Patient Preference and Adherence Dovepress

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ORIGINAL RESEARCH

Hierarchical Medical: What are the Factors Driving ESKD Patients to Choose Community Hemodialysis Centers in China? A Labelled Discrete Choice Experiment

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Purpose: In China, secondary and tertiary hospital-based dialysis facilities had been the most prominent provider of hemodialysis treatment. Developing community hemodialysis centers was the key to constructing hierarchical hemodialysis system. Thus, the aim of this study was to explore end-stage kidney disease (ESKD) patients' preferences for hemodialysis services and attract patients with stable condition to choose community hemodialysis services.

Patients and Methods: The study used a labelled discrete choice experiment with ESKD patients in Wuhan, Hubei Province in China. Patients were asked to make a choice between hospital-based hemodialysis facilities and community hemodialysis centers with different attribute levels. Mixed logit model was used to measure their preferences and heterogeneity for hemodialysis services. The marginal utility was measured to predict the change of patients' choice probability of community hemodialysis centers.

Results: A total of 420 ESKD patients consented to complete the questionnaires and 408 were included in the analysis after excluding responses that did not pass the consistency test. All attributes were significantly influencing respondents' choice of hemodialysis service. Patients were more inclined to hemodialysis services with smooth and effective referral, regular doctors, 20 minutes of travel time, and home-based offline follow-up. Gender, age, income, hemodialysis year, and hemodialysis times weekly were found to influence the preferences. When the community hemodialysis service attributes gradually meet the patients' preferences, as many as 58.39% of patients will choose community hemodialysis centers.

Conclusion: A better understanding of ESKD patients' preferences for hemodialysis service is a crucial step for the future policy implementations. Although patients tended to choose hospital-based hemodialysis facilities, patients' preferences for hemodialysis institutions would reverse with the change of service attribute. Establishing a smooth and effective referral is the most important attribute to improve patients' acceptance of community hemodialysis centers. Strengthening the integration of service can facilitate hierarchical hemodialysis service system.

Keywords: discrete choice experiment, hemodialysis, end-stage renal disease, community hemodialysis centers

Introduction

According to the "Global Kidney Health Report", it is projected that there will be 14.5 million people worldwide suffering from end-stage kidney disease (ESKD) by 2030.[1] Hemodialysis is the most common method for renal replacement therapy for ESKD patients.[2] The number of patients receiving hemodialysis treatment in China has shown a rapid growth trend, rising from 174.1 in 2011 to 379.1 per million people (PMP) in 2017.[3]

The increasing demand has exerted great pressure on China's hemodialysis service system.[4] Most hemodialysis centers in China were allocated in public secondary and tertiary hospitals and patients were crowded in hospitals for treatment.[5] This may result in a mixture of mild and severe patients in a single hospital-based hemodialysis service,

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which may lead to unclear care priorities and poor treatment outcomes. Unbalanced hemodialysis service system failed to align with the requirements of the hierarchical healthcare and had negative impacts on service quality.

Developing community hemodialysis centers plays an important role in the establishment of hierarchical hemodialysis healthcare system. China had initiated several policies to encourage private investment in independent hemodialysis centers and support the development of hemodialysis centers in communities.[6–8] Despite the establishment of numerous private independent hemodialysis centers and the gradual expansion of community hemodialysis centers in recent years, the acceptance and utilization rate of community hemodialysis centers remained low,[9] which focused on the problem in practice of China's hierarchical healthcare system: despite the policy from central government efforts to drive patients "see doctors" in communities, relatively few ESKD patientswere accustomed to choosing primary healthcare facilities for treatment.

The underlying reason for this situation may be related to the mismatch between current community hemodialysis services and patients' preferences. To develop the provision of community hemodialysis centers that meets the actual needs of ESKD patients, policy-makers need to understand and clarify the care preferences of ESKD patients: What types of hemodialysis services do patients prefer, and which factors shape patients' choice between community and hospital hemodialysis service? The answers to these problems not only helped facilitate the formation of scientific hemodialysis service system, but also provide enlightenment for the development of the whole hierarchical healthcare system.

Little is known about the influence of different factors on hemodialysis service choice among ESKD patients. Research has primarily consisted of qualitative and basic quantitative studies, which generally identified patients' demand for hemodialysis services and the factors that influenced patient choice of hemodialysis services.[10–13] However, existing studies have not been able to quantify the utility of different hemodialysis service characteristics, explored the trade-offs between service attributes, nor have they answered how to facilitate the reasonable utility of community hemodialysis services based on the perspective of hierarchical healthcare.

Discrete choice experiment (DCE) enables respondents to make trade-offs between attributes and attribute levels of hemodialysis services under assumptions close to real-world conditions. It allows for the quantification of patients' preferences for different attributes and levels of service, the estimation of the relative importance of attributes, and prediction of the probability of respondents choosing community hemodialysis centers with changes in attribute levels.[14,15]

By using the DCE technique with respondents recruited from Wuhan City in mainland China, this study focused on ESKD patients' preferences of hemodialysis services. It aimed to clarify the patients' preferences for different attributes of hemodialysis services, explore the heterogeneity preferences, measure trade-offs for different service features, and predict the probability of patients choosing community hemodialysis centers under different service scenarios. The findings of this study will provide insights to further optimize community hemodialysis centers and establish a hierarchical hemodialysis service system in China.

