropriate. When no option had a definitive advantage, it was assumed that an opt-out option could raise the probability of neutral responses, increasing the number of individuals that might choose the opt-out scenario.[30-32] While the forced-choice sets under preference uncertainty would favor options that were easier to justify and contributed to a lower likelihood of regret and error.[33] Consequently, forced-choice

sets were used in our DCE. Examples of choice scenarios were shown in Appendix 2.

The questionnaire included four parts. The first part consisted of patients' socio-demographic characteristics, past medical history, comorbidities, and healthcare experience (i.e. types of frequently visited healthcare facilities). The second part contained the DCE tasks. The third part was the items of EQ-5D-5L,[34] which used a health-state classification system defining health in five dimensions, mobility, self-care, usual activities, pain/discomfort, and anxiety/depression. Each of the five dimensions was classified into five levels of perceived problems, no problem, mild problems, moderate problems, severe problems, and unable to/extreme problems. The final part was the level of understanding and confidence when making the DCE choices. The score ranged from zero (worst case) to 10 (best case) (Appendix 3). We excluded the DCE questionnaires with an average score of less than eight.

Sample size

There was no universal standard for the ideal sample size for DCEs.[35] A less efficient design might require a larger sample size, leading to increased costs.[36] We followed a rule-of-thumb[37] when determining sample size:

$$\frac{nta}{c} \geq 500$$

where n was the number of respondents, t was the number of tasks, a was the number of alternatives, and c was the largest number of levels for any attributes. We had six blocks of choice sets; as a result, the minimum sample size was 564.

DCE implementation and data collection

Our formal DCE was carried out from November 1st to December 31st, 2020, in Jiangsu province and Shanghai municipality. Inclusion criteria were patients aged 18 years or older, with a history of hypertension for at least two years, and who took medications regularly. Hypertension patients during pregnancy were excluded. Patients were recruited consecutively from nine healthcare facilities.

To ensure the validity and reliability of the survey, the DCE questionnaires were administrated through one-to-one, face-to-face interviews. Our interviewers consisted of eight medical interns and nine physicians. For quality assurance, we compiled a survey training manual and trained the interviewers before the experiment. The interviewers were required to check the completeness of each questionnaire immediately after it was completed. As long as any missing information, they had to ask patients to provide additional information. For patients who were illiterate or had blurred vision, the interviewers explained the meaning of the questionnaire item by item until the patients fully understood each item.

We proposed a hypothetical situation of poor blood pressure control and uncomfortable symptoms. Patients were asked to think carefully and make a trade-off between two types of services for their first-contact care. The duration of the survey ranged from 20 minutes to one hour. Patients were informed that participation in the survey was anonymous and voluntary, and their verbal and informed consent was obtained prior to the survey. We gave each patient a wrapped cotton towel as a gift (CNY 10, or US$1.4).

Patient and public involvement

One hundred and eight patients participated in the pilot survey to provide feedback on the intelligibility and acceptability of the questionnaire. Responses from the patients contributed to a more apprehensible and concise description of the DCE questions. The patients engaged in the pilot were not involved in the formal survey. No patients took part in the recruitment of study participants or the carry out of the study.

Statistical Analysis

Our DCE data analysis was based on the random-effects model.[38] In the random utility theory, the conventional utility function U consists of two parts: one is the determinism V containing the observable component, and the other is the random

component ε representing the random error term with standard statistical properties.[39] Therefore, the utility of the individual i of alternative n is:

$$U_{in} = V_{in} + \varepsilon_{in} \quad (1)$$

According to equation (1), the probability of the respondent choosing designated healthcare services was simulated. The probability of choice was determined by the indirect utility function of the respondent i who choose j in the selection set s. It was assumed to be a linear and additive form, and its form was:

$$V_{ijs} = X_{ijs}\beta + \varepsilon_{ijs} \quad (2)$$

Where V_{ijs} represented the utility derived from a choice, $X_{ijs}\beta$ was the utility component, and ε was the random component. The $X_{ijs}\beta$ was specified below, where $\beta_{1\text{-}6}$ represented reference scores of attributes and β_0 was the constant:

$$X_{ijs}\beta_j = \beta_0 + \beta_1 Treatment\ effects_j + \beta_2 Physician - patient\ communication_j + \beta_3 Continuity\ of\ care_j + \beta_4 Waiting\ time_j + \beta_5 Travel\ time_j + \beta_6 Out - of - pocket\ costs_j \quad (3)$$

We implemented the above equation by mixed logit regression using STATA 14.2 SE (STATA Corp LLC, College Station, Texas, USA) and was specified with 500 Halton draws. The mixed logit model allows for unknown heterogeneity in individual preferences. We assumed that all variables of the attributes had a random component and that the weights of preference were normally distributed.[40] The choice of patients was the dependent variable, and the selected attributes were independent variables.

Respondents' characteristics are likely to influence their decisions, but they are neither part of the choice alternatives nor a direct source of utility. One way to investigate how respondents' characteristics affect their choices is to include interaction terms between attributes and individuals' characteristics, allowing weights of the attributes to vary with characteristics.[41] Therefore, we extended the main effects model with interaction terms between attribute levels and the factors likely to influence patients' choice. The interaction terms were specified as random parameters

to keep suitable computation times. To assess whether preferences varied, we performed χ^2 tests for joint significance. Standard errors were clustered at the respondent level during the analysis.

Effects coding was used for categorical variables in DCE data. For effects coding, the mean effect for each attribute was normalized at zero, rather than all the reference categories were set to zero.[42] Each coefficient was estimated relative to the mean attribute effect.[42] The marginal rate of substitution (MRS) between attributes could be obtained by calculating the ratio of the partial derivatives of each attribute, where β was the coefficient of the attribute.

$$MRS = -\frac{\beta_a}{\beta_b} \quad (4)$$

Since our DCE attributes included costs, it could be used to generate an estimate of willingness to pay (WTP) of attributes expressed as in the unit of cost by replacing the denominator with the β estimate for the cost attribute. According to the estimated preference scores for each attribute level, WTP for changing attribute A from level 1 to level 2 could be calculated as follows:

$$\text{WTP} = -\frac{\beta_{A2} - \beta_{A1}}{\beta_{cost}} \quad (5)$$

where β_{cost} was the preference score of out-of-pocket costs, and β_{A1} and β_{A2} were preference scores of level 1 and level 2 for attribute A respectively.

RESULTS

Patients' characteristics

A total of 722 hypertension patients were consented to participate in our DCE survey. 19 patients were excluded from the analysis due to non-compliance with the inclusion criteria, incomplete data, lack of understanding and confidence in making the DCE choices. As a result, data from 703 patients were available for analysis. Two hundred and seven patients (29.45%) were enrolled from primary healthcare facilities, 247 (35.13%) from secondary hospitals, and 249 (35.42%) from tertiary hospitals. For

details about the number of patients in each sampled hospital, please refer to Appendix 4. On average, patients found it easy to understand the scenarios (8.23, 95%CI 8.18-8.27), and confident in their choice (8.99, 95%CI 8.92-9.05).

Table 2 summarized the socio-demographic and clinical characteristics of patients. The sample had more males than females (56.90% vs. 43.10%). The average age was 64.66 years old (ranging from 24 to 96 years old). 38.26% of the monthly household income was less than CNY 4,000. 416 patients (59.17%) had comorbidities, and cardiovascular disease (191 patients) was the most common type (Appendix 5). Only 47.80% of patients considered primary healthcare facilities as their first choice, and only 26.17% of patients had contract service with general practitioners.

Table 2. Characteristics of patients (N=703)

Variables	N (%)
Gender	
Male	400 (56.90)
Female	303 (43.10)
Age[#]	
<65	308 (43.81)
65-74	258 (36.70)
⩾75	137 (19.49)
Education	
Primary school/ Unschooled	337 (47.94)
Junior high school/ High school	279 (39.69)
Junior college or higher vocational college	54 (7.68)
Bachelor's degree or above	33 (4.69)
Employment	
Farmer	278 (39.54)
Urban employee	106 (15.08)
Freelancers	74 (10.53)
Unemployed	22 (3.12)
Retiree	223 (31.72)
Type of public health insurance	
UEBMI	272 (38.69)
URRBMI	431 (61.31)

Monthly household income (CNY)	
≤2000	126 (17.92)
2001~4000	143 (20.34)
4001~6000	130 (18.49)
6001~8000	91 (12.95)
8001~10000	72 (10.24)
10001~12000	54 (7.68)
>12000	87 (12.38)
Duration after diagnosis of hypertension (years)	
≤10	474 (67.43)
>10	229 (32.57)
Comorbidities	
No	287 (40.83)
Yes	416 (59.17)
The most frequently visited healthcare facilities	
Primary healthcare facilities	336 (47.80)
Secondary hospitals	228 (32.43)
Tertiary hospitals	139 (19.77)
Contract service with general practitioners	
No	519 (73.83)
Yes	184 (26.17)
EQ-5D-5L index value[Δ]	
≤0.85	423 (60.17)
>0.85	280 (39.83)

Notes: UEBMI, Urban Employees Basic Medical Insurance; URRBMI, Urban-Rural Residents Basic Medical Insurance; CNY, Chinese yuan

[#]Patients were divided into three groups: young and middle-aged (younger than 65 years old), young-old elderly (aged 65-74), old-old elderly (aged 75 and older).[43]

[Δ]The utility index was derived from the Chinese value sets.[44]

Model estimation of preferences

We found that patients valued healthcare services that generated good treatment effects (β=4.502, p<0.05), followed by travel time to healthcare facilities within 1 hour (β=1.285, p<0.001), and the adequate physician-patient communication (β=0.771, p<0.001) (Table 3). Minimal waiting time (β=0.447, p<0.001) and continuity of care (β=0.321, p<0.001) were also positive predictors of patients' choice

of healthcare services. While out-of-pocket cost was a negative predictor of patients' preferences (β= -0.168, p<0.001). The SD revealed coefficient heterogeneity in the random parameters of attributes.

Table 3. Estimates of the mixed logit model (N=703)

Attributes	Mean	SE	SD	SE
Treatment effects				
Poor(ref)	-4.299***	0.348		
Moderate	-0.204**	0.089	0.824***	0.160
Good	4.502*	0.357	2.148***	0.223
Physician-patient communication				
Poor(ref)	-0.727***	0.089		
Moderate	-0.044	0.061	-0.390**	0.147
Good	0.771***	0.084	0.657***	0.116
Continuity of care				
No(ref)	-0.321***	0.048		
Yes	0.321***	0.048	0.318**	0.121
Waiting time				
4 hours or longer (ref)	-0.476***	0.072		
2 hours	0.029	0.063	-0.137	0.225
Within 0.5 hour	0.447***	0.066	0.351**	0.132
Travel time				
6 hours or longer (ref)	-1.490***	0.122		
3 hours	0.205***	0.061	0.409***	0.122
Within 1 hour	1.285***	0.107	0.952***	0.111
Out-of-pocket costs (if reimbursed)				
Cost (per CNY50)	-0.168***	0.020	0.198***	0.033
Log likelihood		-2299.4957		
Observations		11248		

Notes: Ref, reference; SE, standard error; SD, standard deviation; HRQoL, Health-related quality of life; CNY, Chinese yuan.

*p<0.05; **p<0.01; ***p<0.001

The coefficient for the reference group was calculated as the negative sum of other coefficients.

Marginal willingness to pay

According to the average WTP (Table 4), we found that patients highly valued the magnitude of treatment effects. They would be willing to pay an extra CNY 2,489 for healthcare services to improve the effects from poor to good, while their WTP to increase the effects from poor to moderate was CNY 1,155. The WTPs for other attributes from high to low were as follows: travel time, satisfied physician-patient communication, minimum waiting time, moderate physician-patient communication, and moderate waiting time.

Table 4. Marginal willingness to pay for each attribute (N=703)

Attributes	WTP (95% CI)
Treatment effects	
From poor to moderate	1155*** (927～1383)
From poor to good	2489*** (2013～2965)
Physician-patient communication	
From poor to moderate	191*** (113～270)
From poor to good	423*** (315～532)
Continuity of care	
From no to yes	184*** (122～247)
Waiting time	
From 4 hours or longer to 0.5-2 hours	146*** (73～219)
From 4 hours or longer to within 0.5 hour	265*** (185～346)
Travel time	
From 6 hours or longer to 1-3 hours	481*** (368～594)
From 6 hours or longer to within 1 hour	783*** (615～950)

Notes: CNY, Chinese Yuan; ***p<0.001

Preference heterogeneity

The impact of patients' characteristics on preferences for healthcare services was shown in Appendix 6. We tested for interactions of monthly household income levels with different attributes. Compared with low-income patients, those who had high income showed stronger preferences for good physician-patient communication (β=0.377, p<0.05) and minimum waiting time (β=0.396, p<0.01) (Model 1). The

negative interaction term between income and moderate treatment effects showed that high-income patients valued the moderate effects to be less important than did low-income patients.

