ABSTRACT

Objectives To quantify the preference of patients with diabetes mellitus (DM) for primary healthcare (PHC) institutions in China to redirect the patient flow and improve health outcomes.

Design Cross-sectional study. Discrete choice experiment (DCE) surveys asked patients with DM to choose between hypothetical institutions that differed in the medical service capacity, out-of-pocket (OOP) medical costs per month, travel time, the attitude of medical staff and the availability of diabetes drugs.

Setting Shandong province, China.

Participants The participants were 887 patients with DM from 36 urban communities and 36 rural villages in Shandong province. One participant did not provide any DCE answers and a further 57 patients failed the internal consistency test. 829 fully completed surveys were included in the final data analysis.

Main outcomes and measures A mixed logit model was used to calculate the willingness to pay and predict choice probabilities for PHC institution attributes. Preference heterogeneity was also investigated.

Results All five attributes were associated with the preferences of patients with DM. The OOP medical costs and the medical service capacity were the most influential attributes. Improvements simultaneously in the attitude of medical staff, drug availability and travel time increased the likelihood of a patient's PHC institution choice. Preferences differed by region, annual household income and duration of diabetes.

Conclusions Our patient preference data may help policymakers improve health services and increase acceptance of choosing PHC institutions. The OOP medical costs and medical service capacity should be regarded as a priority in decision-making.

STRENGTHS AND LIMITATIONS OF THIS STUDY

⇒ This study uses a discrete choice experiment to capture patients’ preferences regarding PHC institutions, which provides implications for low/middle-income countries facing limited health resources, substantial burdens of chronic disease and weak PHC system.

⇒ The results take into account the heterogeneity of the population and can be used to implement specific strategies to improve health services and increase acceptance of choosing PHC institutions.

⇒ Participants were recruited in three regions of Shandong province. Due to different geographical, political and cultural factors, the results may not apply to other countries or regions.

⇒ The order in which attributes appear in the choice sets may influence patients’ choices. The order of the attributes was not randomised in this study, which might produce ordering bias.

INTRODUCTION

Diabetes mellitus (DM) is a major public health problem and one of the leading causes of death around the world.1 According to the 10th edition of the International Diabetes Federation Diabetes Atlas, China has the largest population with DM worldwide in 2021, and is estimated to exceed 174 million by 2045.2 In 2019, DM led to total deaths of 1.62%, years lived with disability of 4.14% and disability-adjusted life years of 2.59% among the population of China.3 The economic burden of diabetes is estimated to grow faster than China’s economic growth during 2020–2030.4 The overall situation of DM management is not optimistic; only 39.7% of patients had adequate glycaemic control.3 Therefore, promoting the health of patients with DM is a public health imperative.5 In a report on chronic non-communicable diseases in China, the World Bank said that having access to and using primary healthcare (PHC) could help to prevent and control DM.7

In China, the government set up a hierarchical medical system to make sure that medical resources were distributed in the best way.8 It advocated that most rehabilitative and chronic services (such as DM, one of the most common chronic diseases) should be provided primarily by PHC institutions and
large hospitals, which primarily address acute and serious illnesses and provide technical support to PHC providers. Although progress has been made in strengthening the primary medical equipment and medical environment, many patients bypass PHC institutions when they need clinical care due to the poor capacity and skills of the PHC staff. It was reported that the hospital admission rate for diabetes in China was much higher than in most Organization for Economic Co-operation and Development countries, which could explain the underperformance of PHC. Those distorted health-seeking behaviours (over-crowding in hospitals and underutilisation in PHC institutions) resulted in complications from poor glycaemic control, which increase the disease burdens of patients and waste social medical resources.

High-quality PHC should be performed based on patients’ needs. In order to improve the primary care capacity and redirect patient flow, it is necessary for policymakers to understand the preferences of patients with DM for PHC institutions. The patient’s choice of medical institution is a very complicated process, whose subjective and objective factors influence each other, and different individuals have their own preferences. Patients’ socioeconomic status and health status were reported to influence health service utilisation. Another study has summarised the possible influencing factors, including accessibility of PHC services, doctors’ attitudes and physicians’ medical skills. In spite of these efforts, these influencing factors were only evaluated independently by using univariate analysis or logistic regressions. It remains unclear how patients make trade-offs and the relative importance of the factors.