Methods

Discrete choice experiments provide respondents with a choice set consisting of two or more alternatives of goods or services described by a series of attributes. Respondents then choose an alternative that maximizes their utility based on their preferences. The collection of choice outcomes from multiple choice sets reveals their preferences.[16] Our hypothetical scenario involves an ESKD patient with stable physical condition seeking to maintain hemodialysis treatment.

Alternative Design Method

In discrete choice experiment, the alternative design can be categorized into two types: generic design and label design.[17] In the generic design, choices are typically named in a generic manner, such as Hemodialysis Service A and Hemodialysis Service B. In the label design, each choice has specific labels, for example, Community Hemodialysis Centers and Hospital-based Hemodialysis Facilities. The generic design is used to measure utility for assumed generic attributes, while the label design allows for measuring specific trade-offs. Most DCE studies in the field of healthcare services preference have employed the generic design.[18–20] The choice between using the generic or label design depends on the specific research assumptions and objectives.[21]

In this study, a label design was employed with two labels: Hospital-based Hemodialysis Facilities and Community Hemodialysis Centers. Hospital-based Hemodialysis Facilities refer to the hemodialysis service provided by hemodialysis centers within secondary or higher-level hospitals. Community Hemodialysis Centers refer to the hemodialysis service provided by privately owned independent hemodialysis centers or public-owned community hemodialysis centers. The choice of label design is based on the following three reasons:

Firstly, the label design allows us to incorporate specific attribute levels for Hospital-based Hemodialysis Facilities and Community Hemodialysis Centers, considering the actual context.[22] Choice sets formed by specific combinations of attribute levels will also be more realistic and credible.[23] Secondly, the label design allows us to analyze whether the labels themselves (hospital or community) have an impact on patients' preference beyond the attributes, through the estimation of alternative-specific constants (ASC).[24] This helps to determine whether the type of hemodialysis institution (hospital or community) affects patients' utility in making choices. Thirdly, the label design has advantages when it comes to predicting or calculating the marginal utility of attribute level changes.[23] Researchers can conduct more sophisticated modeling when exploring the impact of policy interventions on patients' choices of community hemodialysis centers, and can predict the probability of patients choosing community hemodialysis centers versus hospital-based hemodialysis facilities in different service scenarios, providing valuable insights for policy decision-makers.

Defining Attributes and Attribute Levels

The attributes and their corresponding levels included in the study were developed using qualitative methods. An initial set of attributes was derived from a literature review and subsequently refined through two rounds of expert group interview and a pilot test.

The literature review of previous research revealed a number of attributes identified as important factors. Six initial attributes are as follows: type of hemodialyzer, continuing care, handling of critical situations, OOP (out-of-pocket) cost per treatment, available hemodialysis time, and distance. Then, 3 kidney disease specialists and 4 scholars in the field of health policy were invited to evaluate the attributes and recommend amendments to the list. Through the expert group interview and further literature review, the attribute "type of hemodialyzer" was omitted since there were no significant differences in hemodialyzer between hospital hemodialysis and community hemodialysis facilities in China, and respondents usually have limited understanding with professional equipment. The attribute "dialysis time" was omitted since patients who require nocturnal dialysis were mainly young individuals with stronger labor abilities, and these patients are not representative of the whole group of ESKD patients. Previous research has indicated that the regularity of doctors may influence patients' healthcare preferences, and the experts also suggested adding this attribute; thus, type of hemodialysis doctor was added. Finally, a pilot test was conducted with 15 ESKD patients in a hospital to examine the comprehensibility and importance of the discrete choice experiment attributes and levels. Table 1 lists the final set of attributes and their levels.

Experimental Design

The generation of the choice set for the discrete choice experiment includes the full factorial design and partial factorial design. The full factorial design arranges all attribute levels in combination to generate all possible service combinations. In this study, there will be $1^1*2^1*3^3=54$ possible hospital-based hemodialysis facilities combinations and $2^3*3^2=72$ possible community hemodialysis centers combinations. If we pair hospital and community hemodialysis service combinations, it will produce 54*72=3888 choice sets. This will increase the response burden and decrease compliance. Therefore, we adopted the partial factorial design method. The partial factorial design method can select representative and non-repetitive choice sets.

We used Ngene1.3 software for D-efficient design, and after 7,196,384 iterations, 18 sets of choice sets were generated with a relative D-efficiency value of 60.55. Table 2 presents a sample choice set.