Similarly, we tested for interactions of age with the attributes, with young or mid-aged patients as the reference category (Model 2). Four interaction terms were statistically significant: good treatment effects (β=2.839, p<0.001), shortest travel time (β=0.533, p<0.01), good physician-patient communication (β=0.442, p<0.05), and continuity of care (β=0.232, p<0.05).

There were statistically significant interaction terms of comorbidities with three attributes. Patients who had comorbidities favored more in healthcare services that generated good treatment effects (β=0.986, p<0.05), required minimum travel time (β=0.588, p<0.01), and ensured continuity of care (β=0.318, p<0.01) (Model 3).

Compared with patients who usually visited primary healthcare facilities, those who tended to seek healthcare services from secondary or tertiary hospitals expressed a stronger preference for good treatment effects (β=0.898, p<0.05) and minimum waiting time (β=0.351, p<0.05) (Model 4). Patients with higher HRQoL paid more attention to healthcare services that contributed to good treatment effects (β=1.748, p<0.01) (Model 5).

DISCUSSION

Patients' preferences for healthcare services

To the best of our knowledge, this is the first DCE that systematically investigated the attributes influencing the choice of healthcare services for first-contact care among chronic disease patients like hypertension in China. An in-depth understanding of patients' perspectives on different healthcare service attributes is of global interest since it could inform the providing of appropriate healthcare that could improve patient satisfaction and service utilization.

According to the estimated attribute-level coefficients, we found that the

treatment effect was the most important attribute defining patients' preferences. Our results also showed that older adults, patients who had higher HRQoL, with comorbidities, and who usually visited secondary or tertiary hospitals to treat hypertension cared more about good treatment effects. The findings highlight the importance of taking effectiveness into account to improve patients' acceptance of primary healthcare services. However, the clinical experience of physicians[14 17] and types of healthcare professionals,[15 16] rather than treatment effects were often used to reflect the capabilities of healthcare provision in previous studies. In fact, preferences for provider types, which involved gender, types of medical staff, job titles, and professional training experience, were complex and difficult to interpret.

Our findings demonstrated that the minimum travel time to the healthcare facility was the second most important attribute. The results were consistent with previous DCEs, as the respondents disliked traveling longer distances to the healthcare providers.[16 21 45] Patients who were older and those who had comorbidities might feel inconvenient to travel a long distance for the first-contact care and rated shortest travel time to be more important than the counterparts.

Continuity of care was concerned with the quality of care over time. Traditionally, continuity of care is idealized in the patients' experience of a continuous caring relationship with the same healthcare professionals, as shown in previous DCEs.[45-48] However, for providers in vertically integrated healthcare systems, the contrasting ideal is the delivery of a 'seamless service'.[49] In our study, continuity of care was defined as coordinated and patient-centered care. It is a process involving the orderly, uninterrupted movement of patients among the diverse elements of the service delivery system.[49] We found that patients desired healthcare services that were consistent and coordinated according to their health needs. In addition, the continuity of care was considered even more important for older patients and patients who had comorbidities. They needed more health resources than other groups, and their choices of first-contact care should be paid more attention to.

We found that good physician-patient communication was also an important

attribute preferred by patients. In fact, effective physician-patient communication is essential in healthcare, affecting the patients' compliance with recommendations for care.[50] Physician-patient communication is a powerful indicator of healthcare quality that can determine patients' self-management behavior and satisfaction with healthcare providers.[51 52] This is shown by greater patient involvement and decisions are reached through shared decision-making.[53] Our analyses revealed that high-income and older patients valued good physician-patient communication more than did lower-income and younger groups.

Longer waiting time and increased out-of-pocket costs were significant, negative predictors for the entire sample, showing that patient preferences decreased as the waiting time and out-of-pocket costs increased. Similar results were noted in DCEs eliciting preferences for the choice of healthcare providers.[19 21] What's more, we found high-income patients and those who likely to visit secondary or tertiary hospitals were more concerned about waiting time. As shown in the previous study conducted in a Chinese public tertiary hospital, the reduced waiting time led to increased patient satisfaction.[54] Patients might have an increased willingness to pay for services that require less waiting time for an appointment to diagnose or treat, especially in the case of severe symptoms.[55]

Implications of the study findings

In China, patients sought first-contact care in a disorderly manner, and the gate-keeping role of primary healthcare has not been fully implemented.[56] Patients' preferences should be known to guide the delivery of appropriate, effective, and efficient care. Our research confirms that the ideal healthcare services that meet hypertension patients' demands for first-contact care comprise the following attributes: produce good treatment effects, closer to home, offer good physician-patient communication, need short waiting time, ensure continuity of care and require low out-of-pockets per visit.

The treatment effect was the most important attribute to attract patients. Patients

were more likely to choose the healthcare services that led to the experience of good quality. It is worth noting that older patients, patients who had high HRQoL, patients with comorbidities, and those who tended to visit secondary or tertiary hospitals would pay special attention to treatment effects. Meanwhile, patients expect to communicate with physicians to deliberate and express their preferences and views during the clinical decision-making process. Furthermore, older patients who are emotionally vulnerable and socially isolated are particularly in need of the emotional, social, and practical support that sensitive physician-patient communication can provide.[57]

Evidence of variations in the perceived utility of healthcare services among patients emphasizes the importance of taking individual patient preferences into account to address the problems of inadequate primary healthcare service utilization and the ineffectiveness of the two-way referral mechanism. Healthcare systems need to be adaptable enough to offer patients choices to account for heterogeneity in patients' preferences.

Our study highlights the importance of improved service quality, timely access, and shared decision-making for the first-contact care of chronic diseases like hypertension. The improvement of service quality, physician-patient communication, and continuity of care will contribute to patients' preference to choose primary healthcare facilities as the first-contact care. Our findings were consistent with the optimal healthcare delivery strategies to achieve universal health coverage, which involves providing effective, safe, people-centered care that is timely, equitable, integrated, and efficient.[58]

The quality of primary healthcare in China needed to be strengthened, and evidence-based monitoring and evaluation of the service quality are crucial for attaining the goals of healthcare system reform.[56] In addition to education for the general practitioners, the Chinese government could consider tailoring continuing training for the primary healthcare workforce.[59] Shared decision-making is appropriate for clinical decisions involving multiple reasonable options,[60] such as the

management of chronic diseases. To improve the physicians' communication skills, strictly planned, culturally competent, effectively implemented, and rigorously evaluated trainings are required.[61] Care coordination approaches should also be advocated to engage patients in decision-making, support effective management of comorbidities, and ensure accessibility to interventions. Furthermore, the primary healthcare-based integrated delivery system in China should be strengthened.[62]

Strengths and limitations

Our DCE provides valuable information about how patients weigh their first-contact care options and trade-off different healthcare service features. A better understanding of patients' preferences will guide the future development of the two-way referral mechanism, as policymakers aim to bridge the gap between the optimal models for patient-centered service delivery and patients' first-contact care needs.

The major contributions of our study are as follows. First, we used a DCE which followed good research practices, offering the advantage to explore the trade-offs between attributes of healthcare services. Second, the Bayesian-efficient design was applied to increase the statistical efficiency of the choice sets design, and a blocking technique was used to increase the response efficiency of patients. Third, we derived WTP estimates in hypothetical settings among patients with chronic diseases like hypertension. Fourth, this is the most comprehensive study that identifies preference heterogeneity according to age, income, HRQoL, comorbidities, and past healthcare service experience.

Our study has several limitations. First, the DCE results are not representative of all patients with chronic diseases, because we only explored the preferences among hypertension patients to ensure the comparability of patients. Future studies need to enroll patients with other types of chronic diseases and identify variations in patients' preferences across different subgroups. Second, our samples were from Jiangsu and Shanghai, which stand for the most economically developed regions in China. Future

studies should have a nationally representative sample by including the economically underdeveloped regions. Third, given the limited number of attributes and levels tested in DCE, it might not represent complex real-life situations. To further understand the relationship between stated (those elicited in the DCE) and revealed preferences (actual first-contact care-seeking behavior), studies are warranted to investigate if and how patients' preferences in healthcare services impact their long-term clinical outcomes.

CONCLUSION

Our DCE provides evidence about how hypertension patients value the attributes of healthcare services, including the capabilities, efficiency, affordability, and convenience of service provision, in the context of chaotic first-contact care-seeking behavior in China. The findings underline the importance of effective, convenient, efficient, coordinated, and patient-centered care for chronic diseases like hypertension. We also found preference heterogeneity that is correlated with patients' socio-demographic characteristics, feelings of health conditions, the severity of disease (i.e. comorbidities), and the prior experience of healthcare services. Policymakers and healthcare providers are suggested to work on aligning the service provision with patients' preferences, thus promoting the rational utilization of healthcare resources.

Ethics approval

This study, including the patient consent process, has been approved by the Medical Ethics Committee in Nantong University (Ethical Approval-202054) and conforms to the ethical guidelines of the Declaration of Helsinki.

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Author contributions

Geng JS, Yu XL, and Bao HN led the design and analysis of the discrete choice experiment. Shi JW and Yuan XY contributed to the literature search and data interpretation. Yu XL, Qian LL, and Feng Z contributed to implementing the discrete choice experiment. Yu XL, Bao HN and Geng JS performed the statistical analysis and wrote the manuscript.

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Disclosure

The authors report no conflict of interest in this research.

Data sharing statement

Data will be available upon reasonable request to the corresponding author.

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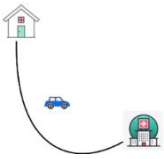
Appendix 1: Explanations to attributes and levels

Investigators were required to convey the following definitions to patients:

- Treatment effects: 'Good treatment effects' means that the ideal treatment goals set out in the evidence-based guidelines for individual patients can be achieved, and your accompanying symptoms disappear; 'Moderate treatment effects' suggests that although the blood pressure is almost to the ideal treatment goals, the accompanying symptoms still exist; 'Poor treatment effects' implies that both blood pressure and accompanying symptoms are not well controlled.
- 'Physician-patient communication' refers to the communication between the physician and the patient. 'Good' suggests that the physician always treats patients with respect, listens carefully when the patient is explaining, and engages the patient in clinical decision-making; 'Moderate' implies that the physician sometimes treats patients with respect, and sometimes feels boring and becomes impolite; listening to patients explaining, but not likely to involve the patient in clinical decision-making; 'Poor' indicates that attitude of the physician is impatient and impolite, never engages the patient in clinical decision-making.
- 'Continuity of care' suggests that the healthcare facility operates in a well-functioning integrated care delivery system, which can provide coordinated healthcare services for chronic disease patients, i.e. the appropriate care and care management is perceived to occur at the right time and in the right order.
- 'Waiting time' is the amount of time for patients seeking care at the healthcare facility before being attended for physician consultation, i.e. the time from registration to seeing a physician.
- 'Travel time' refers to the time it takes for the patient to drive from home to the healthcare facility (one way). In our study, the travel time is measured by taking a taxi or private car.
- The cost is defined as the out-of-pocket costs per visit if reimbursed, including the direct medical costs when accessing care. Those who participate in public health insurance programs may be eligible to receive reimbursement which contributes to reducing the out-of-pocket costs.

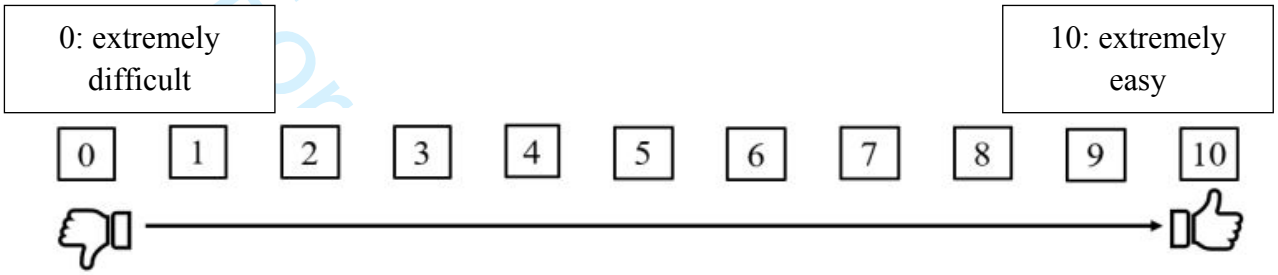
Appendix 2: Examples of DCE choice sets

Suppose you have poor blood pressure control, which results in uncomfortable symptoms like dizziness, headache, palpitation, chest pain, shortness of breath, nausea. If you can only choose one type of healthcare service for your first-contact visit, which one would you prefer? Please think carefully and make a trade-off.

