Patient Preference and Adherence

Dovepress
Taylor & Francis Group

Open Access Full Text Article

ORIGINAL RESEARCH

Patient Priorities for Coverage of New Antihypertensive Drugs: A Discrete Choice Experiment in China

Jiaran Chen[1], Chen Pan[1], Guohua Wang[2], Leilei Qian[1,3], Yiming Lu[1], Tongling Xie[1,3], Jianjun Gu[4], Jinsong Geng[1]

[1]Center for Evidence-Based Medicine, Medical School of Nantong University, Nantong, Jiangsu, 226001, People's Republic of China; [2]National Clinical Research Center for Neurological Diseases, Xuanwu Hospital Capital Medical University, Beijing, 100053, People's Republic of China; [3]Hospital Performance Evaluation Office, The People's Hospital of Rugao, Nantong, Jiangsu, 226500, People's Republic of China; [4]Department of Neurosurgery, Henan Provincial People's Hospital Affiliated to Zhengzhou University, Zhengzhou, Henan, 450003, People's Republic of China

Correspondence: Jianjun Gu, Department of Neurosurgery, Henan Provincial People's Hospital Affiliated to Zhengzhou University, Zhengzhou, Henan, 450003, People's Republic of China, Email gujianjundt@163.com; Jinsong Geng, Center for Evidence-based Medicine, Medical School of Nantong University, Nantong, Jiangsu, 226001, People's Republic of China, Email gjs@ntu.edu.cn

Objective: Hypertension is a chronic condition in which patient-centered decisions are crucial for long-term adherence and outcomes. We aimed to obtain patient priorities for health insurance coverage of new antihypertensive drugs, and translate these preferences into reimbursement proposals using a discrete choice experiment.

Methods: A systematic literature review and semi-structured interviews were conducted to determine the attributes and levels. A Bayesian D-efficient design with blocking techniques was used to generate choice scenarios in the experiment. We conducted one-on-one, face-to-face interviews with patients with hypertension across four provinces in China. A mixed logit model was used to estimate patient preferences, marginal willingness-to-pay, and preference heterogeneity.

Results: Data analysis included 802 patients. When prioritizing new antihypertensives for health insurance coverage, patients placed more importance on improvement in health-related quality of life (HRQoL), followed by lower out-of-pocket costs per year, systolic blood pressure (SBP) control, fewer common side effects, and decreased five-year mortality due to cardiovascular diseases. Patients were willing to pay CNY 4049 (95% CI 3418–4681) annually for significant improvements in HRQoL. Patients with higher untreated office SBP prioritized effective SBP control and the lowest five-year stroke risk.

Conclusion: Hypertensive patients primarily prefer improved HRQoL, lower out-of-pocket costs, and favorable long-term health outcomes. Our findings support preference-responsive reimbursement mechanisms, such as tiered coverage based on patient-valued outcomes and risk-stratified subsidies for patients at high cardiovascular disease risk.

Keywords: antihypertensive drugs, patient priorities, health insurance, discrete choice experiment

Introduction

Hypertension is a leading cause of cardiovascular disease, disability, and premature death, imposing substantial burdens on patients, health systems, and economies.[1] Only a fraction of patients achieved optimal blood pressure control globally.[2,3] In China, hypertension significantly raises the risk of catastrophic health expenditure among older adults, with the likelihood of 11.3% higher than those without hypertension.[4] The availability and affordability of antihypertensive drugs are crucial for preventing major adverse cardiovascular events and reducing mortality.[5,6] When these drugs are inaccessible or unaffordable, health inequities widen and cardiovascular disease progresses more rapidly.[7,8]

The Chinese healthcare system has made remarkable progress in improving drug affordability through the National Centralized Drug Procurement policy, which has reduced drug prices by over 50% through competitive bidding.[9,10] However, disparities persist in health insurance coverage and access. The aging population poses challenges to the sustainability of insurance funds due to the increasing demand for healthcare services.[11] Significant socioeconomic gaps

https://doi.org/10.2147/PPA.S588300
Received: 11 December 2025
Accepted: 6 April 2026
Published: 16 April 2026

remain in hypertension control, with lower treatment and control rates among low-income patients and rural populations.[12,13] Discrepancies also exist between Urban Employee Basic Medical Insurance (UEBMI) and Urban and Rural Resident Basic Medical Insurance (URRBMI), as URRBMI enrollees facing lower reimbursement ceilings and higher out-of-pocket costs even for generic antihypertensive drugs.[14] These inequalities highlight the need for insurance policies that go beyond drug price reduction to ensure equitable access aligned with patient priorities.

As healthcare costs continue rising, integrating patient perspectives becomes essential for making policies that advance value-based care.[15] Patient-centered, outcome-driven health insurance policies can improve healthcare and reduce medical expenditure.[16] Discrete choice experiment (DCE) is a well-established method f to elicit patient preferences for healthcare delivery, shared decision-making, and health policymaking.[17,18] Grounded in a robust statistical framework, DCE quantifies the strength of preference for attribute levels, producing interpretable marginal utilities and willingness-to-pay (WTP) estimates for decision-makers.[19] DCEs can predict real-world choices and offer valuable insights into health-related preferences and behaviors with strong external validity.[20,21]

This study aimed to investigate patient priorities for the coverage of new antihypertensive drugs using the DCE approach. Specifically, our study would: (1) estimate patient preferences for antihypertensive drug attributes; (2) quantify preference heterogeneity through interactions with socioeconomic characteristics; and (3) derive WTP values for specific therapeutic features. Our findings would inform the design of preference-responsive reimbursement policies that reflect patient-valued outcomes, thereby promoting equitable access to antihypertensive therapy within health insurance budget constraints.

Methods

Our DCE was designed, conducted, and reported in accordance with the reporting checklist for discrete choice experiments in health DIRECT checklist.[22]

Systematic Literature Review and Attribute Identification

We conducted a systematic literature review to identify attributes and levels of antihypertensive drugs. We searched PubMed, EMBASE, and Web of Science using search terms consisting of the generic and brand names of new drugs, as well as the term "hypertension". Studies assessing the multi-attribute value of antihypertensive drugs were also included. The term "new drugs" in our study refers to antihypertensive drugs that have been recently included in China's National Reimbursement Drug List within the past five years. We also included new drugs that have been approved for marketing in China over the past five years but have not yet been added in the list.