This article used a discrete choice experiment (DCE) to capture trade-off information regarding PHC institutions of patients with DM. The DCE is a stated preference approach that has been popular when measuring preferences in the healthcare field. To the best of our knowledge, there has only been one study conducted in China to look at the preferences of patients with type 2 DM for urban integrated primary care. However, the above study focused on urban patients with a well-developed health system in China and could not represent the broad patient population. Our study is more comprehensive than before in that the sample includes a mix of rural and urban areas. Another study investigated the patient preferences for facility-based management of hypertension and diabetes in rural Uganda. Several studies have examined the health-seeking preferences of an adult population. However, there is a lack of information on how and to what extent patients with DM prefer and are willing to seek for health services from PHC institutions.

We aimed to conduct a DCE study to determine the PHC institution attributes preferred by patients with DM, and whether sociodemographic and clinical characteristics were associated with institution choice. In addition, we tried to predict future probability of patient visits by calculating the simulation probability. Results from our work can assist policymakers in the redesign of primary care services according to patient preference, which will strengthen the gatekeeping roles of PHC institutions and improve the hierarchical medical system.

**METHODS**

The DCE is a robust tool for quantitative measurement of stated preferences, which is grounded theory of demand and random utility theory in economics. In DCEs, participants are expected to make trade-offs among a series of institution scenarios given. Each scenario typically includes two or more alternatives which can be described by attributes and levels. Participants’ preferences depend on the alternatives that they have chosen. Our study was undertaken in sequential steps following the good practice checklist, which can be summarised in four key steps: (1) selection of attributes and levels, (2) experiment design, (3) data collection and (4) discrete choice data analysis.

**Selection of attributes and levels**

Our study used a literature review and in-depth interview to select attributes and their corresponding levels. Initially, six potentially important institution attributes from literature review were identified. Then, eight patients with DM were recruited to join an in-depth interview in Jinan City in March 2019. During the interview, patients were asked to rank these potential attributes in order of importance. ‘Confidentiality during treatment’ was removed because most of patients with DM thought diabetes treatment did not involve the disclosure of privacy. Furthermore, we consulted two doctors and three experts in the field of DCE to confirm the final attributes and levels in the questionnaire.

Table 1 showed the final attributes and levels. The attitude of medical staff represented the provider factor. Healthcare quality was measured by medical service attributes and attribute levels

<table>
<thead>
<tr>
<th>Attribute</th>
<th>Level</th>
</tr>
</thead>
<tbody>
<tr>
<td>Medical service capacity</td>
<td>Low</td>
</tr>
<tr>
<td></td>
<td>Moderate</td>
</tr>
<tr>
<td></td>
<td>High</td>
</tr>
<tr>
<td>Out-of-pocket medical costs per month</td>
<td>¥750</td>
</tr>
<tr>
<td></td>
<td>¥450</td>
</tr>
<tr>
<td></td>
<td>¥150</td>
</tr>
<tr>
<td>Travel time</td>
<td>90 min</td>
</tr>
<tr>
<td></td>
<td>45 min</td>
</tr>
<tr>
<td></td>
<td>15 min</td>
</tr>
<tr>
<td>Attitude of medical staff</td>
<td>Bad</td>
</tr>
<tr>
<td></td>
<td>Good</td>
</tr>
<tr>
<td>Availability of diabetes drugs</td>
<td>60%</td>
</tr>
<tr>
<td></td>
<td>80%</td>
</tr>
<tr>
<td></td>
<td>100%</td>
</tr>
</tbody>
</table>

capacity and the availability of diabetes drugs. The levels of all three attributes mentioned above were all specified to reflect the current healthcare services in Shandong province. In particular, it should be noted that the affordability factor referred to the out-of-pocket (OOP) medical expenses. The price of diabetes drugs varies significantly. The price of glipizide and metformin is relatively low, while the economic burden of insulin is heavy for patients. After combining open online data such as Yaofang website and medical insurance negotiation, the final cost range was identified to be ¥150–¥750. The accessibility factor is reflected by travel time rather than travel distance, which can be more intuitively understood by patients. Based on the geographical distribution of PHC institutions in Shandong province, we identified three levels of travel time, which are 15 min, 45 min and 90 min.