Table 1 Attributes and Levels Used in the Labelled Discrete Choice Experiment

Attribute	Community Hemodialysis Centers	Hospital-Based Hemodialysis Facilities
Type of hemodialysis doctors	Regular doctors Different doctors	Regular doctors Different doctors
Continuing care	None Telephone/online follow-up Home-based offline follow-up	None Telephone/online follow-up Home-based offline follow-up
Handling of critical situation	Smooth and effective referral	Intra-hospital referral
	Ineffective referral pathway	
OOP cost per treatment	30 CNY (4 USD) 90 CNY (13 USD)	30 CNY (4 USD) 90 CNY (13 USD) 150 CNY (21 USD)
Travel time	20 mins 40 mins	20 mins 40 mins 60 mins

Abbreviations: OOP, out-of-pocket; CNY, Chinese Yuan; USD, United States dollar.

Table 2 Choice Set Sample

Attribute	Community Hemodialysis Centers	Hospital-Based Hemodialysis Facilities
Type of hemodialysis doctors	Regular doctor	Different doctor
Continuing care	Telephone/online follow-up	None
Handling of critical situation	Smooth and effective referral	Intra-hospital referral
OOP cost per treatment	30 CNY(4 USD)	90 CNY(13 USD)
Travel time	40 mins	60 mins
I choose		

Notes: Example of choice set. Imagine you need to choose a hemodialysis facility for regular hemodialysis treatment and your overall health state is stable with minimal risk of significant complications. Which of the following two hemodialysis service do you prefer?
Abbreviations: OOP, out-of-pocket; CNY, Chinese Yuan; USD, United States dollar.

Data Collection

The sample size was determined based on the Johnson & Orme principle[25].

$$\frac{nta}{c} \geq 500 \quad \text{(i)}$$

where "n" is the recommended minimum sample size, "t" is the number of tasks, "a" is the number of choices per task, and "c" is the maximum number of attribute levels in the DCE. According to the above formula, the minimum acceptable sample size of this DCE (t = 9, a = 2, and c = 3) is 84 respondents.

We adopted a stratified cluster sampling method to select one provincial public hospital and one municipal public hospital hemodialysis center in Wuhan, Hubei Province. A total of 420 patients were investigated. Respondents' inclusion criteria were as follows: (1) ESKD patients who have been undergoing maintenance hemodialysis for more than 3 months; (2) having good language communication and information understanding abilities; (3) age not exceeding 80 years old. Exclusion criteria included patients who are hospitalized or receiving hemodialysis emergency treatment and with temporary vascular access, cognitive dysfunction, or a history of mental illness.

In addition to preferences, we also collected demographic information, health information, and utilization of hemodialysis services information, awareness and attention towards policies of community hemodialysis policies. Prior to conducting field research, we organized a one-day offline training session for the investigators. Additionally, face-to-face cognitive interviews were conducted with patients to gauge their understanding of the questionnaire content, enabling prompt revisions to any unclear or ambiguous wording. During formal surveys, the researcher first described a hypothetical scenario and explained the meaning of each attribute level to ensure that the respondents understood before conducting the discrete choice experiment. Regarding data management, questionnaires were excluded when they did not pass the consistency check, had missing key information, or had contradictory logic answers.

Econometric Analysis

Data analysis in DCE is based on random utility theory. Mixed logit model, also known as the random coefficients logit model or random parameters logit model, is a widely utilized model for analyzing data from discrete choice experiments.[26] Traditional models such as the multinomial logit model and conditional logit model assume independence among the choices made by decision-makers. However, the mixed logit model allows decision-makers to have random preferences, enabling the incorporation of unobservable utility and providing a better reflection of their random preferences. In the mixed logit model employed in this study, the dependent variable represents the choice utility for each ESKD patient, while the independent variables capture the preferences of patients for each attribute feature of the service. In this study, a mixed logit model was constructed to analyze the overall service preferences of ESKD patients and incorporate interaction regression. The utility function was derived based on the null model.

$$U_i = ASC + \left(\beta_{type\ of\ hemodialysis\ doctors} + \sigma_{1i}\right)X_1 + \left(\beta_{continuing\ careI} + \sigma_{2i}\right)X_2 + \left(\beta_{continuing\ careII} + \sigma_{3i}\right) X_3 + \left(\beta_{handling\ of\ critical\ situation} + \sigma_{4i}\right)X_4 + \left(\beta_{travel\ time} + \sigma_{5i}\right)X_5 + \beta_{oop\ cost\ per\ treatment}X_6 + \varepsilon_i$$

Where U_i represents the overall utility of a specific hemodialysis service alternative for patient i, ASC is the alternative-specific constant, $\beta_{\text{type of hemodialysis doctors}}$, $\beta_{\text{continuing care}I}$, $\beta_{\text{continuing care}II}$, $\beta_{\text{handling of critical situation}}$, $\beta_{\text{travel time}}$, $\beta_{\text{OOP cost per treatment}}$ are regression coefficients, σ_i denotes the random parameter for each service attribute of patient i, ε_i represents the random component of utility, which captures the unobserved variation in service attributes and individual preferences. The selected alternative has a higher total utility than the other alternatives in one set. The distribution simulations are based on 500 iterations of Halton random sampling.