Studies including systematic reviews and meta-analyses, randomized controlled trials (RCTs), and real-world evidence were considered. RCTs are the most rigorous design to assess the health benefits of a new intervention.[23] Real-world evidence is a valuable alternative to address evidence gaps when RCTs are unavailable.[24] We developed a standardized data extraction form to collect key information from the included literature. Detailed results are presented in Electronic Supplementary File 1. In addition, we obtained out-of-pocket costs for drugs from the Moshang Pharmaceutical Database, a well-recognized platform for pharmaceutical data in China.

Six key attributes were identified through literature review: systolic blood pressure (SBP) control, change in health-related quality of life (HRQoL), incidence of common side effects, five-year stroke risk, five-year mortality due to cardiovascular diseases (CVD), and out-of-pocket costs per year if reimbursed. These attributes were selected to measure distinct dimensions of therapeutic value. SBP control represents short-term symptom control, whereas five-year stroke risk and CVD mortality reflect long-term prognosis. HRQoL captures patient-reported well-being. The incidence of common side effects indicates treatment safety and tolerability, and out-of-pocket costs represents affordability. Previous DCEs have shown the feasibility of integrating intermediate clinical measures with long-term cardiovascular outcomes.[25–27] The attributes selected consistent with the goals of health insurance coverage, namely to improve health outcomes, enhance patient well-being, and provide financial protection.[28]

Our literature review provided reliable evidence for defining the attributes and levels to be used in DCE. We then conducted semi-structured interviews with four experts to evaluate the feasibility of these attributes and levels. The expert panel comprised two cardiologists and two health insurance decision-makers, all of whom were informed of the

study design. We also consulted four patient representatives to assess the applicability of these attributes. The attributes and levels in our DCE are listed in Table 1, and further details presented in Electronic Supplementary File 2.

Experimental Design and Development of the Questionnaire

DCE choice sets were generated using the Bayesian D-efficient design implemented in Ngene V.1.3 (Choice-Metrics, Sydney, Australia). Following the development and piloting of initial scenarios, we applied the criteria of orthogonality, balance, and minimal overlap to obtain an optimal experimental design. This process yielded 48 distinct scenario-based choice sets. To reduce respondents' cognitive burden, these choice sets were randomly divided into six blocks, with eight choice sets per block. An unlabeled DCE design was used, as this approach enables direct comparison of different attributes without the interference of pre-existing preferences that may be associated with labeled options.

The questionnaire used in the DCE included three parts. The first part collected patients' demographic information and clinical features. Trained interviewers checked clinical features by reviewing patients' electronic medical records. The second part assessed patients' HRQoL using the EQ-5D-5L questionnaire,[29] with interviewers ensuring that patients were familiar with the concept of HRQoL. The third part consisted of DCE choice scenarios and patients' self-rated confidence in completing each choice task. An example of the questionnaire is provided in Electronic Supplementary Figure 1.

After completing the DCE tasks, respondents rated their confidence in their choices on a 0–10 Likert-type scale (0 = not confident at all, 10 = extremely confident). To ensure data validity, we excluded questionnaires in which patients' confidence scores were below 8. This threshold was established to ensure that only responses from patients who were sufficiently confident in their decisions were included in the analysis.[30,31] Interviewers were responsible for explaining each scenario and verifying that respondents fully understood the choices they were making. This step was crucial for guaranteeing that participants were well informed, which was essential for the validity of the collected data.

There is no universally applicable standard for the ideal sample size for DCEs. Orme proposed a commonly used rule of thumb for determining the DCE sample size:[32]

$$N \geq 500 \ \frac{L_{max}}{JS}$$

where N is the number of respondents, $L_{\max}$ represents the largest product of levels across any two attributes included in the interaction terms, J is the number of alternatives per choice task, and S refers to the number of choice sets per

Table 1 Attributes and Levels in the Discrete Choice Experiment

Dimensions	Attributes	Levels
Clinical benefits	Control of systolic blood pressure	Decreases by 10 mmHg
		Decreases by 20 mmHg
		Decreases by 30 mmHg
Patient-reported outcomes	Change in health-related quality of life	Worse
		No change
		Improved
Safety and tolerability	Incidence of common side effects	15%
		8%
		1%
Long-term prognosis	Five-year stroke risk	7%
		4%
		1%
	Five-year mortality due to cardiovascular diseases	7%
		4%
		1%
Affordability	Out-of-pocket costs per year if reimbursed	CNY 400
		CNY 2300
		CNY 4200

https://doi.org/10.2147/PPA.S588300

respondent. Based on this formula, the minimum required sample size was 281. In general, the recommended sample size for DCEs ranges from at least 20 to 300 respondents.[33] Given the aim of investigating heterogeneity in patient preference, we increased the sample size accordingly. A final sample of 800 respondents would be adequate and robust for our study.

DCE Implementation and Data Collection

We pretested the DCE questionnaires with 48 hypertensive patients in Jiangsu Province to improve their clarity and comprehensibility. The participants were interviewed by researchers, who were able to observe any difficulties encountered during the survey. Each participant completed a draft questionnaire. Based on this feedback, we simplified the language of choice sets and clarified the concept of specific attributes. We have also added detailed explanations of the scenarios in each block to the interview manuals. As this was a pilot survey, data from these 48 patients were excluded from the final sample.

The formal DCE survey was conducted from October 5 to December 6, 2024. Participants were eligible if they were aged at least 18 years old, had a diagnosis of primary hypertension, and were enrolled in the public health insurance. To ensure the geographic and socioeconomic representativeness of the samples, the survey was conducted across four provinces: Jiangsu (east, higher economic level), Henan (central, medium), Hebei (north, medium), and Shaanxi (west, lower economic level).

Patients were consecutively recruited from six hospitals and four primary healthcare centers to capture a broad spectrum of healthcare-seeking behaviors and disease severities. At the hospital sites, patients were primarily enrolled from the Departments of Cardiology, Neurology, and Neurosurgery. All eligible individuals at these departments during the study period were invited to participate. Stratified sampling was employed to ensure an approximately equal sample size in each province.

Eight medical interns and twelve healthcare professionals were recruited as interviewers. They underwent one-on-one training, delivered via either on-site or online. A comprehensive interview manual was provided to ensure consistency across all interviews. Interviewers conducted one-on-one, face-to-face interviews using color-printed questionnaires. To ensure the even distribution of the six DCE blocks, color-printed questionnaires were consecutively allocated to eligible patients in a fixed sequence (one two, three, four, five, six). The sequence was repeated as necessary. Each interviewer was provided with pre-sorted questionnaires and was required to distribute them in strict order.