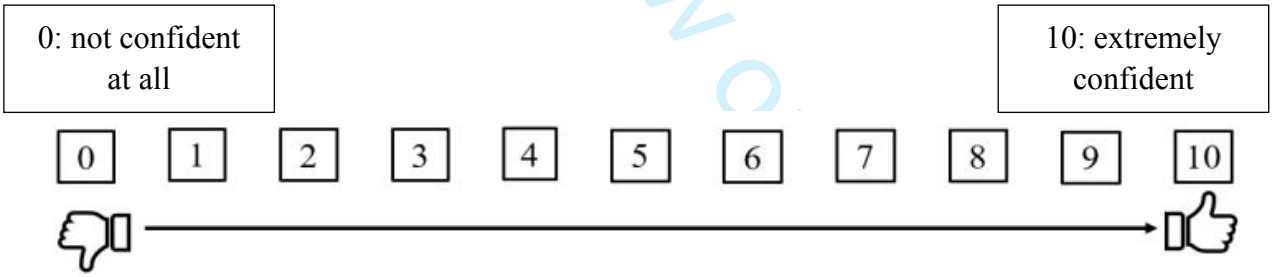
Attributes	Type A	Type B
Treatment effects	 Moderate	 Poor
Out-of-pocket costs (if reimbursed)	 CNY 300 per visit	 CNY 150 per visit
Physician-patient communication	 Poor	 Moderate
Continuity of care	 Yes	 No
Waiting time	 Within 0.5 hour	 2 hours
Travel time	 3 hours	 Within 1 hour
Your choice	☐	☐

Appendix 3: Evaluation of patients' understanding and confidence in DCE choices

1. Do you feel difficult or easy to understand the DCE scenarios and choice sets? Please select the level from zero to 10 and give a tick '√' in the score to reflect your understanding:



2. Are you confident in your choice of healthcare services? Please select the level from zero to 10 and give a tick '√' in the score to represent your confidence:



Appendix 4: Number of patients in the sampled healthcare facilities

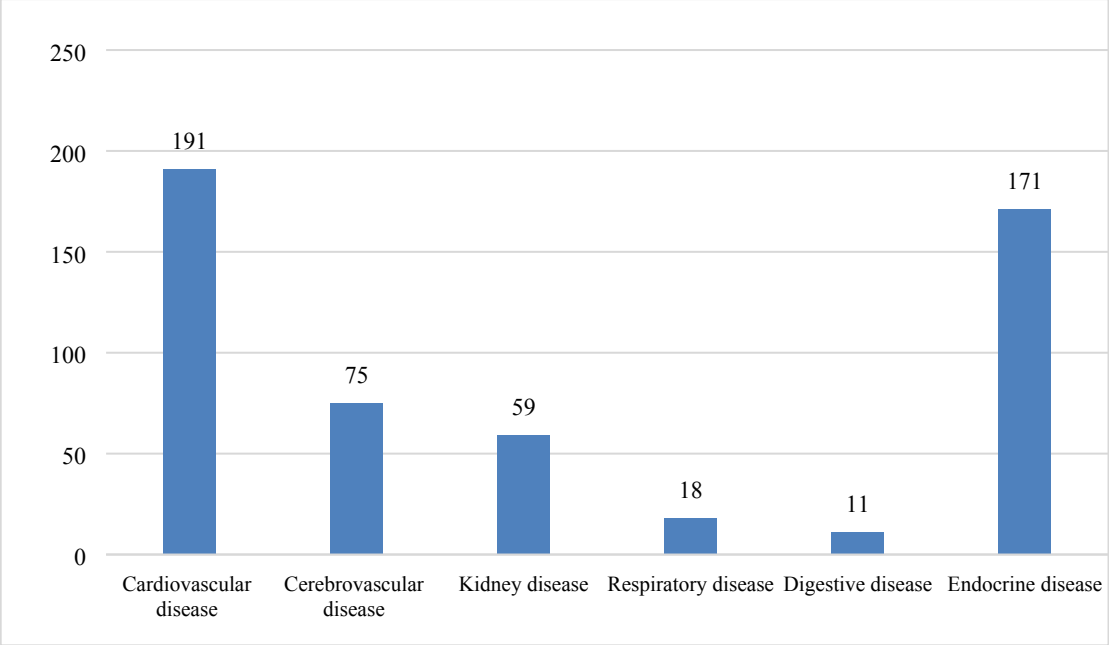
Supplemental Table 1. Number of patients in the sampled healthcare facilities (N=703)

Name of hospitals and health centers	City/District*	Province	Grade#	Number of patients
Affiliated Hospital of Nantong University	Nantong	Jiangsu	3	249
Tongzhou No.3 People's Hospital	Nantong	Jiangsu	2	30
Rudong Yangkou Hospital	Nantong	Jiangsu	1	90
Chongchuan Fumin Health Center	Nantong	Jiangsu	1	29
Xiangshui People's Hospital	Yancheng	Jiangsu	2	113
Dongtai People's Hospital	Yancheng	Jiangsu	2	45
Donghai People's Hospital	Lianyungang	Jiangsu	2	59
Pujiang Community Health Service Center	Pujiang	Shanghai	1	58
Zhuanqiao Community Health Service Center	Minhang	Shanghai	1	30

Notes: *Districts in Shanghai municipality.

#In China, hospitals are divided into three grades, tertiary, secondary, and primary, with tertiary hospitals being the highest grade. The primary healthcare facilities consist of community health service centers or stations, which are located in urban areas, and township healthcare centers, which are located in rural areas. A secondary hospital is similar to a regional hospital. A tertiary hospital is a comprehensive, referral hospital at the city, provincial or national level, with at least 500 hospital beds that are able to provide advanced and specialized medical services.

Appendix 5: Types of comorbidities in the patients



Supplemental Figure 1. Number of patients with comorbidities

Appendix 6: Results of the interaction effects

Supplemental Table 2. Model estimation of the interaction effects between attributes and patients' characteristics

Attributes	Model 1		Model 2		Model 3		Model 4		Model 5	
	Mean	SE	Mean	SE	Mean	SE	Mean	SE	Mean	SE
Treatment effects										
Poor(ref)	-4.874***	0.466	-3.352***	0.302	-4.319***	0.439	-3.894***	0.365	-4.340***	0.429
Moderate	0.059	0.155	-0.091	0.110	-0.018	0.133	-0.234*	0.118	-0.180	0.122
Good	4.816***	0.452	3.443***	0.308	4.337***	0.438	4.128***	0.378	4.520***	0.440
Physician-patient communication										
Poor(ref)	-0.692***	0.130	-0.542***	0.104	-0.659***	0.120	-0.772***	0.116	-0.780***	0.122
Moderate	0.038	0.098	-0.102	0.080	-0.021	0.087	0.019	0.083	-0.045	0.082
Good	0.654***	0.121	0.644***	0.097	0.680***	0.110	0.752***	0.107	0.824***	0.113
Continuity of care										
No(ref)	-0.248***	0.075	-0.236***	0.058	-0.190**	0.065	-0.313***	0.063	-0.408***	0.067
Yes	0.248***	0.075	0.236***	0.058	0.190**	0.065	0.313***	0.063	0.408***	0.067
Waiting time										
4 hours or longer(ref)	-0.375***	0.114	0.469***	0.090	-0.439***	0.104	-0.434***	0.095	-0.538***	0.098
2 hours	0.109	0.106	0.008	0.085	-0.029	0.093	0.116	0.086	0.0004	0.085
Within 0.5 hour	0.266**	0.096	0.461***	0.082	0.468***	0.096	0.318***	0.082	0.537***	0.087
Travel time										
6 hours or longer(ref)	-1.763***	0.175	-1.259***	0.127	-1.204***	0.137	-1.451***	0.139	-1.727***	0.170
3 hours	0.253*	0.103	0.159*	0.080	0.136	0.087	0.206*	0.084	0.249**	0.082
Within 1 hour	1.510***	0.154	1.100***	0.114	1.068***	0.123	1.245***	0.122	1.477***	0.150
Out-of-pocket costs (if reimbursed)										
Cost (per CNY50)	-0.202***	0.031	-0.167***	0.025	-0.153***	0.028	-0.168***	0.024	-0.199***	0.028

Interactions with demographics	Income		Age		Comorbidities		Type of healthcare facilities		EQ-5D-5L index value	
Treatment effects										
Moderate	-0.455*	0.204	-0.334	0.188	-0.348	0.191	0.056	0.180	-0.081	0.205
Good	0.406	0.275	2.839***	0.801	0.986*	0.442	0.898*	0.452	1.748**	0.612
Physician-patient communication										
Moderate	-0.201	0.128	0.133	0.126	-0.070	0.130	-0.156	0.121	0.021	0.139
Good	0.377*	0.154	0.442*	0.183	0.272	0.155	0.102	0.149	0.171	0.178
Continuity of care										
Yes	0.185	0.101	0.232*	0.102	0.318**	0.108	0.045	0.093	-0.130	0.110
Waiting time										
2 hours	-0.137	0.139	0.017	0.136	0.143	0.136	-0.193	0.128	0.006	0.152
Within 0.5 hour	0.396**	0.134	0.044	0.130	0.023	0.135	0.315*	0.132	-0.002	0.143
Travel time										
3 hours	-0.075	0.132	0.111	0.125	0.158	0.131	-0.012	0.125	-0.039	0.133
within 1 hour	-0.121	0.159	0.533**	0.189	0.588**	0.176	0.144	0.170	-0.034	0.202
Out-of-pocket costs (if reimbursed)										
Cost (per CNY50)	0.010	0.038	-0.017	0.039	-0.068	0.039	-0.015	0.037	0.002	0.042
Log likelihood	-2271.4592		-2283.4658		-2278.9024		-2289.7129		-2280.1412	
Participants	703		703		703		703		703	
Observations	11248		11248		11248		11248		11248	

Notes: Ref, reference. Monthly household income: CNY 4000 or less=0, Higher than CNY 4000=1; Age: Young or middle-aged (aged 64 or younger)=0, Elderly (aged 65 or older)=1; Comorbidities: No comorbidities=0, With comorbidities=1; The most frequently visited healthcare facilities: Community health centers=0, Secondary or tertiary hospitals=1; EQ-5D-5L index value: 0.85 and below=0, Higher than 0.85=1.

*p<0.05; **p<0.01; ***p<0.001

STROBE 2007 (v4) checklist of items to be included in reports of observational studies in epidemiology*
Checklist for cohort, case-control, and cross-sectional studies (combined)

Section/Topic	Item #	Recommendation	Reported on page #
Title and abstract	1	(*a*) Indicate the study's design with a commonly used term in the title or the abstract	Page 2
		(*b*) Provide in the abstract an informative and balanced summary of what was done and what was found	Page 3
Introduction			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	Page 5 Page 6 (line 4-32)
Objectives	3	State specific objectives, including any pre-specified hypotheses	Page 6 (line 35-49)
Methods			
Study design	4	Present key elements of study design early in the paper	Page 6 (line 57-60) Page 8 (line 27-60) Page 9 (line 4-26)
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	Page 9 (line 51-53) Appendix 4
Participants	6	(*a*) *Cohort study*—Give the eligibility criteria, and the sources and methods of selection of participants. Describe methods of follow-up *Case-control study*—Give the eligibility criteria, and the sources and methods of case ascertainment and control selection. Give the rationale for the choice of cases and controls *Cross-sectional study*—Give the eligibility criteria, and the sources and methods of selection of participants	Page 9 (line 54-60)
		(*b*) *Cohort study*—For matched studies, give matching criteria and number of exposed and unexposed *Case-control study*—For matched studies, give matching criteria and the number of controls per case	Not applicable
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	Page 7 Page 8 (line 4-24)
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	Page 9 (line 7-21) Page 10 (line 22-34)
Bias	9	Describe any efforts to address potential sources of bias	Page 9 (line 22-26) Page 10 (line 4-20)
Study size	10	Explain how the study size was arrived at	Page 9 (line 29-46)
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	Page 10 (line 55-60) Page 11 (line 4-31)

