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A Study on the Preferences of Chinese Cancer Patients Regarding Telemedicine from a Demand Perspective: A Discrete Choice Experiment

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Abstract

Objectives

This study aimed to investigate the preferences of cancer patients for telemedicine services using a discrete choice experiment (DCE). The findings are intended to provide robust evidence for understanding patient needs and optimizing the delivery of telemedicine by tertiary public hospitals in China.

Methods

Seven key attributes influencing cancer patients' telemedicine choices were systematically identified through comprehensive literature review and iterative expert consultation. A D-efficient experimental design was employed to generate choice sets for the DCE questionnaire. Cancer patients receiving outpatient care at nine geographically diverse tertiary public hospitals across eastern, central, and western China were recruited. Data were analyzed using a mixed logit model.

Results

Out-of-pocket(OOP) cost was found to be a highly sensitive attribute. Among non-price factors, cancer patients demonstrated significant preferences for services with favorable patient ratings ($\beta = 0.6407$, $p < 0.001$), consultations provided by chief physicians ($\beta = 0.3871$, $p < 0.001$), and audio consultations ($\beta = 0.1325$, $p < 0.05$). Additional preferred features included simplified user interface processes ($\beta = 0.0970$, $p < 0.05$), access to electronic medical records(EMRs) and test results ($\beta = 0.1254$, $p < 0.05$), and functions enabling health data upload with abnormal value alerts ($\beta = 0.0891$, $p < 0.05$). Patients exhibited the highest willingness to pay (WTP) for improving physician ratings from unfavorable to favorable, with an additional payment of RMB 612.796. Subgroup analysis further revealed that high-income patients had a particularly strong willingness to pay for video consultations.

Conclusions

The development of telemedicine should be anchored in oncology specialty hospitals or tertiary hospitals, with priority given to engaging high-quality physicians in online consultations and follow-up care. Medical services and prescribed medications delivered through telemedicine should be progressively incorporated into health insurance reimbursement schemes to facilitate the expansion of remote care and follow-up services. Furthermore, differentiated service models should be designed to meet the heterogeneous needs of diverse cancer patient populations.

1 Introduction

Since the turn of the 21st century, cancer has emerged as a leading cause of mortality and a primary impediment to gains in global life expectancy[1]. According to the World Health Organization's (WHO) 2022 global cancer statistics, there were approximately 19.96 million new cancer cases and 9.74 million cancer-related deaths worldwide. Projections from the International Agency for Research on Cancer (IARC) suggest that the annual number of new cases will exceed 35 million by 2050, exacerbating the global economic burden of the disease[2]. China faces a similar and escalating challenge, with both cancer incidence and mortality rates on a continuous upward trend. In 2022, the country recorded an estimated 4.82 million new cancer cases and 2.57 million deaths[3, 4]. The rising prevalence of cancer, coupled with the complexity of its etiology and the protracted, often recurrent, nature of its treatment, necessitates high-frequency, long-term engagement with the healthcare system. This imposes a substantial economic burden on patients and their families[5] and strains the operational efficiency and long-term sustainability of the national health system. Consequently, enhancing the quality of cancer diagnosis, treatment, and follow-up care has become a critical component of chronic disease management and population health strategy. This priority is reflected in national policy, such as the "14th Five-Year" National Health Plan, which calls for the establishment of a comprehensive health management system for chronic diseases and promotes an integrated model of care that combines

prevention, treatment, rehabilitation, and management. However, cancer patients in China continue to face significant challenges in accessing care. Surgical intervention, a critical component of the cancer treatment continuum, is typically unavailable at primary care facilities, compelling patients to seek care at tertiary or specialized cancer hospitals. This centralization of expertise creates several downstream problems. First, patients from remote areas must often travel across regions, frequently encountering difficulties securing appointments with specialists due to high demand[6, 7]. Second, high patient volumes and a limited number of oncology departments in tertiary hospitals result in a complex and inefficient care-seeking process, characterized by prolonged wait times for registration, consultation, and treatment. Furthermore, patients are often in a relatively immunocompromised state post-surgery; the long-distance travel and environmental exposures associated with in-person visits can increase their risk of infection and impede recovery. Finally, while regular post-operative follow-up is clinically vital for the early detection of recurrence or metastasis, the resource constraints of traditional "brick-and-mortar" hospitals make it challenging to provide the continuous, long-term patient monitoring required for effective management[8].