Patients were informed of their right to refuse participation and those who consented to participate signed an informed consent form. Each interview lasted approximately 15–20 minutes, during which patients were asked to make trade-offs between hypothetical scenarios of health insurance coverage. Interviewers immediately clarified any doubts and checked the completeness of each questionnaire on site. Each participant received a cotton towel valued at approximately CNY 8 as compensation for their time and involvement in the survey.

Model Development and Preference Analysis

To analyze patient preferences for attributes relevant to the coverage of antihypertensive drugs, we utilized a mixed logit regression model grounded in the random utility theory. In this model, the utility (U) of patient *i* derived from alternative *j* has two components: an observable component V_{ij} and a stochastic error term ε_{ij}, which can be expressed as:

$$U_{ij} = V_{ij} + \varepsilon_{ij} = \beta_0 + \beta_1 X_{1\mathrm{i,j}} + \beta_2 X_{2\mathrm{ij}} + \cdots + \beta_{\mathrm{m}} X_{\mathrm{mij}} + \varepsilon_{\mathrm{ij}}$$

β coefficients represent the relative preference weights for each attribute level. A positive β coefficient signifies that a higher attribute level increases utility, whereas a negative β coefficient indicates that a higher attribute level decreases utility. We also conducted sensitivity analysis by including patients with confidence scores below 8 to test the robustness of main effect estimates. Random parameters were assumed to follow a normal distribution in the model, consistent with standard practice in DCE analyses.[34]

To enhance the precision of parameter estimation, we tested Halton draws at various incremental scales (200, 500, 1000, 1500, 2000 iterations).[35] The data analysis was performed by STATA 16.0 SE (STATA Corp LLC, USA). We adopted 500 Halton draws in the model, as they yielded the most precise estimation of the model parameters according to the maximum simulated likelihood criterion. We used effects coding for each attribute level, with a zero coefficient

representing the mean utility level rather than an omitted reference, as in dummy coding.[36] Out-of-pocket costs per year if reimbursed was coded as a continuous variable, where higher values represent more out-of-pocket costs. Other attributes were treated as categorical variables. The relative importance (RI) of each attribute was calculated by dividing the utility range of that attribute by the total utility range across all attributes.

To explore preference heterogeneity, we examined the interaction effects between attribute levels and patient characteristics including income, age, type of insurance, and baseline SBP. The model can be expressed as follows:

$$U_{ij} = \beta_0 + \beta_1 X_{1ij} + \beta_2 X_{2ij} + \ldots + \beta_m X_{mij} + \beta_{s1} X_{1ij} S_{interaction\_term} + \beta_{s2} X_{2ij} S_{interaction\_term} + \ldots + \beta_{sm} X_{mij} S_{interaction\_term} + \varepsilon_{ij}$$

where β_1 to β_m quantify the strength of preference for each attribute. The terms β_{s1} to β_{sm} represent the parameter weights assigned to an interaction term, and $X_{mij}S_{interaction\_term}$ denotes the interaction term being considered in the model.

These features were chosen mainly because of the significance of equity considerations, accessibility to healthcare, and severity of disease in decision making.[37–39] A positive interaction term indicates that the preference for a specific attribute level is stronger within a particular patient subgroup compared to others. Conversely, a negative interaction term suggests that preference for a specific attribute level is weaker within a particular patient subgroup.

Additionally, we calculated the marginal WTP for each attribute by dividing the mean coefficient of each attribute by that of the cost attribute.[40,41] This approach reflects the marginal rate of substitution between non-monetary attributes and the monetary attribute, thereby representing the monetary value participants placed on each attribute level. Specifically, the WTP for changing attribute k from Level 1 to Level 2 can be explicitly calculated using the following formula:

$$WTP = \frac{\beta_{k1} - \beta_{k2}}{\beta_{cost}}$$

Results

Patient Characteristics

We initially enrolled 839 patients who consented to participate in the DCE survey. Of these, 37 were excluded due to incomplete data, poor understanding of the survey content, or a lack of confidence in their DCE choices. Consequently, a total of 802 patients were included in the final analysis, with 554 recruited from hospitals and 248 from primary health care centers. Excluded participants were comparable to those included in terms of key baseline characteristics, including gender, age, education level, monthly household income, insurance type, and baseline untreated office SBP. The detailed demographic and socioeconomic characteristics of the included patients are presented in Table 2.

Table 2 Characteristics of the Patients (N = 802)

Variables	N (%)
Gender	
Male	390 (48.63)
Female	412 (51.37)
Age	
18~45	60 (7.48)
46~70	452 (56.36)
>70	290 (36.16)
Education	
Unschooled	106 (13.22)
Elementary school	229 (28.55)
Junior high school/High school	358 (44.64)
Junior college or above	109 (13.59)

(*Continued*)

https://doi.org/10.2147/PPA.S588300

Table 2 (Continued).

Variables	N (%)
Monthly household income	
≤2000	219 (27.31)
2001~4000	152 (18.95)
4001~6000	191 (23.82)
6001~8000	129 (16.08)
8001~10000	42 (5.24)
10001~12000	28 (3.49)
>12000	41 (5.11)
Types of health insurance enrolled	
UEBMI	376 (46.88)
URRBMI	426 (53.12)
Untreated office systolic blood pressure	
140~159mmHg	287 (35.79)
160~179mmHg	289 (36.03)
≥180mmHg	226 (28.18)

Notes: In China, the public health insurance system consists of two principal programs: Urban Employee Basic Medical Insurance (UEBMI), and Urban and Rural Resident Basic Medical Insurance (URRBMI).

The average age of the patients was 65 years (range: 19–96 years), with a slight female predominance (51% female vs. 49% male). Our sample was representative of a hypertensive population with a substantial disease burden, as demonstrated by the fact that the majority (64.21%) of participants had stage 2 or 3 hypertension based on untreated office SBP. Over 70% of the patients reported a monthly household income of equal to or less than CNY 6000 (826 USD). This income level is considered a threshold of high sensitivity to healthcare costs in China.[42]

Main Model Estimation of Patient Preferences

As shown in Figure 1, patients rated changes in HRQoL as the most important attribute (RI=20.89%), followed by out-of-pocket cost (RI=20.29%), SBP control (RI=19.66%), lower incidence of common side effects (RI=17.75%), and less five-year CVD mortality risk (RI=12.85%). However, the relative importance values of the top three attributes were similar (range: 19.66–20.89%), suggesting that their ranking should be interpreted with caution.