			Page 12 (line 10-40)
Statistical methods	12	(*a*) Describe all statistical methods, including those used to control for confounding	Page 11 (line 33-45)
		(*b*) Describe any methods used to examine subgroups and interactions	Page 11 (line 47-60) Page 12 (line 4-8)
		(*c*) Explain how missing data were addressed	Page 10 (line 10-15)
		(*d*) *Cohort study*—If applicable, explain how loss to follow-up was addressed *Case-control study*—If applicable, explain how matching of cases and controls was addressed *Cross-sectional study*—If applicable, describe analytical methods taking account of sampling strategy	Not applicable
		(*e*) Describe any sensitivity analyses	Page 11 (line 47-60) Page 12 (line 4-8)
Results			
Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	Page 12 (line 46-60)
		(b) Give reasons for non-participation at each stage	Not applicable
		(c) Consider use of a flow diagram	Not applicable
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	Page 13 (line 10-60) Page 14 (line 2-46)
		(b) Indicate number of participants with missing data for each variable of interest	Not applicable
		(c) *Cohort study*—Summarise follow-up time (eg, average and total amount)	Not applicable
Outcome data	15*	*Cohort study*—Report numbers of outcome events or summary measures over time	
		Case-control study—Report numbers in each exposure category, or summary measures of exposure	
		Cross-sectional study—Report numbers of outcome events or summary measures	Page 14 (line 51-60) Page 15 (line 4-8)
Main results	16	(*a*) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	Page 15 (line 9-52) Page 16 (4-46)
		(*b*) Report category boundaries when continuous variables were categorized	Not applicable
		(*c*) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	Not applicable
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	Page 16 (line 48-60) Page 17 (line 4-40) Appendix 6
Discussion			

Key results	18	Summarise key results with reference to study objectives	Page 17 (line 45-60) Page 18 Page 19 (4-38)
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	Page 21 (line 49-60)
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	Page 19 (line 40-60) Page 20 (line 4-20)
Generalisability	21	Discuss the generalisability (external validity) of the study results	Page 20 (line 22-60) Page 21 (4-14)
Other information			
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	Page 23 (line 30-44)

*Give information separately for cases and controls in case-control studies and, if applicable, for exposed and unexposed groups in cohort and cross-sectional studies.
Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at http://www.plosmedicine.org/, Annals of Internal Medicine at http://www.annals.org/, and Epidemiology at http://www.epidem.com/). Information on the STROBE Initiative is available at www.strobe-statement.org.

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Preferences for healthcare services among hypertension patients in China: a discrete choice experiment

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ABSTRACT

Objectives

Our study aimed to support evidence-informed policy-making on patient-centered care by investigating preferences for healthcare services among hypertension patients.

Design

We identified six attributes of healthcare services for a discrete choice experiment (DCE), and applied Bayesian-efficient design with blocking techniques to generate choice sets. After conducting the DCE, we used a mixed logit regression model to investigate patients' preferences for each attribute and analyzed the heterogeneities in preferences. Estimates of willingness to pay were derived from regression coefficients.

Setting

The DCE was conducted in Jiangsu province and Shanghai municipality in China.

Participants

Patients aged 18 years or older with a history of hypertension for at least two years and who took medications regularly were recruited.

Results

Patients highly valued healthcare services that produced good treatment effects (β=4.502, $p<0.05$), followed by travel time to healthcare facilities within 1 hour (β=1.285, $p<0.001$), and the effective physician-patient communication (β=0.771, $p<0.001$). Continuity of care and minimal waiting time were also positive predictors ($p<0.001$). However, the out-of-pocket cost was a negative predictor of patients' choice (β= -0.168, $p<0.001$). Older adults, patients with good health-related quality of life, had comorbidities, and who were likely to visit secondary and tertiary hospitals cared more about favorable effects ($p<0.05$). Patients were willing to pay CNY 2,489 (95% CI 2,013-2,965) as long as the clinical benefits gained were substantial.

Conclusions

Our findings highlight the importance of effective, convenient, efficient, coordinated, and patient-centered care for chronic diseases like hypertension. Policymakers and healthcare providers are suggested to work on aligning the service provision with patients' preferences.

Keywords: patients' preferences, healthcare services, discrete choice experiment, hypertension

Strengths and limitations of this study

- The discrete choice experiment is a rigorous method that enables us to measure preferences for healthcare services among hypertension patients.
- Bayesian-efficient design with a blocking technique was applied to improve statistical efficiency as well as response efficiency.
- Comorbidities, past healthcare experience, and health-related quality of life were used as variables to observe preference heterogeneity and address evidence gaps.
- While this study explored the preferences among hypertension patients, future studies need to examine other types of chronic diseases.

INTRODUCTION

Hypertension, also known as high blood pressure, is a condition in which the blood vessels have raised pressure persistently. Hypertension can damage the brain, heart, kidney, and arterial blood vessels. It is ranked as the leading cause of premature death and the most important modifiable risk factor for cardiovascular disease.[1] The prevalence of hypertension is high and continues to be rising in China in recent years. Among Chinese adults aged over 15 years, 18.14% have hypertension.[2] Despite huge efforts, the awareness, treatment, and control rate of hypertension remained extremely low, which were associated with substantial unnecessary disease burden and significant excess mortality.[3-5] Moreover, many hypertension patients have multiple comorbidities, which is associated with increased utilization of healthcare services and great financial burden to individuals and the health system.[6 7]

To optimize the allocation of healthcare resources and reach the goal of delivering high-standard healthcare services, since 2009, the Chinese government has vigorously promoted the implementation of the hierarchical medical system. Primary healthcare facilities like community health service centers are expected to offer affordable first-contact care, while secondary and tertiary hospitals provide specialist referral services. In the past decade, advances have been made by the Chinese government in achieving universal health coverage and providing financial protection for its citizens.[8] However, primary healthcare was underutilized, and the referral system was still practiced with poor effectiveness.[9]

Patients were more favorable to healthcare services in hospitals than primary healthcare facilities in China.[10] Individuals with better socioeconomic status and greater healthcare needs seemed to be less likely to utilize primary healthcare.[11] As a result, hospitals were overloaded, and the long waiting time became the major source of dissatisfaction.[12] On the contrary, an integrated delivery system based on primary healthcare is helpful to meet the needs of China's aging population that are facing an increased chronic disease burden.[13] Nevertheless, patients' preferences for

hospital-based services for first-contact care place a huge obstacle to promoting community-based primary healthcare service.[14]

Understanding patients' preferences are particularly worthwhile when patient decisions are preference-sensitive, like the choice in healthcare services. Eliciting patients' preferences is a key element of patient-centered care. The discrete choice experiment (DCE) is a well-established quantitative approach to elicit stated preferences. Despite several DCEs being carried out to investigate patients' preferences for healthcare services, none of them involved patients with hypertension in China, one of the most common types of chronic diseases.[15-19]

Although patient-reported outcomes, such as health-related quality of life (HRQoL) are essential measures of health status, whether patients' preferences on healthcare services differ from HRQoL remain unclear. Furthermore, preferences contain a learned component, and past experience might influence an individual's present choice.[20 21] We remain unclear about whether the healthcare facilities that patients usually visited in the past could have an impact on their current preferences for healthcare services.

Due to the high prevalence, serious complications, and heavy burden, hypertension has become an important public health challenge. Effective and efficient healthcare services for hypertension patients are essential to successful disease control. Meanwhile, patients' demand for healthcare services varies according to the severity of the disease.[22 23] Therefore, we aim to fill the gap by measuring preferences of healthcare services for first-contact care among hypertension patients, thus supporting evidence-informed policy-making to address the problems of inappropriate healthcare service utilization. Specifically, we conducted a DCE to test the following hypotheses: (1) attributes regarding health benefits are more important than other attributes for patients' preferences of healthcare services for first-contact care; (2) patients' preferences differ by socio-demographic characteristics, feelings of health status (i.e. HRQoL), the severity of disease (i.e. comorbidities), and the prior experience of healthcare services.

METHODS

Identification of attributes and levels

Our DCE design, implementation, and analysis followed the user guide jointly developed by the World Bank, World Health Organization, and the U.S. Agency for International Development.[24] First, a literature search on February 10th, 2020, was conducted to identify attributes that were used in DCEs regarding preferences of healthcare services among patients with chronic diseases or chronic conditions. Twenty-seven studies were identified, with one DCE[25] conducted in the UK aimed to explore patients' preferences for the management of hypertension (Appendix 1). We found that the most commonly mentioned domains were the service provision capabilities (skills and attitudes of medical staff, accessibility of medicines and medical equipment, clinical benefits, environment, continuity of the care/coordination and continuity), service efficiency (waiting time for the appointment or treatment), affordability (costs or out-of-pocket costs for healthcare services), and convenience (travel time or distance from home to healthcare facilities) (Appendix 2). While in the DCE for preferences of hypertension patients[25], there were four attributes including service provision capabilities (frequency of blood pressure measurement), clinical benefits (reduction in 5-year cardiovascular risk), affordability (at the macro level as measured by the annual cost to National Health Service in the UK), and model of care (as defined by types of personnel who was responsible for disease management).

Second, focus group discussions with physicians and hospital managers were carried out to determine the attributes and levels. According to their suggestions, although the expertise of healthcare professionals was found to be an important attribute for patients' preferences, benefit from healthcare was also indispensable. Effectiveness is one of the important domains in quality assessment measures.[26 27] The effectiveness of healthcare has been considered as the ultimate validator of the quality of care.[28] Furthermore, improvement in the effectiveness of healthcare service would be helpful to achieve population health improvement and health system

sustainability.[29] Healthcare services that could bring health benefits usually had strong recommendations from experts.[30-32] As shown in guidelines on management and control of hypertension, getting blood pressure under control and reducing the risk of complications are the goals for hypertension treatment.[33 34] Therefore, we classified the levels of treatment effects according to the control of blood pressure and complications.

Continuity of care is a necessary part of the framework on integrated people-centered health services proposed by the World Health Organization.[35] Continuity of care was correlated with increased patient satisfaction, and effective physician-patient communication was regarded as a central clinical function.[36 37] Traditionally, a continuous caring relationship with the same healthcare professionals was found in previous DCEs.[38-42] However, for providers in vertically integrated healthcare systems, the contrasting ideal is the delivery of a 'seamless service'.[43] Similarly, multidisciplinary care became an attribute in a DCE that measured preferences for urban integrated primary care among type 2 diabetes patients.[44] As a result, we defined continuity of care as the healthcare facility operating in a well-functioning care delivery system, which could provide coordinated healthcare services for patients.[43]

Attributes and levels of healthcare services that were used in our DCE were shown in Table 1. Details of the explanation of attributes and levels were listed in Appendix 3. Our research objective was to identify the healthcare service attributes and levels that were preferred by hypertension patients, not the grade of hospitals (i.e. primary, secondary, tertiary). Hence, the scenarios in our DCE were not restricted to a specific grade of hospitals.

Table 1. Attributes and levels of healthcare services in the DCE

Domains	Attributes	Levels	Variables coding
Capabilities	Treatment effects	Good; Moderate; Poor	Categorical
	Physician-patient communication	Good; Moderate; Poor	Categorical
	Continuity of care	Yes; No	Categorical
Efficiency	Waiting time	Within 0.5 hour; 2 hours; 4 hours or longer	Categorical
Affordability	Out-of-pocket costs per visit (if reimbursed)	CNY 150 to 600	Continuous
Convenience	Travel time	Within 1 hour; 3 hours; 6 hours or longer	Categorical

Note: The average exchange rate of US Dollars to Chinese Yuan (CNY) in 2020 was about 6.90. Therefore, CNY 150 was approximately US$21.7 and CNY 600 was about US$87.0.

Experimental design and development of the questionnaire

We used Ngene1.2 software (Choice-Metrics, Sydney, Australia) to conduct the D-efficiency experimental design. After obtaining priors of the attributes and levels from the pilot, the Bayesian-efficient design was used to create the formal choice sets, which comprised 48 pairs of scenarios and were divided into six blocks, with eight pairs in each block. Blocking design boosted response efficiency by reducing the cognitive burden on respondents.[45]

We applied unlabeled DCE, which had been widely used to investigate public preferences for healthcare.[16-18 46-48] Respondents in unlabeled DCEs found that they were not subject to the psychological cues of the labels, thus reflecting the real-life choice.[49 50] Also, in our research, we did not investigate patients' preferences for specific types of healthcare facilities. Therefore, the unlabeled DCE was considered appropriate. When no option had a definitive advantage, it was assumed that an opt-out option could raise the probability of neutral responses, increasing the number of individuals that might choose the opt-out scenario.[51-53] While the forced-choice sets under preference uncertainty would favor options that were easier to justify and contributed to a lower likelihood of regret and error.[54] Consequently, forced-choice sets were used in our DCE. Examples of choice scenarios were shown in Appendix 4.