Results

Patient Characteristics

A total of 420 questionnaires were distributed to ESKD patients at the hemodialysis centers of two hospitals in Wuhan city. After excluding 12 questionnaires that did not pass the consistency test, 408 valid questionnaires were obtained with an effective response rate of 97.14%. Of the 408 patients, 150 were from provincial hospital and 258 were from municipal hospital. About 56.6% respondents were males (Table 3). The average age of the patients was 60.3 ± 11.72 years (with a median of 61 years). About 39.7% respondents had an education level with middle school and below, while 40.0% respondents had a high school or equivalent education level. The majority of patients were married (80.6%). About 55.1% of the patients had a monthly household income of less than 6000 CNY (US$834.17). Among participants, 64.2% self-rated health was mediocre or poor. The majority (73.0%) of the respondents had low knowledgeable degree of community hemodialysis policy.

Patient Preferences

The survey acquired 408 respondents, with a total of 3672 choices made. Of these choices, 2408 (65.58%) were hospital-based hemodialysis facilities, while 1264 (34.42%) were community hemodialysis centers. As shown in Table 4, ASC reflected the average utility of alternatives beyond attribute levels. The coefficient for community hemodialysis centers was significantly negative (β=−2.404, P<0.001), indicating that the type of dialysis institution has a significant effect on patients' preferences for hemodialysis services. Patients were more inclined to choose hospital over community. All five service attributes significantly affected patients' preferences. Regarding out-of-pocket cost per treatment, patients preferred lower cost (β= −0.015, P<0.001). In terms of type of hemodialysis doctors, patients preferred regular doctors over different doctors (β=1.087, P<0.001). Regarding continuity of care, patients preferred home-based offline follow-up service over no continuing care

Table 3 Characteristics of Participants [Number (%)]

Variable	Overall
Gender	
Male	231(56.6)
Female	177(43.4)
Age	
≤60	192(47.1)
> 60	216(52.9)
Education	
Middle school and below	162(39.7)
High school or equivalent	163(40.0)
Junior college and above	83(20.3)
Marital status	
In marriage	329(80.6)
Not married	79(19.4)
Family monthly income(CNY)	
≤6000	225(55.1)
>6000	183(44.9)
Self-rated health:	
Excellent good, very good, good	141(35.8)
Mediocre, poor	267(64.2)
Year of dialysis	
≤5	249(61.0)
>5	159(39.0)
Knowledgeable degree of community hemodialysis policy	
High	9(2.2)
Medium	102 (24.8)
Low	298(73.0)

Abbreviation: CNY, Chinese Yuan.

service (β=0.257, P<0.001). In terms of critical situation handling attribute, patients preferred a smooth and effective referral pathway (β=1.343, P<0.001). Regarding travel time, patients prefer 20 minutes over 40 minutes (β=0.695, P<0.001).

Ranked by RI value, the non-monetary service attributes that ESKD patients valued the most were critical situation handling (39.71%), followed by the type of dialysis doctor (32.14%), travel time (20.55%), and continuing care (7.60%). The relative importance of service attributes is presented in Figure 1.

Heterogeneity Analysis

This study incorporates interaction terms between demographic, hemodialysis treatment characteristics, and service attributes into the mixed logit model to explore the heterogeneity of preferences.

Table 4 Preference of Hemodialysis Services Among ESKD Patients

Attributes	Level	β	*P*	SE
ASC	Hospital-based hemodialysis facilities (ref)			
	Community hemodialysis centers	−2.404	<0.001	0.164
Type of hemodialysis doctors	Different doctors(ref)			
	Regular doctors	1.087	<0.001	0.108
Continuing care	None(ref)			
	Telephone/online follow-up	0.141	0.166	0.102
	Home-based offline follow-up	0.257	<0.001	0.087
Handling of critical situation	Ineffective upward referral pathway(ref)			
	Smooth and effective referral	1.343	<0.001	0.134
Travel time	40 minutes(ref)			
	20 minutes	0.695	<0.001	0.096
OOP cost per treatment (CNY)	–	−0.015	<0.001	0.001
Observations	7344			
AIC	3384.668			
BIC	3474.390			
Log likelihood	−1679.334			
LR chi-square value	490.96, *P*<0.001			

Notes: β, standardized regression coefficient; italics are used for P values.
Abbreviations: SE, standard error; OOP, out-of-pocket; CNY, Chinese Yuan; AIC, akaike information criterion; BIC, Bayesian information criterion; LR chi-square value, likelihood ratio chi-square value.

Compared to male patients, female patients were more likely to prefer services with lower out-of-pocket expenses per session ($\beta = -0.007$, $P < 0.01$). Patients with a stable income source were more inclined to prefer a fixed physician compared to those without a stable income source ($\beta = 0.589$, $P < 0.01$). Patients aged 60 and above tended to prefer a 20-minute travel time ($\beta = 0.390$, $P < 0.05$) (Table 5).