The most preferred attribute level was improved HRQoL (β=1.030, p<0.001), followed by the lowest incidence of common side effects (β=1.023, p<0.001), the most significant level of SBP control (β=0.881, p<0.001), the lowest five-year CVD mortality (β=0.653, p<0.001), and the lowest five-year stroke risk (β=0.425, p<0.001) (Table 3). Results of

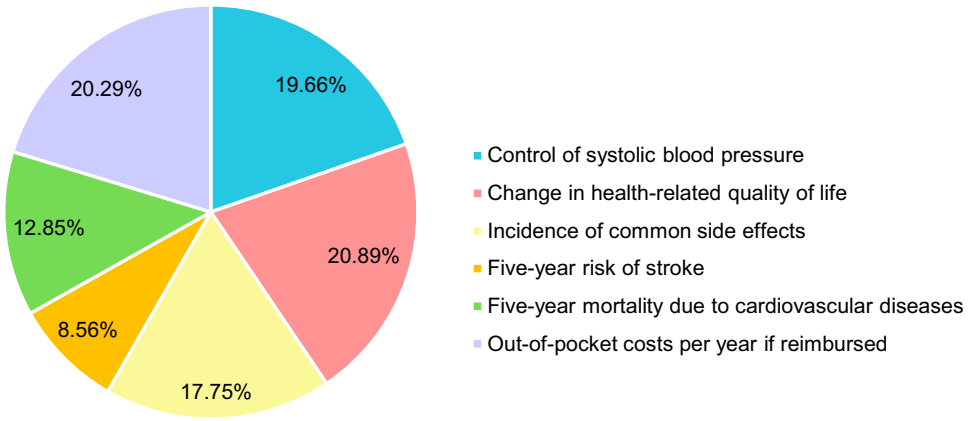

Figure 1 Relative importance of attributes.

https://doi.org/10.2147/PPA.S588300

Table 3 Main Effect Results of Mixed Logit Model

Attributes	Coefficients	
	β (SE)	SD (SE)
Control of SBP		
Decreases by 10 mmHg (ref)	−0.838***(0.077)	
Decreases by 20 mmHg	−0.043(0.053)	0.040(0.226)
Decreases by 30 mmHg	0.881***(0.083)	0.990***(0.099)
Change in HRQoL		
Worse (ref)	−1.309***(0.106)	
No change	0.280***(0.051)	0.468***(0.104)
Improved	1.030***(0.092)	1.308***(0.114)
Incidence of common side effects		
15% (ref)	-0.964***(0.079)	
8%	-0.059 (0.048)	0.020(0.457)
1%	1.023***(0.076)	0.702***(0.084)
Five-year stroke risk		0.016(0.133)
7% (ref)	-0.533***(0.061)	
4%	0.109*(0.053)	0.221(0.156)
1%	0.425***(0.063)	0.554***(0.102)
Five-year CVD mortality		
7% (ref)	-0.803***(0.072)	
4%	0.168*(0.067)	0.016(0.133)
1%	0.635***(0.072)	0.562***(0.098)
Out-of-pocket costs per year if reimbursed		
Cost (per CNY200)	−0.117***(0.010)	0.139***(0.012)
Const	0.107***(0.028)	
Log likelihood	−3150.037	
Participants	802	
Observations	12832	

Notes: The out-of-pocket costs was coded as a continuous variable, where higher values represent more out-of-pocket costs.

Abbreviations: SBP, systolic blood pressure; HRQoL, health-related quality of life; CVD, cardiovascular disease; SE, standard error; SD, standard deviation; *p<0.05; ***p<0.001.

sensitivity analyses showed consistent preference estimates (Electronic Supplementary File 3), indicating that exclusion of low-confidence respondents did not substantially alter the main findings.

Estimation of Preference Heterogeneity by Interaction Effects

Interaction analyses revealed distinct preference patterns across different patient subgroups (Table 4 and Electronic Supplementary File 4). Compared with higher-income groups, lower-income groups demonstrated a stronger preference for SBP control and cost savings. Specifically, these patients significantly favored a 30 mmHg reduction in SBP ($\beta = -0.501$, $p < 0.001$; Model 1) and expressed a preference for lower out-of-pocket costs ($\beta = 0.033$, $p < 0.001$). In contrast, higher-income patients placed greater emphasis on improvements in HRQoL ($\beta = 0.462$, $p < 0.01$).

Regarding age, younger patients showed a stronger preference for a reduced five-year stroke risk ($\beta = -0.240$, $p < 0.05$) (Model 2). URRBMI enrollees expressed a stronger preference for lower out-of-pocket costs than UEBMI enrollees ($\beta = -0.067$, $p < 0.05$) (Model 3). By contrast, UEBMI enrollees placed higher value on the lowest incidence of common side effects ($\beta = -0.330$, $p < 0.01$). In addition, SBP level significantly influenced patient preferences. Notably, patients with SBP ≥ 160 mmHg prioritized both significant SBP control (β=0.438, $p<0.001$) and the lowest five-year stroke risk (β=0.255, $p<0.05$; Model 4).