The emergence of telemedicine has undoubtedly provided a critical solution to the aforementioned challenges. In 2018, the State Council of China issued the Opinions on Promoting the Development of“Internet + Healthcare”, which explicitly encouraged the establishment of telemedicine services under the premise of ensuring medical quality and information security. Subsequently, the outbreak of COVID-19 in 2020 further accelerated the adoption of telemedicine, with a growing proportion of patients preferring telemedicine for follow-up consultations[9]. Telemedicine refers to a healthcare delivery model that relies on physical medical institutions and provides integrated services such as online follow-up visits, routine consultations, and medication delivery through digital platforms[10]. As a key component of the digital health ecosystem, telemedicine effectively overcomes geographical and temporal barriers inherent in traditional healthcare systems. It enables cancer patients, particularly those in remote areas, to access continuous, high-quality remote care, thereby significantly improving convenience and healthcare accessibility. In addition, telemedicine platforms can triage follow-up demands from patients with common and chronic conditions through automated processes, alleviating outpatient workload and reducing pressure on tertiary hospitals. Moreover, telemedicine minimizes the need for postoperative travel, thereby reducing the risk of disease exacerbation associated with physical strain and environmental exposure. It also facilitates continuous patient engagement throughout the cancer care trajectory, contributing to the establishment of an integrated “treatment–rehabilitation–management” continuum. This approach supports both psychological well-being and clinical recovery among cancer patients. Furthermore, telemedicine enables repeated follow-up while reducing non-medical expenditures such as transportation and accommodation costs, thereby alleviating the overall economic burden on patients and their families. Despite these advantages, telemedicine in China remains at an early stage of development and faces several challenges. Most cancer patients have limited understanding of telemedicine service models and operational mechanisms, leading to concerns regarding the safety, standardization, and privacy of online care, which in turn constrain their willingness to use such services. In addition, given the highly individualized and complex nature of cancer treatment, some patients are concerned that the lack of in-person examinations in telemedicine settings may result in incomplete clinical information, potentially affecting the appropriateness and precision of treatment decisions[11]. Furthermore, health insurance reimbursement systems have not yet been fully integrated with telemedicine services, preventing patients from directly settling medical expenses through online platforms, which compels them to seek offline care for follow-up visits. Against this backdrop, systematically examining cancer patients’ preferences and choice mechanisms for telemedicine services from a demand-side perspective is of substantial theoretical and practical importance. Such insights can inform the optimization of telemedicine service design, enhance patient acceptance, and promote the standardized application of telemedicine in oncology care.

At present, relatively limited attention has been paid to telemedicine platforms (i.e., internet hospitals) in the international literature, with most studies focusing more broadly on telemedicine services[12–17]. In contrast, existing studies in China have predominantly examined telemedicine from the perspectives of government or healthcare institutions, addressing aspects such as development status, practical challenges, operational mechanisms, and optimization pathways[18–23]. Some empirical studies have investigated the factors influencing patients’ awareness and satisfaction with telemedicine services[24–26], while others have analyzed patient preferences for telemedicine within specific hospital settings[27, 28]. However, there remains a notable gap in the literature regarding preference-based analyses specifically targeting cancer patients and their utilization of telemedicine. Against this background, the present study builds upon the existing body of literature to systematically examine

the preference attributes influencing cancer patients' demand for telemedicine services. The findings aim to inform the refinement of the "Internet + Healthcare" framework and contribute to the advancement of the Healthy China Initiative.

2 Materials and Methods

2.1 Data Source

A stratified sampling approach was employed. The research team conducted face-to-face questionnaire surveys in representative regions across eastern (Jiangsu, Shanghai, Zhejiang), central (Anhui, Hubei, Henan), and western China (Sichuan, Gansu). In each participating tertiary public hospital, oncology outpatient clinics were selected as the primary recruitment sites. Eligible cancer patients were recruited using convenience sampling in outpatient waiting areas.