Experiment design
This DCE design was constructed using an orthogonal main effects plan in Ngene V.1.2 (ChoiceMetrics, Sydney, Australia). We generated a subset of 12 choice sets to ensure balance among the attributes and levels. These 12 choice sets were then divided into two separate versions to reduce cognitive burden of participants. A forced-choice design was used in order to arrive at a more efficient design. Each patient was asked to choose between two unlabelled options of which PHC institution he/she preferred. We conducted an internal consistency test to ensure the robustness of the data. Respondents were considered to have passed the test if they chose the clearly dominant alternative. After the questionnaire design was completed, we first conducted a quantitative pilot (N=30) in Jinan to examine the participants’ responses. Most of patients indicated that they understood the content of the questionnaire. An example of a DCE question was presented in table 2.

Data collection
Data were collected in Shandong province from August to September 2019. A multistage sampling strategy was adopted. According to the geographical location and economic development level, we recruited participants in Qingdao, Weifang and Liaocheng. First, three urban districts and three rural towns in each city were selected. Second, we selected three communities in each urban district and three villages in each rural town. Finally, 27 communities and 27 villages were selected as the sample areas. Inclusion criteria for participants included having diagnosed DM by a physician and being incorporated into the management of basic public health services.

According to the rule of thumb, the minimum sample size in this study should be 125. It is necessary to increase the sample size to satisfy the subgroup analysis and the application of complex models. Therefore, we targeted a sample of 800 patients with DM in Shandong province. Data collection was strongly supported by local health bureau, who helped us invite eligible patients with DM. All patients participated voluntarily and signed written consent. Each patient would take 20 min to complete a questionnaire and would receive a gift worth ¥20 after completion. In light of the complexity of the DCE questions, our study decided to adopt a face-to-face and one-on-one survey where interviewers could fully explain the tasks.

Discrete choice data analysis
We adopted STATA V.15.1 (StataCorp, College Station, Texas, USA) to analyse data. Descriptive statistics were used to present respondents’ sociodemographic characteristics. The mixed logit (MIXL) model was employed to analyse the choice observations. The MIXL model is the most general choice model and accounts for various types of heterogeneity and correlation in the data. The OOP medical costs and travel time were coded as continuous variables, while dummy coding was used for the remaining attributes. The omitted/reference levels were low medical service, bad attitude of medical staff and 60% of diabetes drugs’ availability.

In the MIXL model, β coefficient reflects preference weight of attribute relative to the reference level. Relative Attribute Importance (RAI) score of an attribute is equal to the percentage of the preference weight of this attribute (utility value of the best level minus that of the worst level within the same attribute) in the sum of all attribute weights. We divide the utility value of the attribute level by the utility value of the cost attribute to derive the willingness to pay (WTP) of an attribute level. The WTP results provide attribute trade-off information and express how much additional cost patients are willing to pay for changes in other attributes.

In this study, we calculated the predicted probability of choosing to visit a PHC institution and recorded the changes given the adjustments in attribute levels. It is straightforward for policy decision-makers to facilitate the implementation of institution-predicted probability. We also conducted subgroup analysis by including some sociodemographic variables to explore preference heterogeneity among different kinds of population.

Patient and public involvement
Patients participated in interviews and pilots, which helped us to better complete the design of the DCE.

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### Table 2 Example of a discrete choice experiment question (translated version)

<table>
<thead>
<tr>
<th>PHC institution A</th>
<th>PHC institution B</th>
</tr>
</thead>
<tbody>
<tr>
<td>Medical service capacity</td>
<td>High</td>
</tr>
<tr>
<td></td>
<td>Moderate</td>
</tr>
<tr>
<td>OOP medical costs per month</td>
<td>¥450</td>
</tr>
<tr>
<td></td>
<td>¥750</td>
</tr>
<tr>
<td>Travel time</td>
<td>90 min</td>
</tr>
<tr>
<td></td>
<td>45 min</td>
</tr>
<tr>
<td>Attitude of medical staff</td>
<td>Bad</td>
</tr>
<tr>
<td></td>
<td>Good</td>
</tr>
<tr>
<td>Availability of diabetes drugs</td>
<td>100%</td>
</tr>
<tr>
<td></td>
<td>80%</td>
</tr>
<tr>
<td>OOP, out-of-pocket; PHC, primary healthcare.</td>
<td></td>
</tr>
</tbody>
</table>