https://doi.org/10.2147/PPA.S588300

Table 4 Model Estimation of the Interaction Effects

Attributes	**Model 1**	**Model2**	**Model 3**	**Model 4**
	β (SE)	**β (SE)**	**β (SE)**	**β (SE)**
Control of SBP				
Decreases by 20 mmHg	−0.045(0.063)	−0.101 (0.066)	−0.041(0.073)	0.013(0.066)
Decreases by 30 mmHg	1.010***(0.094)	0.820*** (0.093)	0.775***(0.107)	0.730***(0.090)
Change in HRQoL				
No change	0.272***(0.058)	0.343*** (0.063)	0.187*(0.072)	0.319***(0.062)
Improved	0.853***(0.093)	1.032***(0.105)	1.079***(0.120)	1.021***(0.102)
Incidence of common side effects				
8%	−0.032***(0.056)	−0.111(0.060)	−0.060(0.070)	0.010(0.060)
1%	0.940***(0.077)	1.040***(0.085)	1.207***(0.100)	0.992***(0.081)
Five-year stroke risk				
4%	0.114 (0.062)	0.189**(0.066)	0.173*(0.078)	0.188**(0.066)
1%	0.345***(0.071)	0.461***(0.078)	0.533***(0.094)	0.337***(0.076)
Five-year CVD mortality				
4%	0.134 (0.077)	0.195*(0.082)	0.253*(0.098)	0.210*(0.083)
1%	0.653***(0.082)	0.552***(0.085)	0.744***(0.103)	0.546***(0.084)
Out-of-pocket costs per year if reimbursed				
Cost (per CNY200)	−0.133***(0.011)	−0.117***(0.011)	−0.081***(0.011)	−0.122***(0.011)
Interactions with demographics	**Income**	**Age**	**Insurance**	**SBP**
	β (SE)	**β (SE)**	**β (SE)**	**β (SE)**
Control of SBP				
Decreases by 20 mmHg	−0.008(0.112)	0.156 (0.110)	0.007(0.107)	−0.163(0.111)
Decreases by 30 mmHg	−0.501***(0.141)	0.153(0.137)	0.205(0.133)	0.438**(0.142)
Change in HRQoL				
No change	0.008(0.100)	−0.189(0.100)	0.173(0.097)	−0.111(0.099)
Improved	0.462**(0.148)	0.003 (0.144)	−0.078(0.139)	0.013(0.145)
Incidence of common side effects				
8%	−0.100(0.101)	0.124(0.098)	−0.000(0.097)	−0.208*(0.099)
1%	0.194 (0.112)	−0.054(0.109)	−0.330**(0.107)	0.079(0.109)
Five-year stroke risk				
4%	−0.013(0.114)	−0.240*(0.111)	−0.107(0.105)	−0.232*(0.111)
1%	0.243 (0.127)	−0.092(0.122)	−0.196(0.122)	0.255*(0.124)
Five-year CVD mortality				
4%	0.101 (0.140)	−0.079(0.134)	−0.150(0.131)	−0.121(0.134)
1%	−0.094(0.135)	0.235(0.133)	−0.175(0.129)	0.248(0.134)
Out-of-pocket costs per year if reimbursed				
Cost (per CNY200)	0.033***(0.008)	0.000(0.015)	−0.067***(0.015)	0.016(0.015)
Const	0.105***(0.027)	0.104***(0.028)	0.111***(0.028)	0.108***(0.028)
Log likelihood	−3114.778	−3135.496	−3121.131	−3136.556
Participants	802	802	802	802
Observations	12,832	12,832	12,832	12,832

Notes: The data in the upper half of the table show the main preference estimates for attributes, independent of demographic characteristics. The data in the lower half of the table show how these preferences were modified by specific demographic characteristics. *p<0.05; **p<0.01; ***p<0.001. Age: Age 70 or less=0, age > 70=1; monthly household income: CNY 6000 or less=0, More than CNY 6000=1; type of insurance: Urban Employee Basic Medical Insurance enrollees =0, Urban and Rural Resident Basic Medical Insurance enrollees =1; SBP: Less than 160 mmHg =0, 160 mmHg or more =1. For the interaction term involving out-of-pocket costs, a positive β indicates that the reference group is less likely to choose the drug with higher out-of-pocket costs than the comparison group.

Abbreviations: SBP, systolic blood pressure; HRQoL, health-related quality of life; CVD, cardiovascular disease; SE, standard error; SD, standard deviation.

Marginal Willingness to Pay

The analysis of the patients' WTP for antihypertensive drugs is shown in Electronic Supplementary File 5. Results indicated that patients valued improvements in HRQoL most, with a WTP of CNY 4049 (95% CI 3418–4681) per year to change HRQoL from worse to improved. The second most valued attribute was a reduction in the incidence of common side effects. Patients were willing to pay CNY 3373 (95% CI 2831–3916) per year to lower the incidence from 15% to 1%.

Patients also highly valued a decrease in SBP and a reduction in the five-year stroke risk. For instance, they were willing to pay CNY 2919 (95% CI 2429–3410) per year to realize a decrease in SBP from 10 mmHg to 30 mmHg, and CNY 2415 (95% CI 1933–2898) per year to reduce the five-year CVD mortality risk from 7% to 1%. Subgroup analysis by income showed that higher-income patients consistently expressed substantially higher marginal WTP values for drug attributes compared with lower-income patients (Electronic Supplementary File 6).

Discussion

As China's National Healthcare Security Administration advances value-based reimbursement reforms,[43] our DCE offers actionable evidence to support the design of equitable and efficient coverage policies for antihypertensive therapy. We found that patients prioritized improvements in HRQoL and control of SBP, which were consistent with previous studies emphasizing the importance of both clinical outcomes and HRQoL in hypertension management.[44] Our study further showed that patients also placed high value on the reduction in common side effects and lower CVD mortality. The attribute of five-year stroke risk had a relatively lower ranking. Patients may underestimate their personal stroke risk due to optimistic bias or low health literacy, resulting in lower perceived importance of this attribute in decision-making.[45,46] These findings underline the necessity for policymakers to consider HRQoL, treatment tolerability, and long-term prognosis alongside clinical benefits when selecting new antihypertensive drugs for insurance coverage. We propose outcome-based reimbursement contracts where insurers negotiate tiered coverage rates based on drug performance, thus aligning payment directly with the attributes patient value most.

Increased out-of-pocket cost was a significant negative predictor in our study, indicating a high sensitivity to financial burden among patients. This finding is particularly relevant in China, where healthcare expenditures and reimbursement ratios (ie, the percentages of medical costs covered by insurance) are major determinants of treatment adherence.[47] Our results highlight the importance of health insurance in providing sufficient financial protection and preventing cost-related barriers to accessing antihypertensive therapies.

Based on our findings, patients' WTP for key attributes, such as significant improvement in HRQoL and a reduction in the incidence of common side effects from 15% to 1%, exceeded the average out-of-pocket healthcare expenditure per capita (CNY 2547 in 2024). A cross-sectional survey in Xi'an found the out-of-pocket costs ranged from CNY 168 to CNY 1104 among UEBMI enrollees and from CNY 228 to CNY 2820 among URRBMI enrollees.[14] This discrepancy suggests that patients place a higher economic value on superior attribute levels than what they currently pay for basic, procurement-covered medications, highlighting a considerable unmet demand for more effective and better-tolerated antihypertensive drugs.

Our interaction analysis further revealed distinct preference patterns across different patient subgroups, which has important implications for the design of patient-centered health insurance policies. Lower-income patients exhibited a stronger preference for SBP control and lower out-of-pocket costs. This finding is particularly meaningful, as the financial burden of healthcare can significantly hinder treatment adherence and disease management among these patients.[7] Therefore, reimbursement policies that prioritize the affordability and effectiveness of antihypertensive drugs are crucial. Multitiered co-payment structures and targeted subsidies would be helpful in alleviating the financial burden on lower-income patients.[48]

The results of our study indicate that URRBMI enrollees had a stronger preference for lower out-of-pocket costs than UEBMI enrollees. Previous studies have shown that hypertensive patients enrolled in the UEBMI tend to have a higher frequency of hospital visits, higher average medical expenses per visit, and a higher rate of healthcare utilization.[39,49] Additionally, UEBMI beneficiaries could have higher total medical expenditures but lower out-of-pocket costs.[50]

Consequently, the observed gap in preferences between the two groups may reflect an equity concern. Our results suggest that a one-size-fits-all benefit package is unlikely to meet the heterogeneous needs of different patient populations.