The inclusion criteria for cancer patients were as follows: (1) Chinese nationality or long-term residence in mainland China; (2) age ≥ 18 years; (3) self-reported diagnosis of cancer; (4) ability to read and comprehend the questionnaire, with no evident disorders or cognitive impairments, and capable of completing the survey independently or with assistance; and (5) provision of written informed consent on a voluntary basis.

This study was approved by the Ethics Committee of the Shanghai Health Development Research Center (Shanghai Institute of Medical Science and Technology Information), with approval number 2025003. All procedures adhered to the principles of the Declaration of Helsinki. Data were anonymized to ensure participant confidentiality. All participants provided written informed consent prior to participation and received appropriate compensation.

2.2 Study Design

2.2.1 Discrete Choice Experiment

A Discrete Choice Experiment (DCE) is an econometric approach used to evaluate preferences for different interventions, products, services, or policy alternatives [29, 30]. It is based on the assumption that respondents, when faced with specific hypothetical scenarios, make rational choices by integrating individual characteristics, subjective perceptions, and external contextual factors, following the principle of utility maximization. The probability of a particular option being chosen is then modeled as a function of its attributes.

Currently, DCE is widely applied in academic research to elicit preferences across diverse populations[31, 32], and has also been utilized in studies examining cancer patients' preferences for treatment options and follow-up care services[33–35]. Notably, DCE represents a valuable methodological tool in health services research, as it enables researchers to quantify and prioritize patient preferences for healthcare services within the context of constrained healthcare resources[36].

2.2.2 Identification of Attributes and Levels

In the preliminary phase, an extensive literature review was conducted. A total of 34 attributes were initially extracted from 11 relevant studies. Subsequently, qualitative interview findings were used to consolidate similar or overlapping items, resulting in 29 potential attributes, including platform type and hospital level. These attributes were further categorized into four domains: platform and institutional characteristics, physician service capacity, specific service content, and medication delivery and related costs.

Next, multiple rounds of online and offline consultations were conducted with 12 experts. The Best–Worst Scaling (BWS) method was applied to calculate composite scores based on expert input. Attributes such as platform type, hospital level, physician response time, auxiliary services, medical record and health file management, follow-up reminder functions, drug delivery mode, drug delivery time, and service fees (by outpatient type) were excluded. For the complete questionnaire, see Attachment S1.

Ultimately, seven key attributes were identified: out-of-pocket(OOP) cost[37], platform usability[38], physician title[39], consultation modality[40], access to EMRs and test results[41], health monitoring data upload with abnormal value alerts[42],

and patient ratings of physicians[43]. These attributes comprised a total of 18 levels, as detailed in Table 1.

Table 1
Attributes and Levels Included in the DCE

No.	Attribute	Levels	Definition/Notes
1	Out-of-pocket Cost (per visit)	10	Non-reimbursed payment per telemedicine visit
		70	
		200	
		1000	
2	Platform Usability (interface workflow)	Simple	The convenience of navigating and using the telemedicine platform.
		Complex	
3	Physician's Professional Title	Chief physician	The professional qualification and clinical experience level of the consulting physician.
		Associate chief physician	
		Attending physician	
4	Consultation Modality	Video	The method of communication used for the patient-physician interaction.
		Audio	
		Text/image	
5	Access to EMRs and Test Results	Available	Whether the telemedicine platform supports centralized management of medical records and longitudinal health information
		Unavailable	
6	Home-monitoring Data Upload with Abnormal-value Alerts	Available	Support for home-monitoring device data upload and automated abnormal-value alerts (e.g., glucose spikes, abnormal blood pressure)
		Unavailable	
7	Patient Ratings of Physicians	Favorable	Patient ratings of physicians' service quality, communication, and perceived treatment outcomes.
		Unfavorable	

2.2.3 Choice Set and Questionnaire Design

The DCE design incorporated the seven identified attributes with varying complexity levels: one four-level attribute (OOP cost), two three-level attributes (physician title and consultation modality), and four two-level attributes (platform usability, access to EMRs and test results, health monitoring data upload with abnormal value alerts, and patient ratings of physicians). A D-efficient experimental design was implemented using the %MktRuns macro command in SAS 9.4 software, generating 16 choice sets. Each choice set presented two alternative telemedicine service profiles to simulate realistic decision-making scenarios for cancer patients. Randomization was implemented throughout the survey administration using the random scenario function in the Wenjuanxing platform, with respondents randomly assigned to commence the survey at any given choice set.