The interaction regression results for hemodialysis treatment characteristics indicated that these factors influence patient preferences. The average number of dialysis sessions per week had an impact on the preferences for the out-of-pocket expenses per session and the type of dialysis physician. Compared to ESKD patients with an average of less than three dialysis sessions per week, patients with three or more sessions per week showed a stronger preference for lower out-of-pocket cost per session ($\beta = -0.008$, $P < 0.01$) and a preference for a regular doctor ($\beta = 0.648$, $P < 0.01$). Regarding time on dialysis, patients with a dialysis duration of more than five years were less inclined to prefer a 20-minute travel time compared to those with a dialysis duration of five years or less ($\beta = -0.496$, $P < 0.01$).

Policy Simulations

Based on the results of the mixed logit model, we calculated the marginal utilities of each service attribute to predict the changes in the willingness of ESKD patients to choose community hemodialysis centers under different service scenarios.

The study first set the basic community hemodialysis centers scenario as follows: different doctor, no continuing care, no smooth and effective referral established, OOP cost per treatment of 150 CNY (US$20.85), and travel time of 40 minutes. Setting this community hemodialysis centers as the reference level, the marginal utilities were calculated to

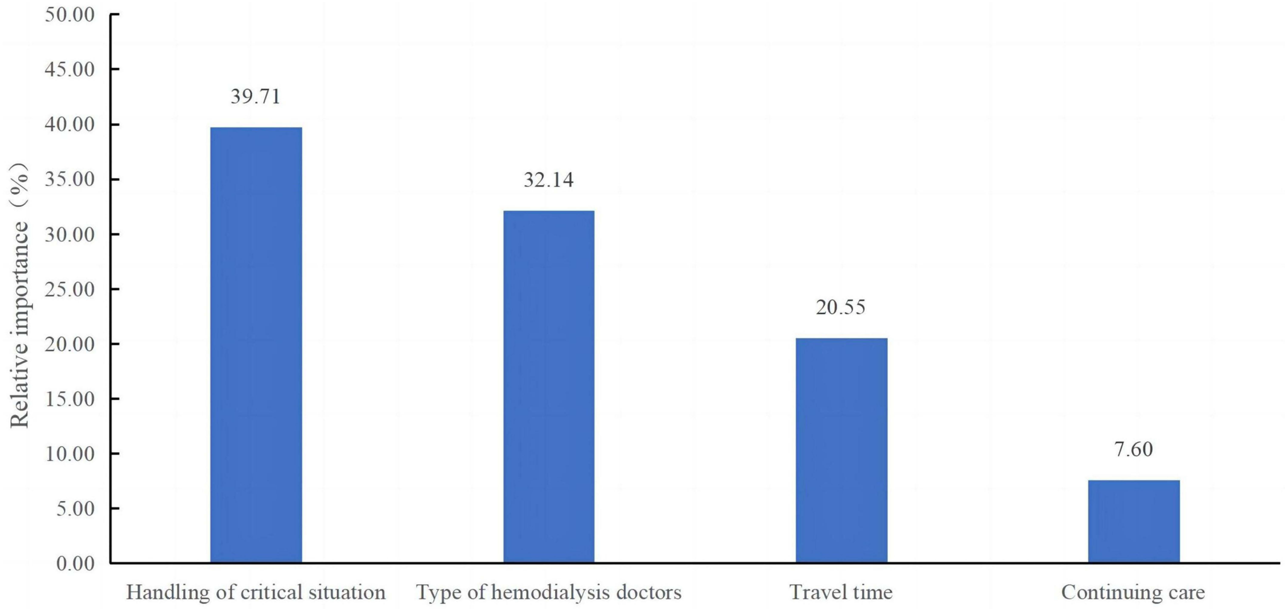

Figure 1 Relative importance of service attributes.

measure the changes in the willingness of ESKD patients to choose between community and hospital hemodialysis services under different combinations of service attributes. As changes in community hemodialysis service attributes' level accumulated, the probability of patients choosing community and hospital hemodialysis services shows opposite trends. In the baseline community hemodialysis centers scenario, the probability of patients choosing community

Table 5 Preference Heterogeneity of Different Demographic and Hemodialysis Characteristics Patients

Attributes	Level	Model1 β(SE)	Model2 β(SE)
ASC	Hospital-based hemodialysis facilities (ref)		
	Community hemodialysis centers	−2.567*** (0.171)	−2.755*** (0.195)
OOP cost per treatment		−0.014*** (0.001)	−0.013*** (0.001)
Type of hemodialysis doctors	Different doctors(ref)		
	Regular doctors	0.663***(0.199)	0.885***(0.156)
Continuing care	None(ref)		
	Telephone/online follow-up	0.173(0.106)	0.176(0.116)
	Home-based offline follow-up	0.303*** (0.092)	0.301**(0.096)
Handling of critical situation	Ineffective upward referral pathway(ref)		
	Smooth and effective referral	1.242*** (0.188)	1.492***(0.169)
Travel time	40 mins(ref)		
	20 mins	0.917*** (0.135)	0.760***(0.145)

(*Continued*)

Table 5 (Continued).