We found that patients with a higher baseline SBP favored both significant SBP control and the lowest five-year stroke risk. Among these patients, the risk of serious cardiovascular complications is a key determinant of adherence to antihypertensive therapy.[51] Ensuring access to effective and affordable medications for patients with elevated SBP is critical for optimizing hypertension management and reducing the risk of adverse cardiovascular outcomes.[52,53] Furthermore, health insurance policies that provide expanded coverage or lower copayments for high-risk patients would help mitigate financial barriers and address their most pressing health concerns.[54] Our results support the implementation of risk-stratified benefit designs, under which patients with higher baseline CVD risk are eligible for enhanced subsidies for drugs that lower cardiovascular mortality.

Data on patient preference can inform health insurance policy decisions by identifying the most highly valued treatment attributes, generating utility estimates for indications where standard measures are unavailable, and quantifying patients' WTP for therapies. The National Institute for Health and Care Excellence in the UK recognizes patient preference studies as a valuable complementary evidence, especially when comparing distinct treatment options, eliciting patient choices, incorporating non-health benefits, or addressing the needs of diverse patient populations.[55]

Our study has several notable strengths that contribute to health insurance decision-making in China and other countries facing similar challenges in managing chronic diseases and optimizing healthcare resource allocation. First, our patient-centered preference assessment employed the DCE methodology, which is a rigorous approach for quantifying the relative importance of treatment attributes from the patient perspective. Second, the comprehensive analysis of multiple attributes in our study, such as HRQoL, clinical benefits, side effects, long-term prognosis, and out-of-pocket costs, established a flexible framework to inform the optimization of antihypertensive drug coverage across diverse healthcare systems.

Third, our DCE revealed preference heterogeneity across socioeconomic and clinical subgroups. Such variations offer actionable insights for designing precise insurance policies that address the distinct priorities of vulnerable populations. Finally, our findings provide empirical evidence to inform the design of health insurance policies that better reflect patient preferences and improve the accessibility of new antihypertensive drugs.

Despite its notable strengths, our study has several limitations. First, participants were recruited from four Chinese provinces. These provinces were selected to reflect different levels of economic development and geographic regions, thus generating diverse and informative empirical data. However, the sample may not fully represent the entire population. Future studies should broaden the geographic scope to enhance the generalizability of the findings across regions. Second, while our study included individuals covered by UEBMI and URRBMI, preferences among those with private health insurance were not investigated. Future studies should incorporate this group to capture the full spectrum of coverage priorities. Third, SBP was included as an attribute in our DCE. Although excluding diastolic blood pressure helped preserve attribute independence, it restricted our understanding of patient preferences. Fourth, we did not apply multiple comparison correction across the four interaction models. Accordingly, our findings should be interpreted as exploratory rather than confirmatory. Finally, WTP estimates derived from DCE are constrained by their hypothetical nature and their reliance on linear assumptions for the cost attribute.

Conclusions

Our DCE offers a comprehensive analysis of what really matters to hypertensive patients regarding the attributes of antihypertensive drugs within the context of health insurance coverage. Patients consistently prioritize improvement in HRQoL, SBP control, reduced common side effects, and lower CVD mortality risk. These priorities indicate a strong desire for insurance coverage of new drugs that improve daily well-being and long-term prognosis. Our analysis also revealed heterogeneity in patient preferences influenced by income, age, insurance type, and baseline SBP. Tailoring benefit designs to meet the specific needs of patient subgroups, such as introducing multitiered co-payments for lower-income patients or expanding coverage for high-risk patients with CVD, would strengthen population-level hypertension management.

In an era of patient-centered care, our study provides actionable evidence to inform the design of efficient and equitable health insurance policies. By prioritizing patient preferences, we can move closer to a healthcare system that better meets the needs of hypertensive patients, regardless of their socioeconomic status or clinical risk profiles.

Abbreviations

HRQoL, health-related quality of life; DCE, discrete choice experiment; WTP, willingness to pay; RCT, randomized controlled trial; SBP, systolic blood pressure; CVD, cardiovascular disease; URRBMI, Urban and Rural Resident Basic Medical Insurance; UEBMI, Urban Employee Basic Medical Insurance.

Data Sharing Statement

The original data for this article will be shared upon reasonable request from the corresponding author, Jinsong Geng.

Ethics Approval and Consent to Participate

This study, including the patient consent process, was approved by the Medical Ethics Committee of Nantong University (Ethical Approval-202303), and conformed to the ethical guidelines of the Declaration of Helsinki. The Medical Ethics Committee of Nantong University approved the written informed consent form.

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.

Funding

This study was supported by the National Natural Science Foundation of China (Grant Number: 72374113) and the Postgraduate Research and Practice Innovation Program of Jiangsu Province (Grant Number: KYCX24-3568). The funder of the study had no role in the design, implementation, statistical analysis, data interpretation, or manuscript writing.

Disclosure

The authors declare no competing interests in this work.

References

1. Kario K, Okura A, Hoshide S, Mogi M. The WHO global report 2023 on hypertension warning the emerging hypertension burden in globe and its treatment strategy. *Hypertens Res*. 2024;47(5):1099–1102. doi:10.1038/s41440-024-01622-w
2. World Health Organization. Global report on hypertension: the race against a silent killer. World Health Organization, Geneva. 2023.
3. Kandasamy G, Subramani T, Sam G, et al. Biosocial predictors and blood pressure goal attainment among postmenopausal women with hypertension. *Front Cardiovasc Med*. 2024;11:1268791. doi:10.3389/fcvm.2024.1268791
4. Zhai X, Zhou Z, Liu G, et al. Catastrophic health expenditure of households with hypertension: a comparative study in China. *Front Public Health*. 2023;11:1176170. doi:10.3389/fpubh.2023.1176170
5. Chow CK, Nguyen TN, Marschner S, et al. Availability and affordability of medicines and cardiovascular outcomes in 21 high-income, middle-income and low-income countries. *BMJ Glob Health*. 2020;5(11):e002640. doi:10.1136/bmjgh-2020-002640
6. Prabahar K, Katikam T, Punniyakotti S, Devanandan P. A retrospective study on evaluation of anti-hypertensive drugs used in gestational hypertension. *Pak J Pharm Sci*. 2019;32(1):213–215.
7. Chaturvedi A, Zhu A, Gadela NV, Prabhakaran D, Jafar TH. Social determinants of health and disparities in hypertension and cardiovascular diseases. *Hypertension*. 2024;81(3):387–399. doi:10.1161/hypertensionaha.123.21354
8. Attaei MW, Khatib R, McKee M, et al. Availability and affordability of blood pressure-lowering medicines and the effect on blood pressure control in high-income, middle-income, and low-income countries: an analysis of the PURE study data. *Lancet Public Health*. 2017;2(9):e411–e419. doi:10.1016/S2468-2667(17)30141-X
9. Zhu Z, Wang Q, Sun Q, Lexchin J, Yang L. Improving access to medicines and beyond: the national volume-based procurement policy in China. *BMJ Glob Health*. 2023;8(7):e011535. doi:10.1136/bmjgh-2022-011535
10. Wang Z, Wang K, Hua Y, Dong X, Zhang L. Impact and implications of national centralized drug procurement in China. *Int J Clin Pharm*. 2024;46(6):1557–1562. doi:10.1007/s11096-024-01767-1