A self-administered questionnaire was developed comprising three components: (1) study objectives and informed consent documentation, (2) baseline characteristics assessment, and (3) DCE choice tasks. The baseline survey collected information on sociodemographic and clinical characteristics including gender, age, region of residence, educational attainment, health insurance coverage, household income, cancer diagnosis details, and prior telemedicine utilization experience.

To evaluate whether the selected attributes and levels were salient to respondents, capable of significantly influencing stated preferences, whether coefficient signs aligned with a priori expectations, and whether the questionnaire content was comprehensible, the research team conducted a pilot study. Cancer patients meeting the inclusion criteria were recruited from

outpatient departments at randomly selected tertiary hospitals. Based on pilot study feedback, iterative refinements were implemented to finalize the survey instrument. A representative DCE choice task is presented in Table 2.

Table 2
Example of a Discrete Choice Experiment Choice Task

Out-of-pocket (OOP) cost	**Scenario 1**	**Scenario 2**
	CNY 10	**CNY 70**
Platform usability	Complex	Simple
Physician title	Associate chief physician	Attending physician
Consultation modality	Audio consultation	Video consultation
Access to EMRs and test results	Unavailable	Available
Health monitoring data upload with abnormal value alerts	Unavailable	Available
Patient ratings of physicians	Unfavorable	Favorable
Which service option would you prefer?	□	□

2.2.4 Data Collection

The survey was conducted between July and December 2025. Data collection was primarily carried out by uniformly trained nursing staff and head nurses, who administered one-on-one surveys in outpatient clinics or inpatient wards. After providing a full explanation of the study and obtaining informed consent, participants completed and submitted the questionnaire electronically. Considering that some respondents were middle-aged or elderly cancer patients with limited mobility, and that certain individuals were unfamiliar with electronic devices, a paper-based questionnaire identical to the electronic version was also provided to ensure equitable participation. Questionnaire distribution and collection were facilitated through a professional online survey platform. Survey links were disseminated to the target population via WeChat or QR codes, enabling efficient data acquisition. The platform supported automatic data classification, preliminary analysis, and export, eliminating the need for manual data entry.

Regarding sample size determination for the Discrete Choice Experiment (DCE), several approaches have been proposed in the literature. Among them, Bryan Orme and Richard Johnson introduced a widely used rule-of-thumb, as shown in Eq. (1). In this formula, c represents the largest number of levels among all attributes, a denotes the number of alternatives per choice set, and t indicates the number of choice sets in the questionnaire[44]. In this study, the parameters were set as c = 4, t = 8, and a = 2. Substituting these values into Eq. (1) indicates that a minimum sample size of 125 would be sufficient for analysis. Considering potential non-response and invalid questionnaires, and to enhance the robustness and reliability of the findings, the sample size was expanded. Ultimately, a total of 807 valid samples were included in the analysis.

$$N > \frac{500c}{t \times a} \quad (1)$$

2.3 Statistical Analysis

Data entry, cleaning, and database construction were conducted using a professional online survey platform. Data coding was performed with Microsoft Excel 2021, and statistical analyses were carried out using Stata 16.1. First, descriptive analyses were used to summarize respondents' sociodemographic characteristics and their utilization of telemedicine services. Model selection was then conducted by comparing the log-likelihood, Akaike Information Criterion, and Bayesian Information Criterion across the mixed logit model and conditional logit model to identify the optimal specification. Subsequently, the relative importance of each attribute was calculated based on standardized coefficients. Out-of-pocket cost was treated as the price attribute, and willingness to pay (WTP) was estimated by taking the ratio of attribute coefficients to the cost coefficient. In addition, subgroup analyses were conducted to estimate WTP for different attribute levels among cancer patients with varying

characteristics, thereby deriving the monetary value of different service combinations. Finally, scenario simulations were performed to predict the probability of cancer patients choosing telemedicine services under different conditions. All statistical tests were two-sided, with a significance level set at $p < 0.05$.