Attributes	**Level**	**Model1 β(SE)**	**Model2 β(SE)**
OOP cost per treatment(CNY)			
×gender: female(ref: male)		−0.007**(0.002)	
Type of hemodialysis doctors: Regular doctors			
×stable income: yes(ref: no)		0.589**(0.226)	
Traffic time: 20minutes			
×age(year): ≥60(ref: <60)		0.390* (0.165)	
OOP cost per treatment			
×hemodialysis times weekly:3 times and above (ref: below 3 times)			−0.008**(0.001)
Type of hemodialysis doctors: Regular doctors			
×hemodialysis times weekly:3 times and above (ref: below 3 times)			0.648**(0.205)
Travel time: 20 minutes			
×hemodialysis year: above 5 years(5 years and below)			−0.496**(0.197)
Observations		7344	7344
AIC		3330.548	3283.553
BIC		3475.482	3442.291
Log likelihood		−1644.274	−1618.777
LR chi-square value		547.380	598.790

Notes: *P<0.05, **P<0.01, ***P<0.001; β, standardized regression coefficient.
Abbreviations: SE, standard error; CNY, Chinese Yuan; OOP, out-of-pocket; USD, United States dollar; AIC, akaike information criterion; BIC, Bayesian information criterion; LR chi-square value, likelihood ratio chi-square value.

hemodialysis centers is 6.02%. As the level of community hemodialysis service attributes increases, the probability of patients choosing community hemodialysis centers rises continuously. When the level of the critical situation handling attribute changes to establishing "smooth and effective upward referral" the probability increases to up to 58.39%, higher than the probability of choosing hospital-based hemodialysis facilities. See Figure 2 for details.

Discussion

This study was based on the perspective of demand side, using a labelled discrete choice experiment to explore the preferences of ESKD patients for hemodialysis service and how to improve the acceptance of community hemodialysis centers. We found that the service attribute most valued by patients was handling of critical situation. Out-of-pocket cost per treatment, type of dialysis doctor, travel time, and continuing care also affected patients' choice of hemodialysis services.

The results indicated that establishing a smooth and effective referral pathway could significantly increase the probability of ESKD patients choosing community hemodialysis centers. During the long-term maintenance hemodialysis treatment process, the disease burden of patients continues to increase due to the progressive development of primary diseases, worsening complications, and the limitations of dialysis treatment. In the sample of this study, 90.4% of the patients had one or more complications, and only 28.9% of the patients were self-reported in good health status.

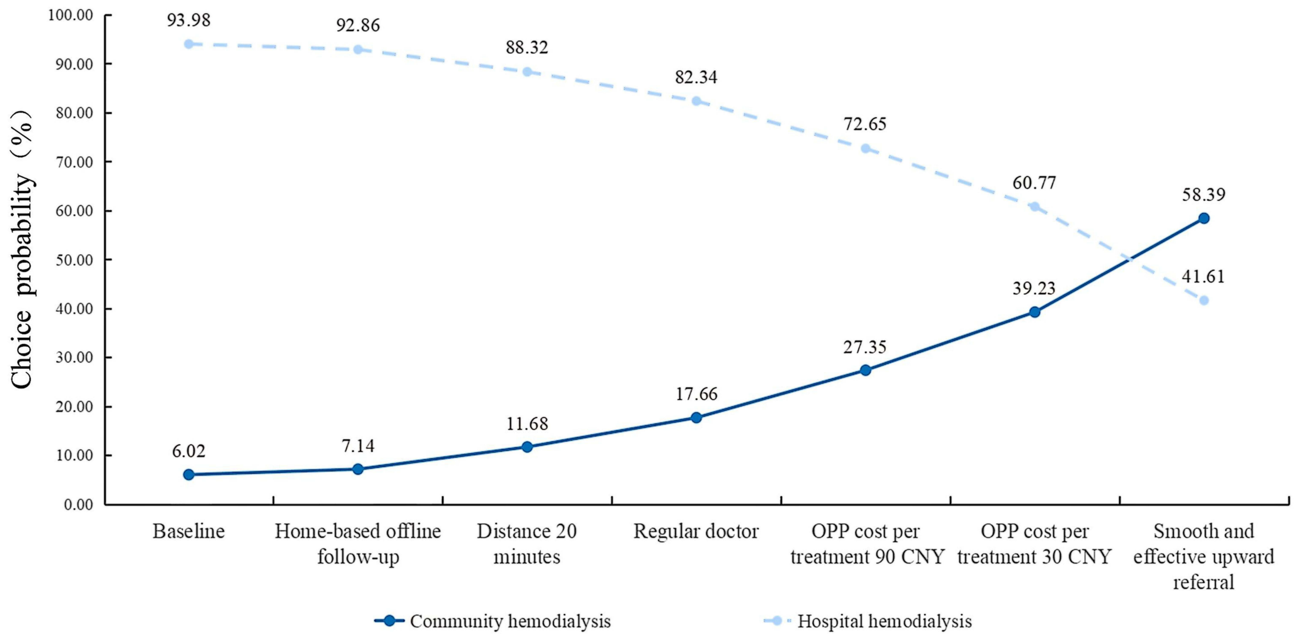

Figure 2 Policy simulations showing changes in probability of ESKD patients opting for community hemodialysis centers.
Abbreviations: OOP, out-of-pocket; CNY, Chinese Yuan; USD, United States dollar.