The questionnaire included four parts. The first part consisted of patients' socio-demographic characteristics, past medical history, comorbidities, and healthcare experience (i.e. types of frequently visited healthcare facilities). The second part contained the DCE tasks. The third part was the items of EQ-5D-5L, which used a health-state classification system defining health in five dimensions, mobility, self-care, usual activities, pain/discomfort, and anxiety/depression.[55] Each of the five dimensions was classified into five levels of perceived problems, no problem, mild problems, moderate problems, severe problems, and unable to/extreme problems. The final part was the level of understanding and confidence when making the DCE choices. The score ranged from zero (worst case) to 10 (best case) (Appendix 5). We excluded the DCE questionnaires with an average score of less than eight to ensure the validity of the data.

Sample size

There was no universal standard for the ideal sample size for DCEs.[56] A less efficient design might require a larger sample size, leading to increased costs.[57] We followed a rule-of-thumb[58] when determining sample size:

$$\frac{nta}{c} \geq 500$$

where n was the number of respondents, t was the number of tasks, a was the number of alternatives, and c was the largest number of levels for any attributes. We had six blocks of choice sets; as a result, the minimum sample size was 564.

DCE implementation and data collection

Our formal DCE was carried out from November 1st to December 31st, 2020, in Jiangsu province and Shanghai municipality. Both Jiangsu province and Shanghai belong to the Yangtze River Delta region, which is the largest urban agglomeration in China. In recent years, the integration of healthcare resources and services in the region has been listed in the Chinese government's agenda. Inclusion criteria were patients aged 18 years or older, with a history of hypertension for at least two years,

and who took medications regularly. Hypertension patients during pregnancy were excluded. Patients were recruited consecutively from nine healthcare facilities.

To ensure the validity and reliability of the survey, the DCE questionnaires were administrated through one-to-one, face-to-face interviews. Our interviewers consisted of eight medical interns and nine physicians. For quality assurance, we compiled a survey training manual and trained the interviewers before the experiment. The interviewers were required to check the completeness of each questionnaire immediately after it was completed. As long as any missing information, they had to ask patients to provide additional information. For patients who were illiterate or had blurred vision, the interviewers explained the meaning of the questionnaire item by item until the patients fully understood each item.

We proposed a hypothetical situation of poor blood pressure control and severely uncomfortable symptoms. Patients were asked to think carefully and make a trade-off between two types of services for their first-contact care. The duration of the survey ranged from 20 minutes to one hour. Patients were informed that participation in the survey was anonymous and voluntary, and their verbal and informed consent was obtained prior to the survey. We gave each patient a wrapped cotton towel as a gift (CNY 10, or US$1.4).

Patient and public involvement

One hundred and eight patients participated in the pilot survey to provide feedback on the intelligibility and acceptability of the questionnaire. Responses from the patients contributed to a more apprehensible and concise description of the DCE questions. The patients engaged in the pilot were not involved in the formal survey. No patients took part in the recruitment of study participants or the carry out of the study.

Statistical Analysis

Our DCE data analysis was based on the random-effects model.[59] In the random utility theory, the conventional utility function U consists of two parts: one is the determinism V containing the observable component, and the other is the random component ε representing the random error term with standard statistical properties.[60] Therefore, the utility of the individual i of alternative n is:

$$U_{in} = V_{in} + \varepsilon_{in} \quad (1)$$

According to equation (1), the probability of the respondent choosing designated healthcare services was simulated. The probability of choice was determined by the indirect utility function of the respondent i who choose j in the selection set s. It was assumed to be a linear and additive form, and its form was:

$$V_{ijs} = X_{ijs}\beta + \varepsilon_{ijs} \quad (2)$$

Where V_{ijs} represented the utility derived from a choice, $X_{ijs}\beta$ was the utility component, and ε was the random component. The $X_{ijs}\beta$ was specified below, where $\beta_{1\text{-}6}$ represented reference scores of attributes and β_0 was the constant:

$$X_{ijs}\beta_j = \beta_0 + \beta_1 Treatment\ effects_j + \beta_2 Physician - patient\ communication_j + \beta_3 Continuity\ of\ care_j + \beta_4 Waiting\ time_j + \beta_5 Travel\ time_j + \beta_6 Out - of - pocket\ costs_j \quad (3)$$

We implemented the above equation by mixed logit regression using STATA 14.2 SE (STATA Corp LLC, College Station, Texas, USA) and was specified with 500 Halton draws. The mixed logit model allows for unknown heterogeneity in individual preferences. We assumed that all variables of the attributes had a random component and that the weights of preference were normally distributed.[61] The choice of patients was the dependent variable, and the selected attributes were independent variables.

Respondents' characteristics are likely to influence their decisions, but they are neither part of the choice alternatives nor a direct source of utility. One way to investigate how respondents' characteristics affect their choices is to include interaction terms between attributes and individuals' characteristics, allowing weights

of the attributes to vary with characteristics.[62] Therefore, we extended the main effects model with interaction terms between attribute levels and the factors likely to influence patients' choices. The interaction terms were specified as random parameters to keep suitable computation times. To assess whether preferences varied, we performed χ^2 tests for joint significance. Standard errors were clustered at the respondent level during the analysis.

Effects coding was used for categorical variables in DCE data. For effects coding, the mean effect for each attribute was normalized at zero, rather than all the reference categories being set to zero.[63] Each coefficient was estimated relative to the mean attribute effect.[63] The marginal rate of substitution (MRS) between attributes could be obtained by calculating the ratio of the partial derivatives of each attribute, where β was the coefficient of the attribute.

$$MRS = -\frac{\beta_a}{\beta_b} \quad (4)$$

Since our DCE attributes included costs, it could be used to generate an estimate of willingness to pay (WTP) of attributes expressed as in the unit of cost by replacing the denominator with the β estimate for the cost attribute. According to the estimated preference scores for each attribute level, WTP for changing attribute A from level 1 to level 2 could be calculated as follows:

$$\text{WTP} = -\frac{\beta_{A2} - \beta_{A1}}{\beta_{cost}} \quad (5)$$

where β_{cost} was the preference score of out-of-pocket costs, and β_{A1} and β_{A2} were preference scores of level 1 and level 2 for the attribute A respectively.

RESULTS

Patients' characteristics

A total of 722 hypertension patients were consented to participate in our DCE survey. 19 patients were excluded from the analysis due to non-compliance with the inclusion criteria, incomplete data, lack of understanding and confidence in making

the DCE choices. As a result, data from 703 patients were available for analysis. Two hundred and seven patients (29.45%) were enrolled from primary healthcare facilities, 247 (35.13%) from secondary hospitals, and 249 (35.42%) from tertiary hospitals. For details about the number of patients in each sampled hospital, please refer to Appendix 6. On average, patients found it easy to understand the scenarios (8.23, 95%CI 8.18-8.27), and confident in their choice (8.99, 95%CI 8.92-9.05).

Table 2 summarized the socio-demographic and clinical characteristics of patients. The sample had more males than females (56.90% vs. 43.10%). The average age was 64.66 years old (ranging from 24 to 96 years old). 38.26% of the monthly household income was less than CNY 4,000. 416 patients (59.17%) had comorbidities, and cardiovascular disease (191 patients) was the most common type (Appendix 7). Only 47.80% of patients considered primary healthcare facilities as their first choice, and only 26.17% of patients had contract service with general practitioners.

Table 2. Characteristics of patients (N=703)

Variables	N (%)
Gender	
Male	400 (56.90)
Female	303 (43.10)
Age[#]	
<65	308 (43.81)
65-74	258 (36.70)
⩾75	137 (19.49)
Education	
Primary school/ Unschooled	337 (47.94)
Junior high school/ High school	279 (39.69)
Junior college or higher vocational college	54 (7.68)
Bachelor's degree or above	33 (4.69)
Employment	
Farmer	278 (39.54)
Urban employee	106 (15.08)
Freelancers	74 (10.53)
Unemployed	22 (3.12)
Retiree	223 (31.72)

Type of public health insurance	
UEBMI	272 (38.69)
URRBMI	431 (61.31)
Monthly household income (CNY)	
⩽2000	126 (17.92)
2001~4000	143 (20.34)
4001~6000	130 (18.49)
6001~8000	91 (12.95)
8001~10000	72 (10.24)
10001~12000	54 (7.68)
>12000	87 (12.38)
Duration after diagnosis of hypertension (years)	
⩽10	474 (67.43)
>10	229 (32.57)
Comorbidities	
No	287 (40.83)
Yes	416 (59.17)
The most frequently visited healthcare facilities	
Primary healthcare facilities	336 (47.80)
Secondary hospitals	228 (32.43)
Tertiary hospitals	139 (19.77)
Contract service with general practitioners	
No	519 (73.83)
Yes	184 (26.17)
EQ-5D-5L index value[Δ]	
⩽0.85	423 (60.17)
>0.85	280 (39.83)

Notes: UEBMI, Urban Employees Basic Medical Insurance; URRBMI, Urban-Rural Residents Basic Medical Insurance; CNY, Chinese yuan

[#]Patients were divided into three groups: young and middle-aged (younger than 65 years old), young-old elderly (aged 65-74), old-old elderly (aged 75 and older).[64]

[Δ]The utility index was derived from the Chinese value sets.[65]

Model estimation of preferences

We found that patients valued healthcare services that generated good treatment effects (β=4.502, p<0.05), followed by travel time to healthcare facilities within 1 hour (β=1.285, p<0.001), and the adequate physician-patient communication (β=0.771, p<0.001) (Table 3). Minimal waiting time (β=0.447, p<0.001) and

continuity of care (β=0.321, p<0.001) were also positive predictors of patients' choice of healthcare services. While out-of-pocket cost was a negative predictor of patients' preferences (β= -0.168, p<0.001). The SD revealed coefficient heterogeneity in the random parameters of attributes. We excluded patient data from healthcare facilities in Shanghai to do the sensitivity analysis, and the statistical significance of attributes was stable (Appendix 8).

Table 3. Estimates of the mixed logit model (N=703)

Attributes	Mean (SE)	SD (SE)
Treatment effects		
Poor(ref)	-4.299*** (0.348)	
Moderate	-0.204** (0.089)	0.824*** (0.160)
Good	4.502* (0.357)	2.148*** (0.223)
Physician-patient communication		
Poor(ref)	-0.727*** (0.089)	
Moderate	-0.044 (0.061)	-0.390** (0.147)
Good	0.771*** (0.084)	0.657*** (0.116)
Continuity of care		
No(ref)	-0.321*** (0.048)	
Yes	0.321*** (0.048)	0.318** (0.121)
Waiting time		
4 hours or longer (ref)	-0.476*** (0.072)	
2 hours	0.029 (0.063)	-0.137 (0.225)
Within 0.5 hour	0.447*** (0.066)	0.351** (0.132)
Travel time		
6 hours or longer (ref)	-1.490*** (0.122)	
3 hours	0.205*** (0.061)	0.409*** (0.122)
Within 1 hour	1.285*** (0.107)	0.952*** (0.111)
Out-of-pocket costs (if reimbursed)		
Cost (per CNY50)	-0.168*** (0.020)	0.198*** (0.033)
Log likelihood	-2299.4957	
Observations	11248	

Notes: The coefficient for the reference group was calculated as the negative sum of other coefficients.[63]

Ref, reference; SE, standard error; SD, standard deviation; HRQoL, Health-related quality of life; CNY, Chinese yuan; *p<0.05; **p<0.01; ***p<0.001

Marginal willingness to pay

According to the average WTP (Table 4), we found that patients highly valued the magnitude of treatment effects. They would be willing to pay an extra CNY 2,489 for healthcare services to improve the effects from poor to good, while their WTP to increase the effects from poor to moderate was CNY 1,155. The WTPs for other attributes from high to low were as follows: travel time, satisfied physician-patient communication, minimum waiting time, moderate physician-patient communication, and moderate waiting time.

Table 4. Marginal willingness to pay for each attribute (N=703)

Attributes	WTP (95% CI)
Treatment effects	
From poor to moderate	1155*** (927～1383)
From poor to good	2489*** (2013～2965)
Physician-patient communication	
From poor to moderate	191*** (113～270)
From poor to good	423*** (315～532)
Continuity of care	
From no to yes	184*** (122～247)
Waiting time	
From 4 hours or longer to 0.5-2 hours	146*** (73～219)
From 4 hours or longer to within 0.5 hour	265*** (185～346)
Travel time	
From 6 hours or longer to 1-3 hours	481*** (368～594)
From 6 hours or longer to within 1 hour	783*** (615～950)

Notes: CNY, Chinese Yuan; ***p<0.001

Preference heterogeneity

The impact of patients' characteristics on preferences for healthcare services was shown in Appendix 9. We tested for interactions of monthly household income levels with different attributes. Compared with low-income patients, those who had high income showed stronger preferences for good physician-patient communication (β=0.377, p<0.05) and minimum waiting time (β=0.396, p<0.01) (Model 1). The

negative interaction term between income and moderate treatment effects showed that high-income patients valued the moderate effects to be less important than did low-income patients.