RESULTS

Respondent characteristics

The response rate of this study was 93.46%. The final sample used in the analysis consisted of 829 respondents. Table 3 presents some of their demographic and clinical characteristics. The results indicated that there were no significant differences in characteristics between analysis sample and excluded sample. Among the analysis sample, the mean age of patients was 64 years. Over half of the sample was female (552, 67%) and came from rural areas (468, 57%). Most respondents were married and 42% of the respondents had received middle school education or higher. Five hundred seventeen (63%) of patients had diabetes complications, and the average duration of diabetes is nearly 10 years.

Main effects model and relative attribute importance results

Table 4 presents the MIXL model results. It is significant to understand the unit of measurement when interpreting these coefficients. The coefficients of OOP medical costs per month and travel time reflect the change of ¥1 in medical costs and a minute’s change in travel time, respectively. The coefficients of the remaining other attributes showed the change in benefit for a unit change in healthcare institution based on reference level. All attributes had their expected sign and levels that were significant. For example, the marginal utility for the ‘100%’ level of the availability of diabetes drugs was larger than that of the ‘80%’ level. Moreover, the majority of SD estimates are statistically significant, suggesting the existence of preference heterogeneity.

The RAI results shown in online supplemental file 1 indicate that respondents give most importance to the OOP diabetes drug costs (26.83%), followed by medical service capacity (25.09%), availability of diabetes drugs (20.84%), travel time (17.29%) and attitude of medical staff (9.94%).

Willingness to pay

Table 4 also shows the WTP results, which explain how much in OOP costs a patient with DM is willing to pay to visit a higher level of PHC institution. Patients on average are willing to pay the largest amount of money for high medical service capacity (¥561), followed by moderate medical service capacity (¥537), availability of diabetes drugs (¥504), travel time (¥279) and attitude of medical staff (¥246). Subgroup analysis

Online supplemental file 2 shows the WTP results for some subgroups based on social demographic and
clinical characteristics. All variables were reclassified into two categories. Notably, rural patients were willing to pay more fees for a higher level of PHC institution attributes relative to patients from the city. We observed that female patients with DM paid more attention on the attitude of medical staff and travel time. However, patients who were younger, with higher education or unemployed reduced the importance of travel time. In addition, we found a more WTP to visit a PHC institution with a high level of medical service capacity among patients with no family history, longer duration of diabetes or multimorbidity. Regarding the availability of diabetes drugs, patients with complications valued it more, as they were willing to pay ¥597 to obtain 100% of the availability of diabetes drugs. More detailed results of the subgroup analysis are presented in online supplemental file 3–12.

Simulation results
Results of simulation probability were shown in figure 1. We set the low medical service capacity, monthly OOP medical costs of ¥750, travel time of 90 min, bad attitude of medical staff and the availability of diabetes drugs of 60% as the baseline scenario. Change in one single level could vary the proportions of patients who were willing to visit a PHC institution from less than 57% to more than 95%. The OOP medical cost decrease to ¥150 had the largest effect on preference, while the impact of the availability of diabetes drugs and attitude of medical staff was small.

Furthermore, we tried various combinations for those measures that have less impact, particularly the availability of diabetes drugs, the attitude of medical staff and travel time. When the attitude of medical staff improved from bad to good and travel time reduced to 45 min simultaneously, the proportion increased to 88%. By contrast, patients preferred the institution with the availability of diabetes drugs of 100%. For the multiple combinations, the most effective measure was ‘①+②+③’; almost all patients were willing to seek healthcare services in PHC institution.

DISCUSSION
The survey provided the preference information of patients with DM in choices of PHC institutions. All attributes were statistically significant in the current study. We found that patients are strongly influenced by the OOP medical costs, medical service capacity and the availability of diabetes drugs in choosing where to receive care. Subgroup analysis results suggested that patients place different weights on attributes. For example, patients with complications valued it more. In addition, PHC institutions that respond to these preferences for higher quality increase the likelihood of patients’ visiting.