Effective referral channel means the integration of services and ensures services quality and the safety of patients, so patients showed strong preferences for it.

To strengthen the integration of the hemodialysis service system, the National Health Commission of China issued the "Basic Standards for Hemodialysis Centers (Trial)" in 2016[6]. It stipulated that within a 10-kilometer radius of a hemodialysis center, there must be a second-level or higher comprehensive hospital equipped with emergency treatment capabilities. The center and the hospital should sign an agreement to ensure smooth upward referral pathways. However, in practice, many community-based hemodialysis facilities and hospitals lacked a shared motivation, and the intended "green channel" failed to guarantee the safety of dialysis patients.[27] To address this problem and improve the quality and safety of community healthcare, the establishment of closely integrated specialized medical consortiums, serves as a crucial approach.[28] It is suggested that tertiary hospitals should take the lead in developing the upward and downward referral standards for hemodialysis treatment within the specialized medical consortium. Patients with stable conditions should be treated in the community after personalized dialysis plans are formulated by experts, and patients with critical conditions should be transferred to higher-level hospitals through green channels. Tertiary hospitals should also take the lead in developing the regional homogeneous hemodialysis diagnosis and treatment guidelines and clinical paths to ensure the quality and adequacy of dialysis, and promoted the application in all medical units.

The study found that patients were sensitive to out-of-pocket payments. In order to ease the financial burden on patients and their families, the Chinese government has included ESKD in serious disease insurance in 2012, and provinces have gradually improved the medical insurance coverage.[29] However, due to the high frequency and long period of maintenance hemodialysis, patients also need to travel to and from the hospital several times a week, resulting in transportation costs and labor loss, so the direct and indirect disease burden for patients and their families was still heavy.[30] By the end of 2019, hemodialysis patients had spent more than 22.2 billion CNY (about US$3.17 billion) on treatment. Zong Nan calculated the disease economic burden of hemodialysis patients in six provinces, and 5.53% of hemodialysis patients borrowed money to pay medical expenses. The direct disease economic burden of patients in the six provinces was 136,635 CNY (US$18,996.08); In Hubei Province, patients' average out-of-pocket expenses accounted for 44.41% of their personal income.[31] As the World Health Organization recommends that household expenditure on personal health account for 40% of non-food expenditure as the standard for the definition of catastrophic health expenditure, it can be inferred that the expenditure caused by hemodialysis treatment has exceeded the affordability of many families, resulting in economic risks.[32] It suggests that the medical insurance department should strengthen the guarantee of hemodialysis services, and at the same time play a leverage role in the formulation of payment standards to guide the diversion of patients. The results of interaction term analysis showed that gender and weekly dialysis times had an impact on patients' preference for out-of-pocket costs. Compared with men, female patients were more inclined to choose services with lower out-of-pocket costs, which may be due to the social role expectations that shape women's attitudes and decision-making towards medical service costs. Women were generally regarded as family caregivers and financial managers,[33] so they were more inclined to choose medical services with lower prices to ensure the financial stability of their families. Compared with patients who receive dialysis less than 3 times per week, patients with more than 3 times dialysis per week preferred lower cost. One possible reason was that patients who needed more frequent dialysis were more likely to choose less expensive treatment.

Patients had a positive preference for regular hemodialysis doctors, indicating the desire for stable hemodialysis services. A regular dialysis physician can better understand the patient's condition and treatment history, thus formulating more scientifically reasonable treatment plans and improving treatment outcomes. In addition, ESKD not only causes poor physical health but also leads to negative emotions such as anxiety and depression.[34] A regular hemodialysis doctor can establish a continuous and stable relationship with the patient, helping to alleviate the patient's tension and fear and better adapt to the treatment process. However, human resources in China's healthcare system are not sufficient, and hospital doctors are generally overloaded.[35] Data showed that the ratio of nephrologists to patients with chronic kidney disease has reached 1:15,000.[36]

The number of people receiving hemodialysis treatment per million in China rose from 174.1 in 2011 to 379.1 in 2017.[3] According to the China Health Statistics Yearbook, the number of practicing (assistant) doctors in China was 2.61 million and 3.39 million in 2011 and 2017, respectively, indicating that the growth rate of doctors is lower than that of patients. Under the background of insufficient physician resources and high workload, on-duty physicians in hospital hemodialysis centers can usually only be rotated from the nephrology department. When scheduling, it is necessary to consider the reasonable distribution of work tasks among doctors and time coordination, making it difficult for patients to achieve a long-term fixed physician. In comparison, the community can leverage the advantages of the family doctor contract system, enabling patients to establish a long-term and stable diagnosis and treatment relationship with their family doctor. Family doctors can also provide unified management of various chronic complications associated with hemodialysis, improving service quality and enhancing the attractiveness of community hemodialysis centers.