Similarly, we tested for interactions of age with the attributes, with young or mid-aged patients as the reference category (Model 2). Four interaction terms were statistically significant: good treatment effects (β=2.839, $p<0.001$), shortest travel time (β=0.533, $p<0.01$), good physician-patient communication (β=0.442, $p<0.05$), and continuity of care (β=0.232, $p<0.05$).

There were statistically significant interaction terms of comorbidities with three attributes. Patients who had comorbidities favored more in healthcare services that generated good treatment effects (β=0.986, $p<0.05$), required minimum travel time (β=0.588, $p<0.01$), and ensured continuity of care (β=0.318, $p<0.01$) (Model 3).

Compared with patients who usually visited primary healthcare facilities, those who tended to seek healthcare services from secondary or tertiary hospitals expressed a stronger preference for good treatment effects (β=0.898, $p<0.05$) and minimum waiting time (β=0.351, $p<0.05$) (Model 4). Patients with higher HRQoL paid more attention to healthcare services that contributed to good treatment effects (β=1.748, $p<0.01$) (Model 5).

DISCUSSION

Patients' preferences for healthcare services

To the best of our knowledge, this is the first DCE that systematically investigated the attributes influencing the choice of healthcare services for first-contact care among chronic disease patients like hypertension in China. An in-depth understanding of patients' perspectives on different healthcare service attributes is of global interest since it could inform the providing of appropriate healthcare that could improve patient satisfaction and service utilization.

According to the estimated attribute-level coefficients, we found that the

treatment effect was the most important attribute defining patients' preferences. Our results also showed that older adults, patients who had higher HRQoL, with comorbidities, and who usually visited secondary or tertiary hospitals to treat hypertension cared more about good treatment effects. The findings highlight the importance of taking effectiveness into account to improve patients' acceptance of primary healthcare services. However, the clinical experience of physicians[15 17] and types of healthcare professionals,[16] rather than treatment effects, were often used to reflect the capabilities of healthcare provision in previous studies. In fact, preferences for provider types, which involved gender, types of medical staff, job titles, and professional training experience, were complex and difficult to interpret.

Our findings demonstrated that the minimum travel time to the healthcare facility was the second most important attribute. The results were consistent with previous DCEs, as the respondents disliked traveling longer distances to the healthcare providers.[16 44] Patients who were older and those who had comorbidities might feel inconvenient to travel a long distance for the first-contact care and rated shortest travel time to be more important than the counterparts.

Continuity of care was concerned with the quality of care over time. In our study, continuity of care was defined as coordinated and patient-centered care. It is a process involving the orderly, uninterrupted movement of patients among the diverse elements of the service delivery system.[43] We found that patients desired healthcare services that were consistent and coordinated according to their health needs. In addition, the continuity of care was considered even more important for older patients and patients who had comorbidities. They needed more health resources than other groups, and their choices of first-contact care should be paid more attention to.

We found that good physician-patient communication was also an important attribute preferred by patients. In fact, effective physician-patient communication is essential in healthcare, affecting the patients' compliance with recommendations for care.[66] Physician-patient communication is a powerful indicator of healthcare quality that can determine patients' self-management behavior and satisfaction with

healthcare providers.[67 68] This is shown by greater patient involvement and decisions are reached through shared decision-making.[69] Our analyses revealed that high-income and older patients valued good physician-patient communication more than did lower-income and younger groups.

Longer waiting time and increased out-of-pocket costs were significant, negative predictors for the entire sample, showing that patient preferences decreased as the waiting time and out-of-pocket costs increased. Similar results were noted in DCEs eliciting public preferences for the choice of healthcare providers.[47 50] In addition, we found high-income patients and those who were likely to visit secondary or tertiary hospitals concerned more about waiting time. As shown in the previous study conducted in a Chinese public tertiary hospital, the reduced waiting time led to increased patient satisfaction.[70] Patients might have an increased willingness to pay for services that require less waiting time for an appointment to diagnose or treat, especially in the case of severe symptoms.[71]

Implications of the study findings

In China, patients sought first-contact care in a disorderly manner, and the gate-keeping role of primary healthcare has not been fully implemented.[72] Patients' preferences should be known to guide the delivery of appropriate, effective, and efficient care. Our research confirms that the ideal healthcare services that meet hypertension patients' demands for first-contact care comprise the following attributes: produce good treatment effects, closer to home, offer good physician-patient communication, need short waiting time, ensure continuity of care and require low out-of-pockets per visit.

The treatment effect was the most important attribute to attract patients. Patients were more likely to choose the healthcare services that led to the experience of good quality. It is worth noting that older patients, patients who had high HRQoL, patients with comorbidities, and those who tended to visit secondary or tertiary hospitals would pay special attention to treatment effects. Meanwhile, patients expect to

communicate with physicians to deliberate and express their preferences and views during the clinical decision-making process. Furthermore, older patients who are emotionally vulnerable and socially isolated are particularly in need of the emotional, social, and practical support that sensitive physician-patient communication can provide.[73]

Evidence of variations in the perceived utility of healthcare services among patients emphasizes the importance of taking individual patient preferences into account to address the problems of inadequate primary healthcare service utilization and the ineffectiveness of the two-way referral mechanism. Healthcare systems need to be adaptable enough to offer patients choices to account for heterogeneity in patients' preferences.

Our study highlights the importance of improved service quality, timely access, and shared decision-making for the first-contact care of chronic diseases like hypertension. The improvement of service quality, physician-patient communication, and continuity of care will contribute to patients' preference to choose primary healthcare facilities as the first-contact care. Our findings were consistent with the optimal healthcare delivery strategies to achieve universal health coverage, which involves providing effective, safe, people-centered care that is timely, equitable, integrated, and efficient.[74]

The quality of primary healthcare in China needed to be strengthened, and evidence-based monitoring and evaluation of the service quality are crucial for attaining the goals of healthcare system reform.[72] In addition to education for the general practitioners, the Chinese government could consider tailoring continuing training for the primary healthcare workforce.[75] Shared decision-making is appropriate for clinical decisions involving multiple reasonable options,[76] such as the management of chronic diseases. To improve the physicians' communication skills, strictly planned, culturally competent, effectively implemented, and rigorously evaluated trainings are required.[77] Care coordination approaches should also be advocated to engage patients in decision-making, support effective management of

comorbidities, and ensure accessibility to interventions. Furthermore, the primary healthcare-based integrated delivery system in China should be strengthened.[13]

Strengths and limitations

Our DCE provides valuable information about how patients weigh their first-contact care options and trade-off different healthcare service features. A better understanding of patients' preferences will guide the future development of the two-way referral mechanism, as policymakers aim to bridge the gap between the optimal models for patient-centered service delivery and patients' first-contact care needs.

The major contributions of our study are as follows. First, we used a DCE which followed good research practices, offering the advantage to explore the trade-offs between attributes of healthcare services. Second, the Bayesian-efficient design was applied to increase the statistical efficiency of the choice sets design, and a blocking technique was used to increase the response efficiency of patients. Third, we derived WTP estimates in hypothetical settings among patients with chronic diseases like hypertension. Fourth, this is the most comprehensive study that identifies preference heterogeneity according to age, income, HRQoL, comorbidities, and past healthcare service experience.

Our study has several limitations. First, the DCE results are not representative of all patients with chronic diseases, because we only explored the preferences among hypertension patients to ensure the homogeneity of patients. Future studies need to enroll patients with other types of chronic diseases and identify variations in patients' preferences across different subgroups. Second, our samples were from Jiangsu and Shanghai, which stand for the most economically developed regions in China. Future studies should have a nationally representative sample by including the economically underdeveloped regions. Meanwhile, evenly distribution of sampled healthcare facilities in each region should be ensured. Third, given the limited number of attributes and levels tested in DCE, it might not represent complex real-life situations.

To further understand the relationship between stated (those elicited in the DCE) and revealed preferences (actual first-contact care-seeking behavior), studies are warranted to investigate if and how patients' preferences in healthcare services impact their long-term clinical outcomes. Finally, we only used comorbidity to represent disease progression and severity. Researches are suggested to evaluate variations of patients' preferences at different stages of the disease.

CONCLUSION

Our DCE provides evidence about how hypertension patients value the attributes of healthcare services, including the capabilities, efficiency, affordability, and convenience of service provision, in the context of chaotic first-contact care-seeking behavior in China. The findings underline the importance of effective, convenient, efficient, coordinated, and patient-centered care for chronic diseases like hypertension. We also found preference heterogeneity that is correlated with patients' socio-demographic characteristics, feelings of health conditions, the severity of disease (i.e. comorbidities), and the prior experience of healthcare services. Policymakers and healthcare providers are suggested to work on aligning the service provision with patients' preferences, thus promoting the rational utilization of healthcare resources.

Ethics approval

This study, including the patient consent process, has been approved by the Medical Ethics Committee in Nantong University (Ethical Approval-202054) and conforms to the ethical guidelines of the Declaration of Helsinki.

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Author contributions

Geng JS, Yu XL, and Bao HN led the design and analysis of the discrete choice experiment. Shi JW and Yuan XY contributed to the literature search and data interpretation. Yu XL, Qian LL, and Feng Z contributed to implementing the discrete choice experiment. Yu XL, Bao HN, and Geng JS performed the statistical analysis and wrote the manuscript.

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Disclosure

The authors report no conflict of interest in this research.

Data sharing statement

Data will be available upon reasonable request to the corresponding author.

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Appendix 1: Characteristics of the included DCEs

Supplemental Table 1. Characteristics of the included DCEs

ID	Country	Setting	Type of diseases	Perspective	Domains			
					Capabilities	Efficiency	Affordability	Convenience
Ryan M 2001[1]	UK	Delivery of healthcare in clinics	Rheumatology	Patient	√	√	×	×
Ratcliffe J 2002[2]	England	Treatment of asthma	Asthma	Patient	√	×	√	×
Albada A 2009[3]	Netherlands	Choice of ambulatory hospital care centers	Chronic diseases	Patient	√	√	×	×
Dwight-Johnson M 2010[4]	US	Treatment of depression	Depression	Patient	√	×	√	×
Okumura Y 2012[5]	Japan	Treatment of depression	Depression	Patient	√	×	×	√
Lathia N 2013[6]	Canada	Outpatient treatment of febrile neutropenia	Non-Hodgkin lymphoma	Patient	√	×	√	×
Whitty JA 2013[7]	Australia	Delivery of disease management programs	Chronic heart failure	Patient	√	×	√	×
Groenewoud S 2015[8]	Netherlands	Choice of healthcare providers	Knee arthrosis, Chronic depression, Alzheimer's Disease	Patient	√	√	√	√
Wong SF 2016[9]	Australia	Health care appointments	Cancer	Patient	√	√	√	√
O'Hara NN 2016[10]	Canada	Treatment of shoulder osteoarthritis	Shoulder osteoarthritis	Patient	√	√	√	√
Kruk ME 2016[11]	Ethiopia/Mozambique	Treatment of HIV	HIV	Patient	√	×	√	×
Miners AH 2017[12]	England	Clinic appointments	HIV	Patient	√	√	×	×
Kim WL 2017[13]	Korea	Choice of hospitals	Carpal Tunnel Syndrome	Patient	√	√	√	√

Tinelli M 2018[14]	Cyprus	Diabetes care in community	Diabetes	Patient	√	√	×	×
Zanolini A 2018[15]	Zambia	Choice of clinics	HIV	Patient	√	√	×	√
Mishra V 2018[16]	India	Diabetes care in clinics	Diabetes	Patient	√	√	√	√
Mc Morrow L 2018[17]	UK	Diabetes care in clinics	Diabetes	Patient	√	√	√	×
Oliver D 2019[18]	Canada	Primary care appointments	Chronic diseases	Patient	√	√	×	×
Krinke KS 2019[19]	Germany	Primary care provision	Chronic diseases	Patient	√	×	×	√
Jia EP 2019[20]	China	Medical service utilization	Chronic diseases	Patient	√	×	×	√
Eshun-Wilson I 2019[21]	Zambia	Healthcare service delivery model	HIV	Patient	√	√	×	×
Fletcher B 2019[22]	UK	Management of hypertension	Hypertension	Patient	√	×	√	×
Shen X 2019[23]	China	Medical service utilization	Chronic diseases	Patient	√	×	√	√
Peng YY 2019[24]	China	Medical service utilization	Chronic diseases	Patient	√	×	×	√
Zhu J 2019[25]	China	Healthcare providers for primary care	Diabetes	Patient	√	√	×	×
Zhang H 2019[26]	China	Chronic disease appointments	Chronic diseases	Patient	√	×	√	×
Wang X 2019[27]	China	Urban integrated primary care	Diabetes	Patient	√	×	√	√

Notes: The included studies were sorted according to the date of publication.