Simulation results indicated that OOP medical costs were the strongest institution choice indicator for patients. This is confirmed by a study, which suggests that up to one-third of patients would receive PHC services at lower prices. It could be because patients with DM incur greater expenses or have greater financial difficulties associated with their conditions, thereby preferring the OOP drug costs. Most patients with DM require

<table>
<thead>
<tr>
<th>Attributes and levels</th>
<th>β</th>
<th>SE</th>
<th>SD</th>
<th>SE</th>
<th>WTP</th>
<th>95% CI</th>
</tr>
</thead>
<tbody>
<tr>
<td>OOP medical costs per month</td>
<td>-0.006***</td>
<td>0.001</td>
<td>-0.005***</td>
<td>0.001</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>Travel time</td>
<td>-0.031***</td>
<td>0.003</td>
<td>0.026***</td>
<td>0.004</td>
<td>-5.155</td>
<td>-5.995-4.316</td>
</tr>
<tr>
<td>Medical service capacity (ref. low)</td>
<td>3.249***</td>
<td>0.366</td>
<td>1.590***</td>
<td>0.355</td>
<td>537.100</td>
<td>449.855-624.344</td>
</tr>
<tr>
<td>High</td>
<td>3.394***</td>
<td>0.361</td>
<td>-0.113</td>
<td>0.447</td>
<td>561.027</td>
<td>460.856-661.198</td>
</tr>
<tr>
<td>Attitude of medical staff (ref. bad)</td>
<td>1.345***</td>
<td>0.209</td>
<td>1.580***</td>
<td>0.280</td>
<td>222.285</td>
<td>157.226-287.343</td>
</tr>
<tr>
<td>Availability of diabetes drugs (ref. 60%)</td>
<td>1.283***</td>
<td>0.221</td>
<td>2.406***</td>
<td>0.284</td>
<td>212.084</td>
<td>157.679-266.489</td>
</tr>
<tr>
<td>80%</td>
<td>2.819***</td>
<td>0.302</td>
<td>-0.206</td>
<td>0.648</td>
<td>466.015</td>
<td>395.058-536.972</td>
</tr>
<tr>
<td>AIC</td>
<td>4046.136</td>
<td></td>
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<tr>
<td>BIC</td>
<td>4147.003</td>
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<td></td>
</tr>
<tr>
<td>Log likelihood</td>
<td>-2009.068</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Respondents, n</td>
<td>829</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Observations, n</td>
<td>9944</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

***P<0.001.
–, none or not applicable; AIC, Akaike information criterion; BIC, Bayesian information criterion; MIXL, mixed logit; OOP, out-of-pocket; ref, reference; WTP, willingness to pay; β, coefficient.
frequent outpatient service provision, while previous health insurance schemes often tended to prioritise inpatient services.\textsuperscript{33, 34} Therefore, we propose modifying the design of service benefit packages and raising the proportion of outpatient medical insurance reimbursement ratios among primary care providers.

Beyond the cost attribute, the medical service capacity was the most important factor across all subgroups of patients. As an indicator of the quality of healthcare, this attribute was often considered the key determinant in hospital choice.\textsuperscript{35, 36} According to the long-term disease nature and healthcare utilisation of patients with DM, control of disease is more appropriate in PHC institutions.\textsuperscript{21} However, few institutions in China have the qualifications to serve as gatekeepers or provide quality health services.\textsuperscript{33} The major problem was that the number and ability of family doctors in primary institutions were insufficient.\textsuperscript{13} Hence, it is necessary to strengthen the teams of primary physicians through financial and non-financial incentives, such as raising salaries to attract experts from higher-level hospitals and strengthen professional training for diabetes diagnosis and treatment.

Similar to other studies, our results found that the availability of drugs affected the utilisation of PHC institutions by patients.\textsuperscript{37} This is related to the fact that DM as a chronic disease requires long-term medication and continuous management. But the shortage of drugs has been dissatisfied and complained about by patients for a long time in China. The Chinese government has taken measures to ensure the stable supply of drugs, such as the national basic drug system introduced in 2009.\textsuperscript{38} During the implementation of this programme, studies found that both the supplies and variety of essential drugs in PHC institutions could not meet the clinical need of patients adequately.\textsuperscript{39} As a result, it is necessary to establish the unified delivery system covering PHC institutions and hospitals throughout the region. Moreover, more commonly used diabetes drugs should include the Essential Medicines Directory.