11. Gruber J, Lin M, Yang H, Yi J. China's social health insurance in the era of rapid population aging. *JAMA Health Forum*. 2025;6(4):e251105–e251105. doi:10.1001/jamahealthforum.2025.1105
12. Zhang M, Shi Y, Zhou B, et al. Prevalence, awareness, treatment, and control of hypertension in China, 2004-18: findings from six rounds of a national survey. *BMJ*. 2023;380(e071952). doi:10.1136/bmj-2022-071952
13. Qin Z, Li C, Qi S, et al. Association of socioeconomic status with hypertension prevalence and control in Nanjing: a cross-sectional study. *BMC Public Health*. 2022;22(1):423. doi:10.1186/s12889-022-12799-5
14. Zou Y, Mao J, Dong Y, Yang L, Dong W, Hao Y. Affordability of original and generic antihypertensive drugs under the national centralized drug procurement policy and basic medical insurance system: a cross-sectional survey in Xi'an, China. *Int J Clin Pract*. 2024;2024(1):4355310. doi:10.1155/ijcp/4355310
15. Lindsay SE, Alokozai A, Eppler SL, Yao J, Morris A, Kamal RN. Decision making and cost in healthcare: the patient perspective. *J Surg Orthop Adv*. 2023;32(1):23–27.
16. Achor EC, Okon II, Jader A, Ewelike SC, Ibrahim M, Lucero-Prisno DE. Achieving sustainable healthcare cost containment in the United States: the role of collaborative efforts among stakeholders. *Discov Health Systems*. 2025;4(1):6. doi:10.1007/s44250-025-00188-9
17. Forrest R, Lagarde M, Aggarwal A, Naci H. Preferences for speed of access versus certainty of the survival benefit of new cancer drugs: a discrete choice experiment. *Lancet Oncol*. 2024;25(12):1635–1643. doi:10.1016/S1470-2045(24)00596-5
18. Jia Y, Zhu X, Liu X, et al. Residents' preferences for inclusive commercial health insurance: a comparative study of discrete choice experiment and best-worst scaling in Heilongjiang province, China. *Patient Prefer Adherence*. 2025;19:3453–3467. doi:10.2147/ppa.S558869
19. Quaife M, Terris-Prestholt F, Di Tanna GL, Vickerman P. How well do discrete choice experiments predict health choices? A systematic review and meta-analysis of external validity. *Eur J Health Econ*. 2018;19(8):1053–1066. doi:10.1007/s10198-018-0954-6
20. de Bekker-Grob EW, Swait JD, Kassahun HT, et al. Are healthcare choices predictable? The impact of discrete choice experiment designs and models. *Value Health*. 2019;22(9):1050–1062. doi:10.1016/j.jval.2019.04.1924
21. Zhang Y, Anh Ho TQ, Terris-Prestholt F, et al. Prediction accuracy of discrete choice experiments in health-related research: a systematic review and meta-analysis. *EClinicalMedicine*. 2024;79:102965. doi:10.1016/j.eclinm.2024.102965
22. Ride J, Goranitis I, Meng Y, LaBond C, Lancsar E. A reporting checklist for discrete choice experiments in health: the DIRECT checklist. *PharmacoEconomics*. 2024;42(10):1161–1175. doi:10.1007/s40273-024-01431-6
23. Hariton E, Locascio JJ. Randomised controlled trials - the gold standard for effectiveness research: study design: randomised controlled trials. *BJOG*. 2018;125(13):1716. doi:10.1111/1471-0528.15199
24. Tan YY, Papez V, Chang WH, Mueller SH, Denaxas S, Lai AG. Comparing clinical trial population representativeness to real-world populations: an external validity analysis encompassing 43 895 trials and 5 685 738 individuals across 989 unique drugs and 286 conditions in England. *Lancet Healthy Longev*. 2022;3(10):e674–e689. doi:10.1016/S2666-7568(22)00186-6
25. Raghunandan R, Howard K, Ilomaki J, Hilmer SN, Gnjidic D, Bell JS. Preferences for deprescribing antihypertensive medications amongst clinicians, carers and people living with dementia: a discrete choice experiment. *Age Ageing*. 2023;52(8). doi:10.1093/ageing/afad153
26. Kandzari DE, Weber MA, Poulos C, et al. Patient preferences for pharmaceutical and device-based treatments for uncontrolled hypertension: discrete choice experiment. *Circ Cardiovasc Qual Outcomes*. 2023;16(1):e008997. doi:10.1161/circoutcomes.122.008997
27. de Vries ST, de Vries FM, Dekker T, et al. The role of patients' age on their preferences for choosing additional blood pressure-lowering drugs: a discrete choice experiment in patients with diabetes. *PLoS One*. 2015;10(10):e0139755. doi:10.1371/journal.pone.0139755
28. Kokko P. Improving the value of healthcare systems using the Triple aim framework: a systematic literature review. *Health Policy*. 2022;126(4):302–309. doi:10.1016/j.healthpol.2022.02.005
29. Luo N, Liu G, Li M, Guan H, Jin X, Rand-Hendriksen K. Estimating an EQ-5D-5L value set for China. *Value Health*. 2017;20(4):662–669. doi:10.1016/j.jval.2016.11.016
30. Meng J, Yan F, Chen M, et al. Preferences for public health insurance coverage of new anticancer drugs: a discrete choice experiment among non-small cell lung cancer patients in China. *BMC Public Health*. 2025;25(1):164. doi:10.1186/s12889-024-20951-6
31. Yu X, Bao H, Shi J, et al. Preferences for healthcare services among hypertension patients in China: a discrete choice experiment. *BMJ Open*. 2021;11(12):e053270. doi:10.1136/bmjopen-2021-053270
32. Orme BK. *Getting Started with Conjoint Analysis: Strategies for Product Design and Pricing Research*. 2nd ed. Madison, WI: Research Publishers; 2010.
33. Assele SY, Meulders M, Vandebroek M. Sample size selection for discrete choice experiments using design features. *Journal of Choice Modelling*. 2023;49:100436. doi:10.1016/j.jocm.2023.100436
34. Fischer A-K, Sadler A, Mühlbacher A, Kohlmann T. Unraveling acceptance of healthcare innovations in neurorehabilitation: results from a discrete choice experiment. *Eur J Health Econ*. 2026. doi:10.1007/s10198-026-01914-7
35. Oliveri S, Lanzoni L, Veldwijk J, et al. Balancing benefits and risks in lung cancer therapies: patient preferences for lung cancer treatment alternatives. *Front Psychol*. 2023;14:1062830. doi:10.3389/fpsyg.2023.1062830
36. Hauber AB, González JM, Groothuis-Oudshoorn CGM, et al. Statistical methods for the analysis of discrete choice experiments: a report of the ISPOR conjoint analysis good research practices task force. *Value Health*. 2016;19(4):300–315. doi:10.1016/j.jval.2016.04.004
37. Cao D, Zhou Z, Si Y, et al. Prevalence and income-related equity in hypertension in rural China from 1991 to 2011: differences between self-reported and tested measures. *BMC Health Serv Res*. 2019;19(1):437. doi:10.1186/s12913-019-4289-5
38. Liu Y, Liu N, Cheng M, et al. The changes in socioeconomic inequalities and inequities in health services utilization among patients with hypertension in Pearl River Delta of China, 2015 and 2019. *BMC Public Health*. 2021;21(1):903. doi:10.1186/s12889-021-10879-6
39. Lan L, Hai P, Luo J, Li R, Wang Y. Medical behaviours and medication adherence of older hypertensive patients in different medical insurance programs in Beijing, China: a cross-sectional study. *BMC Geriatr*. 2023;23(1):878. doi:10.1186/s12877-023-04476-y
40. Teoh SL, Ngorsuraches S, Lai NM, Chaiyakunapruk N. Consumer preferences and willingness to pay for nutraceuticals: a discrete choice experiment. *Value Health Reg Issues*. 2021;24:167–172. doi:10.1016/j.vhri.2020.09.003
41. Jiang S, Ren R, Gu Y, Jeet V, Liu P, Li S. Patient preferences in targeted pharmacotherapy for cancers: a systematic review of discrete choice experiments. *Pharmacoeconomics*. 2023;41(1):43–57. doi:10.1007/s40273-022-01198-8
42. National Bureau of Statistics. *China Statistical Yearbook 2023*. Beijing, China: National Bureau of Statistics of China; 2023.