"√" meant that attributes were identified in DCEs, while "×" implied that attributes were not identified in DCEs.

The general term "chronic disease" was used in the type of chronic diseases, due to the specific types remained unclear.

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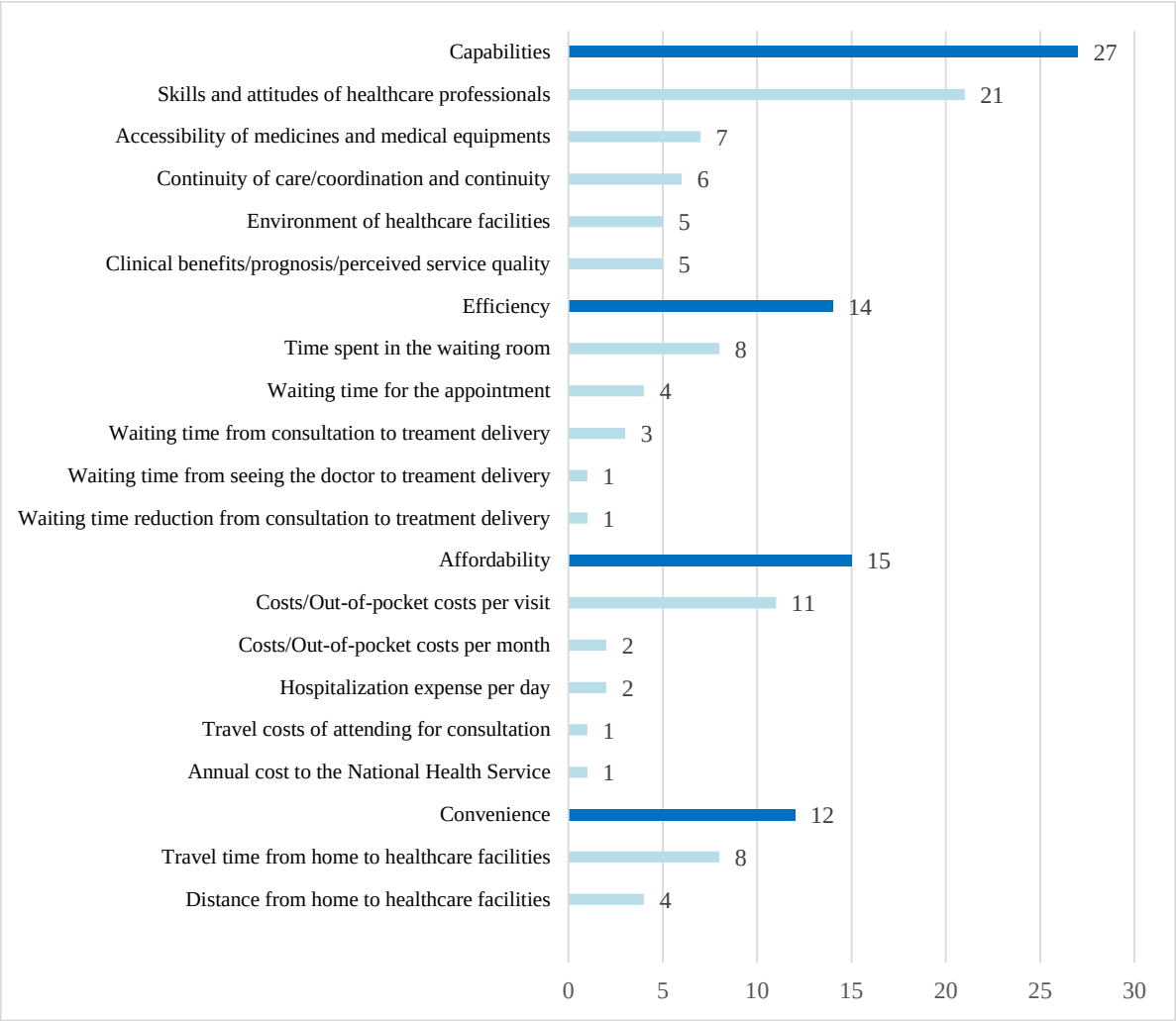
Appendix 2: Domains and attributes in the included DCEs



Supplemental Figure 1. Domains and attributes in the included DCEs

Domains of the attributes

Each attribute in the domains.

Notes: Numbers represent for numbers of literatures that mentioned the relevant domains or attributes. Several literatures had more than one attribute in the same domain. Physician-patient communication was included in the attribute “skills and attitudes of healthcare professionals”.

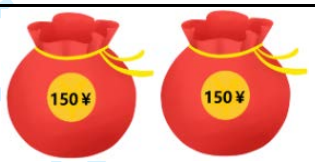
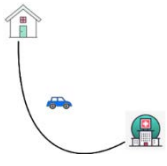
Appendix 3: Explanations to attributes and levels

Investigators were required to convey the following definitions to patients:

- Treatment effects: 'Good treatment effects' means that the ideal treatment goals set out in the evidence-based guidelines for individual patients can be achieved, and your complications disappear; 'Moderate treatment effects' suggests that although the blood pressure is almost to the ideal treatment goals, the complications still exist; 'Poor treatment effects' implies that both blood pressure and complications are not well controlled.
- 'Physician-patient communication' refers to the communication between the physician and the patient. 'Good' suggests that the physician always treats patients with respect, listens carefully when the patient is explaining, and engages the patient in clinical decision-making; 'Moderate' implies that the physician sometimes treats patients with respect, and sometimes feels boring and becomes impolite; listening to patients explaining, but not likely to involve the patient in clinical decision-making; 'Poor' indicates that attitude of the physician is impatient and impolite, never engages the patient in clinical decision-making.
- 'Continuity of care' suggests that the healthcare facility operates in a well-functioning integrated care delivery system, which can provide coordinated healthcare services for chronic disease patients, i.e. the appropriate care and care management is perceived to occur at the right time and in the right order.
- 'Waiting time' is the amount of time for patients seeking care at the healthcare facility before being attended for physician consultation, i.e. the time from registration to seeing a physician.
- 'Travel time' refers to the time it takes for the patient to drive from home to the healthcare facility (one way). In our study, the travel time is measured by taking a taxi or private car.
- The cost is defined as the out-of-pocket costs per visit if reimbursed, including the direct medical costs when accessing care. Those who participate in public health insurance programs may be eligible to receive reimbursement which contributes to reducing the out-of-pocket costs.

Appendix 4: Examples of DCE choice sets

Suppose you have poor blood pressure control, which results in uncomfortable symptoms like dizziness, headache, palpitation, chest pain, shortness of breath, nausea. If you can only choose one type of healthcare service for your first-contact visit, which one would you prefer? Please think carefully and make a trade-off.

Attributes	Type A	Type B
Treatment effects	 Moderate	 Poor
Out-of-pocket costs (if reimbursed)	 CNY 300 per visit	 CNY 150 per visit
Physician-patient communication	 Poor	 Moderate
Continuity of care	 Yes	 No
Waiting time	 Within 0.5 hour	 2 hours
Travel time	 3 hours	 Within 1 hour
Your choice	☐	☐

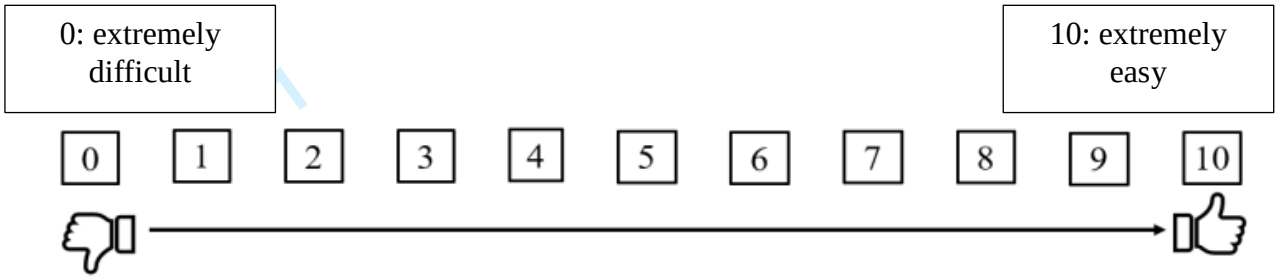
Here are the descriptions of the sampling choice sets.

If you follow the doctor's advice in healthcare facility A, although your blood pressure will be controlled to the ideal treatment goals, severe clinical syndromes and complications still exist. The out-of-pocket cost for your first-contact care in healthcare facility A is CNY 300 per visit. The attitude of the doctor is impatient and doesn't allow you to express your own opinions. However, healthcare facility A would provide you with continuous and coordinated healthcare services. You need to wait for 0.5 hours in the waiting room to see the doctor. It will take you 3 hours to travel from your home to healthcare facility A by car or taxi.

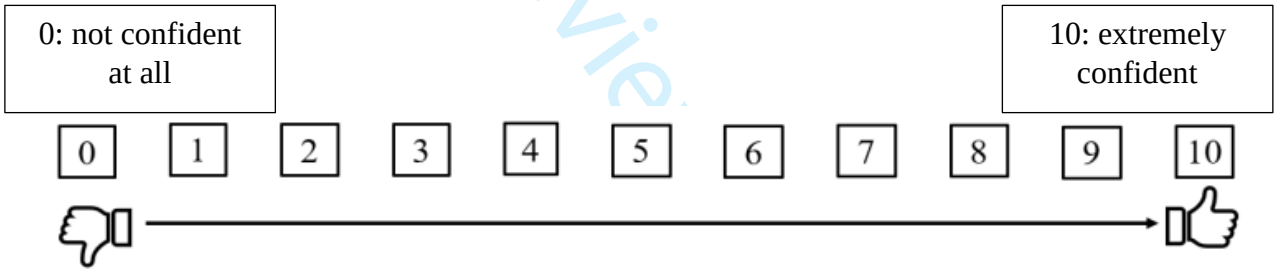
If you follow the doctor's advice in healthcare facility B, both blood pressure and complications will not be controlled at a satisfactory level. However, the out-of-pocket cost for your first-contact care in healthcare facility B is CNY only 150 per visit. The doctor may ask you for your own experience of getting the disease and allow you to express your own ideas, but not likely to make decisions according to your preference and opinions. Healthcare facility B would not provide you with continuous and coordinated healthcare services. You need to wait for 2 hours in the waiting room to see the doctor. It will take you less than 1 hour to travel from your home to healthcare facility B by car or taxi.

Appendix 5: Evaluation of patients' understanding and confidence in DCE choices

1. Do you feel difficult or easy to understand the DCE scenarios and choice sets? Please select the level from zero to 10 and give a tick '√' in the score to reflect your understanding:



2. Are you confident in your choice of healthcare services? Please select the level from zero to 10 and give a tick '√' in the score to represent your confidence:



Appendix 6: Number of patients in the sampled healthcare facilities

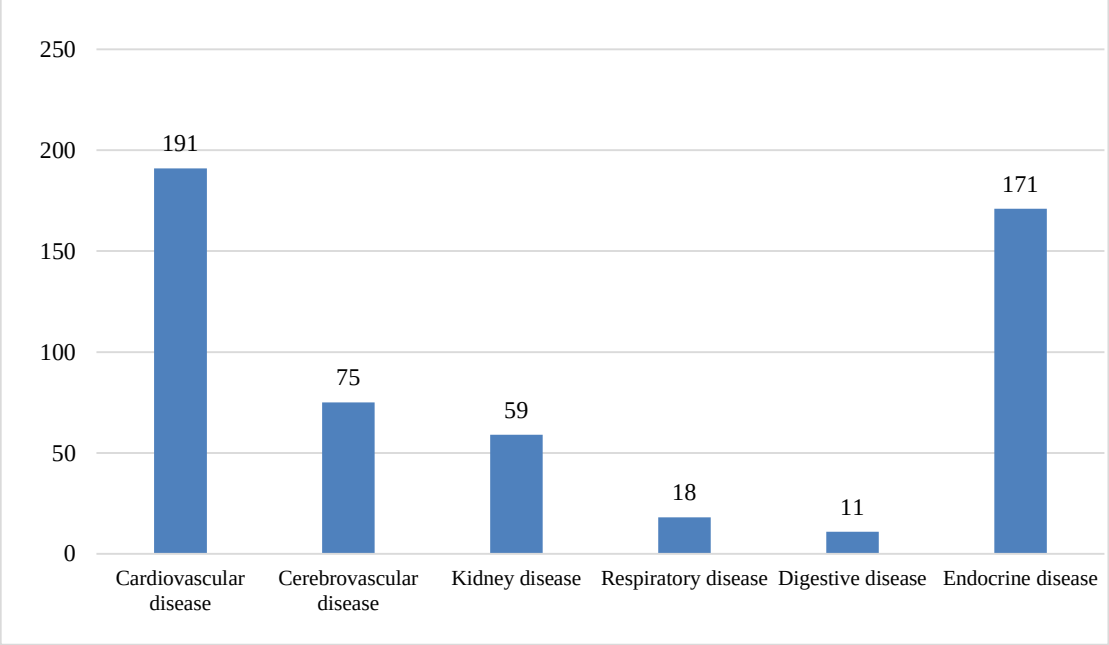
Supplemental Table 2. Number of patients in the sampled healthcare facilities (N=703)

Name of hospitals and health centers	City/District*	Province	Grade#	Number of patients
Affiliated Hospital of Nantong University	Nantong	Jiangsu	3	249
Tongzhou No.3 People's Hospital	Nantong	Jiangsu	2	30
Rudong Yangkou Hospital	Nantong	Jiangsu	1	90
Chongchuan Fumin Health Center	Nantong	Jiangsu	1	29
Xiangshui People's Hospital	Yancheng	Jiangsu	2	113
Dongtai People's Hospital	Yancheng	Jiangsu	2	45
Donghai People's Hospital	Lianyungang	Jiangsu	2	59
Pujiang Community Health Service Center	Pujiang	Shanghai	1	58
Zhuanqiao Community Health Service Center	Minhang	Shanghai	1	30

Notes: *Districts in Shanghai municipality.