The value of travel time was less desirable compared with other attributes, while patients preferred the institutions that were closer to home. Smith and colleagues found that travel time was one of the main factors to consider and estimated that patients were 70\%–80\% more likely to choose a hospital closer to home.\textsuperscript{40} Patients with DM need to make more intensive use of healthcare institutions. However, older patients account for a larger proportion, and they have poor mobility and transportation, so patients prefer an institution closer to them. Therefore, we suggest that PHC institutions should consider its geographical distribution and ensure that most residents can reach the nearest institutions within 15 min.

Figure 1  Simulation probability of choosing to visit a PHC institution. Baseline: medical service capacity_low, out-of-pocket medical costs per month_CNY750, travel time_90 min, attitude of medical staff_bad, availability of diabetes drugs_60\%. CNY, Chinese yuan; PHC, primary healthcare.
The attitude of medical staff has relatively little influence on institution choice. This may be because most patients are satisfied with the friendly attitude of doctors. Compared with tertiary hospitals, doctors in PHC facilities have enough time to listen to patients’ conditions and demands. Most of the doctors and patients at the primary facility reside in the same region, so they develop a familiar personal relationship. The medical service capacity could not improve in the short term because of the long time it takes to train health staff. Thus, although attitude is not as important as clinical attributes (such as the medical service capacity), encouraging doctors to treat patients with a more friendly attitude is a cost-effective way to retain patients in PHC institutions.

Perhaps more interesting in our study is the impact of policy intervention measures on the likelihood of a patient’s hospital choice. In the context of adequate healthcare resources, it is obvious that improving all attributes of PHC institutions to the best would yield the most desirable outcome, which would lead to a significant increase in the probability of patients visiting PHC institutions. However, in the context of limited healthcare resources, we could find more effective interventions with the help of simulation probability results. Policymakers could develop efficient healthcare interventions based on available resources and the choice probability predicted in figure 1. Furthermore, policies that focus solely on strengthening one attribute might be limited. Healthcare intervention measures should be multidimensional, which may effectively increase their utilisation and exert their potential to act as gatekeepers.

There are several limitations in this study. First, the underlying health state of participants might influence how choices are made. Patients with chronic illnesses might have different choices from those with acute illnesses. This study did not collect information on socio-demographic characteristics such as glycaemic status, so the impact of these characteristics on patient preferences could not be obtained. Future research will capture more patient information and explore its association with preferences. Moreover, the order in which attributes appear in the choice sets may influence patients’ choices. The order of the attributes was not randomised in this study, which might produce ordering bias. Finally, this study that was conducted in Shandong province did not support the generalisability of findings across other settings.

Conclusion
Patients with DM value the OOP cost, medical service capacity, availability of diabetes drugs, travel time and the attitude of medical staff when they choose a PHC institution to receive care. There was preference heterogeneity among different patient subgroups. In addition, improvements to the OOP cost in PHC institutions can effectively attract patients to flow from large hospitals to the primary level. This study provides information on patient preferences for policymakers to strengthen the gatekeeping roles of PHC institutions and improve the hierarchical medical system.

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Contributors
All authors made significant contributions to the work reported. HW, CT and S-PL designed the study. JQ and XF conducted the data collection. YL performed statistical analysis of data and wrote the first draft. CT and HW revised and edited the manuscript. All authors have read and agreed to the published version of the manuscript. HW act as guarantor of the work.

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Competing interests
None declared.

Patient and public involvement
Patients and/or the public were involved in the design, or conduct, or reporting, or dissemination plans of this research. Refer to the Methods section for further details.

Patient consent for publication
Obtained.

Ethics approval
The study was approved by the Ethics Committee of the School of Healthcare Management, Shandong University, with ethics approval number of ECSHCMSDU20170401. All methods were performed in accordance with the relevant guidelines and regulations outlined in the Declaration of Helsinki. Informed consent was obtained from all participants.

Provenance and peer review
Not commissioned; externally peer reviewed.

Data availability statement
Data are available upon reasonable request.

Supplemental material
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