43. Chen W, Zhang L, Hu M, Hu S. Use of health technology assessment in drug reimbursement decisions in China. *BMJ*. 2023;381:e068915. doi:10.1136/bmj-2021-068915
44. Ahmed SM, Berhane A, Fekade J. Health related quality of life and associated factors among hypertensive patients attending public hospitals in Addis Ababa, Ethiopia, 2024. *Curr Probl Cardiol*. 2025;50(1):102890. doi:10.1016/j.cpcardiol.2024.102890
45. Wan M, Liu X, Zhang M, et al. Stigmatized stroke? A qualitative study of perception of stroke among community residents with hypertension. *Int J Public Health*. 2024;69:1606781. doi:10.3389/ijph.2024.1606781
46. Ren H, Guo YF, Zhang ZX, et al. Perception of recurrent risk versus objective measured risk of ischemic stroke in first-ever stroke patients from a rural area in China: a cross-sectional study. *Patient Educ Couns*. 2023;107:107586. doi:10.1016/j.pec.2022.107586
47. Shen M, He W, Yeoh EK, Wu Y. The association between an increased reimbursement cap for chronic disease coverage and healthcare utilization in China: an interrupted time series study. *Health Policy Plan*. 2020;35(8):1029–1038. doi:10.1093/heapol/czaa087
48. Ge L, Zhang X, Huang Y, et al. Can a multitiered copayment system affect people's healthcare-seeking behavior? A case study of Wenzhou, China. *BMC Health Serv Res*. 2022;22(1):630. doi:10.1186/s12913-022-08031-0
49. Zhou J, Li M, Lv Y. Social medical insurance system and self-rated health: medical service utilization as the mechanism of action. *Front Public Health*. 2025;13:1581130. doi:10.3389/fpubh.2025.1581130
50. Zhang Y, He Y, Wang Q, et al. Disparities in inpatient treatment and expenditures among lung cancer patients under tiered social health insurance: a population-based study in China. *Int J Equity Health*. 2025;24(1):163. doi:10.1186/s12939-025-02533-z
51. Shiraly R, Khani Jeihooni A, Bakhshizadeh Shirazi R. Perception of risk of hypertension related complications and adherence to antihypertensive drugs: a primary healthcare based cross-sectional study. *BMC Primary Care*. 2022;23(1):303. doi:10.1186/s12875-022-01918-1
52. Li C, Chen K, Cornelius V, et al. Applicability and cost-effectiveness of the Systolic Blood Pressure Intervention Trial (SPRINT) in the Chinese population: a cost-effectiveness modeling study. *PLoS Med*. 2021;18(3):e1003515. doi:10.1371/journal.pmed.1003515
53. Adrija Jha AR, Ladani B, Verma N, Kannan S, Naha A. Temperature and pH-responsive nanogels as intelligent drug delivery systems: a comprehensive review. *J Appl Pharm Sci*. 2021;11(12):1–16. doi:10.7324/JAPS.2021.1101201
54. Frieden TR, Garg R, Banigbe B, et al. Unlocking health equity by eliminating copayments for essential antihypertensive medications. *EClinicalMedicine*. 2025;81:103094. doi:10.1016/j.eclinm.2025.103094
55. Bouvy JC, Cowie L, Lovett R, Morrison D, Livingstone H, Crabb N. Use of patient preference studies in HTA decision making: a NICE perspective. *Patient*. 2020;13(2):145–149. doi:10.1007/s40271-019-00408-4