#In China, hospitals are divided into three grades, tertiary, secondary, and primary, with tertiary hospitals being the highest grade. The primary healthcare facilities consist of community health service centers or stations, which are located in urban areas, and township healthcare centers, which are located in rural areas. A secondary hospital is similar to a regional hospital. A tertiary hospital is a comprehensive, referral hospital at the city, provincial or national level, with at least 500 hospital beds that are able to provide advanced and specialized medical services.

Appendix 7: Types of comorbidities in the patients



Supplemental Figure 2. Number of patients with comorbidities

Appendix 8: Sensitivity analysis of the mixed logit model

Supplemental Table 3. Estimates of the mixed logit model for patients in Jiangsu province (N=615)

Attributes	Mean (SE)	SD (SE)
Treatment effects		
Poor(ref)	-5.137*** (0.465)	
Moderate	-0.137 (0.104)	-0.889*** (0.196)
Good	5.273*** (0.475)	2.708*** (0.283)
Physician-patient communication		
Poor(ref)	-0.881*** (0.115)	
Moderate	0.003 (0.068)	-0.073 (0.157)
Good	0.878*** (0.107)	0.471*** (0.128)
Continuity of care		
No(ref)	0.368*** (0.059)	
Yes	0.368*** (0.059)	0.471*** (0.110)
Waiting time		
4 hours or longer (ref)	-0.526*** (0.087)	
2 hours	0.090 (0.075)	0.323* (0.153)
Within 0.5 hour	0.436*** (0.073)	0.316 (0.169)
Travel time		
6 hours or longer (ref)	-1.707*** (0.156)	
3 hours	0.302*** (0.076)	0.574*** (0.137)
Within 1 hour	1.405*** (0.128)	0.935*** (0.123)
Out-of-pocket costs per visit (if reimbursed)		
Cost (per CNY50)	-0.191*** (0.024)	0.240*** (0.036)
Log likelihood	-1959.9002	
Observations	9840	

Notes: Ref, reference; SE, standard error; SD, standard deviation; HRQoL, Health-related quality of life; CNY, Chinese yuan.

*p<0.05; **p<0.01; ***p<0.001

Appendix 9: Results of the interaction effects

Supplemental Table 4. Model estimation of the interaction effects between attributes and patients' characteristics

Attributes	Model 1		Model 2		Model 3		Model 4		Model 5	
	Mean	SE	Mean	SE	Mean	SE	Mean	SE	Mean	SE
Treatment effects										
Poor(ref)	-4.874***	0.466	-3.352***	0.302	-4.319***	0.439	-3.894***	0.365	-4.340***	0.429
Moderate	0.059	0.155	-0.091	0.110	-0.018	0.133	-0.234*	0.118	-0.180	0.122
Good	4.816***	0.452	3.443***	0.308	4.337***	0.438	4.128***	0.378	4.520***	0.440
Physician-patient communication										
Poor(ref)	-0.692***	0.130	-0.542***	0.104	-0.659***	0.120	-0.772***	0.116	-0.780***	0.122
Moderate	0.038	0.098	-0.102	0.080	-0.021	0.087	0.019	0.083	-0.045	0.082
Good	0.654***	0.121	0.644***	0.097	0.680***	0.110	0.752***	0.107	0.824***	0.113
Continuity of care										
No(ref)	-0.248***	0.075	-0.236***	0.058	-0.190**	0.065	-0.313***	0.063	-0.408***	0.067
Yes	0.248***	0.075	0.236***	0.058	0.190**	0.065	0.313***	0.063	0.408***	0.067
Waiting time										
4 hours or longer(ref)	-0.375***	0.114	0.469***	0.090	-0.439***	0.104	-0.434***	0.095	-0.538***	0.098
2 hours	0.109	0.106	0.008	0.085	-0.029	0.093	0.116	0.086	0.0004	0.085
Within 0.5 hour	0.266**	0.096	0.461***	0.082	0.468***	0.096	0.318***	0.082	0.537***	0.087
Travel time										
6 hours or longer(ref)	-1.763***	0.175	-1.259***	0.127	-1.204***	0.137	-1.451***	0.139	-1.727***	0.170
3 hours	0.253*	0.103	0.159*	0.080	0.136	0.087	0.206*	0.084	0.249**	0.082
Within 1 hour	1.510***	0.154	1.100***	0.114	1.068***	0.123	1.245***	0.122	1.477***	0.150
Out-of-pocket costs per visit (if reimbursed)										
Cost (per CNY50)	-0.202***	0.031	-0.167***	0.025	-0.153***	0.028	-0.168***	0.024	-0.199***	0.028

Interactions with demographics	Income		Age		Comorbidities		Type of healthcare facilities		EQ-5D-5L index value	
Treatment effects										
Moderate	-0.455*	0.204	-0.334	0.188	-0.348	0.191	0.056	0.180	-0.081	0.205
Good	0.406	0.275	2.839***	0.801	0.986*	0.442	0.898*	0.452	1.748**	0.612
Physician-patient communication										
Moderate	-0.201	0.128	0.133	0.126	-0.070	0.130	-0.156	0.121	0.021	0.139
Good	0.377*	0.154	0.442*	0.183	0.272	0.155	0.102	0.149	0.171	0.178
Continuity of care										
Yes	0.185	0.101	0.232*	0.102	0.318**	0.108	0.045	0.093	-0.130	0.110
Waiting time										
2 hours	-0.137	0.139	0.017	0.136	0.143	0.136	-0.193	0.128	0.006	0.152
Within 0.5 hour	0.396**	0.134	0.044	0.130	0.023	0.135	0.315*	0.132	-0.002	0.143
Travel time										
3 hours	-0.075	0.132	0.111	0.125	0.158	0.131	-0.012	0.125	-0.039	0.133
within 1 hour	-0.121	0.159	0.533**	0.189	0.588**	0.176	0.144	0.170	-0.034	0.202
Out-of-pocket costs per visit (if reimbursed)										
Cost (per CNY50)	0.010	0.038	-0.017	0.039	-0.068	0.039	-0.015	0.037	0.002	0.042
Log likelihood	-2271.4592		-2283.4658		-2278.9024		-2289.7129		-2280.1412	
Participants	703		703		703		703		703	
Observations	11248		11248		11248		11248		11248	

Notes: Ref, reference. Monthly household income: CNY 4000 or less=0, Higher than CNY 4000=1; Age: Young or middle-aged (aged 64 or younger)=0, Elderly (aged 65 or older)=1; Comorbidities: No comorbidities=0, With comorbidities=1; The most frequently visited healthcare facilities: Community health centers=0, Secondary or tertiary hospitals=1; EQ-5D-5L index value: 0.85 and below=0, Higher than 0.85=1.
*p<0.05; **p<0.01; ***p<0.001

STROBE 2007 (v4) checklist of items to be included in reports of observational studies in epidemiology*

Checklist for cohort, case-control, and cross-sectional studies (combined)

Section/Topic	Item #	Recommendation	Reported on page #
Title and abstract	1	(*a*) Indicate the study's design with a commonly used term in the title or the abstract	Page 2
		(*b*) Provide in the abstract an informative and balanced summary of what was done and what was found	Page 3
Introduction			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	Page 5 Page 6 (line 3-44)
Objectives	3	State specific objectives, including any pre-specified hypotheses	Page 6 (line 45-60)
Methods			
Study design	4	Present key elements of study design early in the paper	Page 7 (line 10-14) Page 9 (line 23-59) Page 10 (line 4-25)
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	Page 10 (line 50-59) Appendix 6
Participants	6	(*a*) *Cohort study*—Give the eligibility criteria, and the sources and methods of selection of participants. Describe methods of follow-up *Case-control study*—Give the eligibility criteria, and the sources and methods of case ascertainment and control selection. Give the rationale for the choice of cases and controls *Cross-sectional study*—Give the eligibility criteria, and the sources and methods of selection of participants	Page 10 (line 59-60) Page 11 (line 4-6)
		(*b*) *Cohort study*—For matched studies, give matching criteria and number of exposed and unexposed *Case-control study*—For matched studies, give matching criteria and the number of controls per case	Not applicable
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	Page 7 (line 14-60) Page 8 Page 9 (line 4-21)
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	Page 10 (line 4-21) Page 11 (line 26-39)
Bias	9	Describe any efforts to address potential sources of bias	Page 10 (line 22-26) Page 11 (line 8-24)
Study size	10	Explain how the study size was arrived at	Page 10 (line 28-45)
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	Page 12 (line 4-37)

			Page 13 (line 16-46)
Statistical methods	12	(*a*) Describe all statistical methods, including those used to control for confounding	Page 12 (line 39-51)
		(*b*) Describe any methods used to examine subgroups and interactions	Page 12 (line 53-59) Page 13 (line 4-14)
		(*c*) Explain how missing data were addressed	Page 11 (line 14-24)
		(*d*) *Cohort study*—If applicable, explain how loss to follow-up was addressed *Case-control study*—If applicable, explain how matching of cases and controls was addressed *Cross-sectional study*—If applicable, describe analytical methods taking account of sampling strategy	Not applicable
		(*e*) Describe any sensitivity analyses	Page 12 (line 53-60) Page 13 (line 4-14) Page 16 (line 10-14)
Results			
Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	Page 13 (line 54-59) Page 14 (line 4-8)
		(b) Give reasons for non-participation at each stage	Not applicable
		(c) Consider use of a flow diagram	Not applicable
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	Page 14 (line 16-60) Page 15 (line 3-48)
		(b) Indicate number of participants with missing data for each variable of interest	Not applicable
		(c) *Cohort study*—Summarise follow-up time (eg, average and total amount)	Not applicable
Outcome data	15*	*Cohort study*—Report numbers of outcome events or summary measures over time	
		Case-control study—Report numbers in each exposure category, or summary measures of exposure	
		Cross-sectional study—Report numbers of outcome events or summary measures	Page 15 (line 53-60) Page 16 (line 4-14)
Main results	16	(*a*) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	Page 16 (line 15-59) Page 17 (line 4-46)
		(*b*) Report category boundaries when continuous variables were categorized	Not applicable
		(*c*) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	Not applicable
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	Page 17 (line 48-60) Page 18 (line 4-40) Appendix 8 Appendix 9

Discussion			
Key results	18	Summarise key results with reference to study objectives	Page 18 (line 45-60) Page 19 Page 20 (line 4-30)
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	Page 22 (line 41-60) Page 23 (line 3-14)
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	Page 20 (line 35-60) Page 21 (line 4-12)
Generalisability	21	Discuss the generalisability (external validity) of the study results	Page 21 (line 14-60) Page 22 (line 4-6)
Other information			
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	Page 24 (line 28-44)

*Give information separately for cases and controls in case-control studies and, if applicable, for exposed and unexposed groups in cohort and cross-sectional studies.
Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at http://www.plosmedicine.org/, Annals of Internal Medicine at http://www.annals.org/, and Epidemiology at http://www.epidem.com/). Information on the STROBE Initiative is available at www.strobe-statement.org.