The results of the interaction term model showed that patients with stable income sources were more inclined to choose fixed doctors than those without stable income sources. According to Maslow's hierarchy of needs theory, demand satisfaction is sequential.[37] Patients who do not have a stable source of income often face greater financial pressure, which may prevent them from meeting their survival needs. Once the survival needs are met, patients may turn to higher levels of security and social needs. Therefore, patients with a stable source of income are more inclined to choose a fixed doctor in order to obtain medical security and long-term stable doctor–patient relationship. Compared with patients with less than 3 dialysis times per week on average, patients with 3 or more dialysis times prefer fixed doctors, which may be explained that patients are more inclined to establish a stable doctor–patient relationship, improve the continuity of medical services, and avoid medical risks when they need to receive hemodialysis services more frequently.

ESKD patients showed a positive preference for shorter travel time. Previous research has indicated that long commutes to dialysis centers not only increase patients' transportation costs and labor loss but also impact their quality of life and are associated with higher mortality rates.[38] The interaction analysis revealed heterogeneity in travel time preferences among patients in different age groups. Patients aged 60 and above were more inclined towards a 20-minute travel time, which may be attributed to the diminished physical mobility that comes with aging[39]. Longer commutes impose heavier physiological and psychological burdens on patients, and thus, the convenience and promptness of accessing hemodialysis services hold greater utility. The round-trip travel time for patients receiving dialysis at independent dialysis centers is significantly shorter compared to patients receiving dialysis at hospitals.[40] Further enhancing the spatial accessibility of community hemodialysis centers is an important factor in guiding the appropriate diversion of ESKD patients.

Patients were more inclined to home-based offline follow-up services. The effectiveness of hemodialysis treatment is not only influenced by the medical level of service providers but also by the nursing care of arteriovenous fistulas,[41] treatment plans adherence,[42] dietary compliance and control of fluid intake,[43] all of which require patients to have good self-management abilities. Home-based offline follow-up provides medical personnel with more opportunities to obtain information on patient lifestyles and treatment processes, allowing them to comprehensively understand patient situations, and develop or adjust dialysis schemes based on this information. Additionally, medical personnel can conduct targeted health education to enhance patient self-management abilities. Furthermore, offline follow-up by medical personnel also provides humanistic care to hemodialysis patients, improving their social support status and positively impacting their mental health.

This study has some limitations. First, previous studies suggest that it is ideal to consider 4–6 attributes when carrying out discrete selection experiments. This study only included five attributes that we believed would have the most important impact on the choice of hemodialysis service for patients with ESKD, which may omit other factors that may have an impact on the choice of service. Second, all the research methods of declarative preference have a common shortcoming, that is, they are all hypothetical situations and choices, which cannot represent the real choices made by the interviewees when they actually happen, so they may be affected by cognitive biases. Third, the community hemodialysis centers in Wuhan city were in the early development stage. There were a small number of community hemodialysis patients, and limited accessibility for investigation. Therefore, the participants of this study were all ESKD patients receiving hemodialysis at hospital. To control sample bias, we thoroughly introduced and emphasized a hypothetical scenario of DCE to the participants before interview.

Conclusion

In healthcare research, it is crucial to identify patients' needs and preferences for service improvement. Our research focused on studying patients' preference between hospital-based hemodialysis facilities and community hemodialysis centers. Although patients were more inclined to hospital-based hemodialysis service, their preference would reverse with the change in service attributes. Improving the integration of hemodialysis service systems was key to improving patients' utilization of community hemodialysis services and developing hierarchical hemodialysis service system.

Data Sharing Statement

Data will be made available on request.

Ethical Approval

This study complied with the Declaration of Helsinki. All the investigation tools in this study were approved by the Medical Ethics Committee of Tongji Medical College, Huazhong University of Science and Technology (No. [2022] Lunshen Zi (S181)). According to the purpose of this survey, before the formal start of each survey, the investigators would explain the purpose, risks, benefits, confidentiality, refusal or withdrawal of this study to the participants in detail, so as to ensure that the participants were fully aware of the relevant matters of this study and voluntarily accepted the questionnaire survey.

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Author Contributions

All authors made a significant contribution to the work reported, whether that is in the conception, study design, execution, acquisition of data, analysis and interpretation, or in all these areas; took part in drafting, revising or critically reviewing the article; gave final approval of the version to be published; have agreed on the journal to which the article has been submitted; and agree to be accountable for all aspects of the work.

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Disclosure

The authors report no conflicts of interest in this work.

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