3 Results

3.1 Sample characteristics

A total of 807 participants were included in the final analysis. The mean age of the sample was 57 years, with 7.7% aged 18–34, 26.5% aged 35–50, 40.8% aged 51–65, and 25.0% aged over 65. The gender distribution was relatively balanced, with 54.0% male and 46.0% female participants (Table 3).

The majority of respondents resided in China's eastern region (71.3%), while 10.4% and 18.3% were from the central and western regions, respectively. In terms of educational attainment, the largest group (63.0%) had completed high school or less. A further 13.0% held a junior college/associate degree, 20.0% held a bachelor's degree, and 4.0% had a postgraduate degree or higher. The annual household income was predominantly in the low-to-middle range, with over half of the sample (51.0%) reporting an income below ¥100,000. Another 35.0% reported an income between ¥100,000 and ¥200,000, 11.0% between ¥200,000 and ¥500,000, and only 3.0% reported an income exceeding ¥500,000.

China's healthcare financing system comprises a multi-tiered framework anchored by basic medical insurance as the primary pillar, with medical assistance serving as a safety net, complemented by supplementary medical insurance, commercial health insurance, charitable donations, and medical mutual aid programs. Basic medical insurance encompasses two principal schemes: Urban Employee Basic Medical Insurance (UEBMI) and Urban-Rural Resident Basic Medical Insurance (URRBMI). Regarding healthcare payment mechanisms, 98.0% of respondents were enrolled in either UEBMI or URRBMI, 7.0% held commercial health insurance policies, only 2.0% were uninsured, and 2.5% utilized alternative payment methods.

The majority of cancer patients (69.5%) reported prior telemedicine experience, while 30.5% had never utilized such services. Among telemedicine users, the predominant purpose was follow-up prescription renewal/medication refill or diagnostic test ordering (61.7%).

Table 3
Basic Information

Characteristic	Category	N	%
Age(Year)			
	18–34	62	7.7%
	35–65	214	26.5%
	≥ 65	329	40.8%
	18–34	202	25%
Gender			
	Male	432	54%
	Female	375	46%
Region of residence			
	Eastern	575	71.3%
	Central	84	10.4%
	Western	148	18.3%
Education			
	Junior high or below	269	33%
	High school/Vocational high school	243	30%
	Junior college/Vocational college	105	13%
	Bachelor’s degree	159	20%
	Postgraduate or above	31	4%
Annual Household Income			
	<CNY 100,000	410	51%
	CNY 100,000-200,000	282	35%
	CNY 200,000-500,000	86	11%
	>CNY 500,000	29	3%
Payment			
	Urban Employee Basic Medical Insurance (UEBMI)	523	65%
	Urban and Rural Resident Basic Medical Insurance (URRBMI)	272	33%
	Commercial insurance (incl. employer supplementary)	55	7%
	No insurance	16	2%
	Other	20	2.5%
Prior telemedicine utilization			
	Yes	561	69.5%
	No	246	30.5%
Notes:			

Characteristic	Category	N	%
Age(Year)			
Primary purpose for telemedicine use(among users)			
	Online consultation	309	38.3%
	Follow-up prescription refill/diagnostic test ordering	498	61.7%
Notes:			

1.Participants could select multiple options for health insurance coverage. 2.Percentages may not sum to 100% due to rounding.

3.2 Preference Analysis

By comparing the goodness-of-fit between the conditional logit model and the mixed logit model, we found that the mixed logit model yielded a log-likelihood value closer to zero (log likelihood = − 4178.5936), while both the Akaike Information Criterion (4328.282) and Bayesian Information Criterion (4451.420) were lower than those of the conditional logit model. These results indicate that the mixed logit model provides a better model fit and was therefore selected for further analysis.

As shown in Table 4, at least one level of each of the seven included attributes was statistically significant ($p < 0.05$), suggesting that all selected attributes are key determinants of cancer patients' choice of telemedicine services. The signs of the estimated coefficients were generally consistent with prior expectations. Regarding preference direction, only out-of-pocket cost exhibited a negative coefficient, indicating that higher patient payments were associated with lower preference for telemedicine services, reflecting a high degree of price sensitivity.

Among non-monetary attributes, improvement in patient ratings from unfavorable to favorable generated the highest utility for cancer patients ($\beta = 0.6407$, $p < 0.001$). Compared with consultations provided by attending physicians, patients showed a stronger preference for services delivered by chief physicians ($\beta = 0.3871$, $p < 0.001$) and associate chief physicians ($\beta = 0.2032$, $p < 0.001$). Compared with text-based consultation, patients were more likely to prefer voice-based consultation ($\beta = 0.1325$, $p < 0.05$), while the coefficient for video consultation was not statistically significant, possibly reflecting concerns related to privacy protection among most respondents. Compared with the absence of access to EMRs and diagnostic test results, availability of such access ($\beta = 0.1254$, $p < 0.05$) was positively associated with patient preference. In addition, simplified user interface processes ($\beta = 0.0970$, $p < 0.05$) and the availability of health monitoring data upload with abnormal value alerts ($\beta = 0.0891$, $p < 0.05$) both had significant positive effects on patients' telemedicine choices.

Table 4
Preference results for cancer patients' selection of telemedicine services based on the mixed logit model

Attribute/Level	β(SE)	P	SD(SE)	P	WTP	95%CI	
Out-of-pocket(OOP) Cost	-0.0010455(0.0000811)	< 0.001	-0.0010947(0.0001243)	< 0.001			
Platform Usability (ref: Complex)							
Simple	0.0969877(0.0448597)	0.031	0.7381601(0.0635684)	< 0.001	92.766	8.056	177.475
Physician's Professional Title(ref: Attending)							
Chief Physician	0.3871396(0.0540758)	< 0.001	0.2681386(0.1626721)	0.099	370.287	262.313	478.260
Associate Chief Physician	0.2032294(0.0471485)	< 0.001	0.2486859(0.1288371)	0.054	194.382	105.154	283.610
Consultation Modality (ref: Text/image)							
Audio	0.1325696(0.0503708)	0.008	0.0061179(0.1019096)	0.952	126.799	31.019	222.578
Video	0.0848084(0.0460068)	0.071	0.0268042(0.1567268)	0.864	81.117	-7.127	169.360
Access to EMRs and test results (ref: Unavailable)							
Available	0.1254255(0.0397206)	0.002	0.5323945(0.0665373)	< 0.001	119.956	44.975	194.956
Home-monitoring upload with abnormal-value alerts (ref: Unavailable)							
Available	0.0890785(0.0348789)	0.011	0.004485(0.0888459)	0.960	85.201	19.504	150.897
Patient ratings of physicians (ref: Unfavorable)							
Favorable	0.6406865(0.0585374)	< 0.001	1.227518(0.0727756)	< 0.001	612.796	477.843	747.749
AIC	4328.282						
BIC	4451.420						
Log-likelihood	-3959.203						
Respondents (N)	807						
Observations	12912						

3.3 Relative Importance Analysis

As shown in Fig. 1, the relative importance analysis indicated that out-of-pocket cost was the most influential attribute in cancer patients' choice of telemedicine services, with a relative importance score (RIS) of 41.28%. This was followed by patient ratings,

which reflect perceived service quality and satisfaction (RIS = 25.56%), and physician title, which represents clinical expertise and professional competence (RIS = 15.44%), suggesting that both service quality and physician expertise play important roles in patients' decision-making.

Compared with these attributes, the relative importance of consultation modality and access to diagnostic test results was substantially lower, at 5.29% and 5.00%, respectively—approximately 21 percentage points lower than patient ratings, the most influential non-price attribute. This was followed by user interface simplicity (RIS = 3.87%) and abnormal value alert functions (RIS = 3.55%). Although these attributes had positive and statistically significant coefficients, their marginal contributions to overall decision-making remained limited. (see Appendix 2).

Figure 1 Relative Importance Scores (RIS) of Telemedicine Attributes

3.4 Willingness-to-Pay (WTP) Analysis

As shown in Column 6 of Table 4, the WTP estimates for each attribute among cancer patients are presented. Overall, the highest WTP was observed for improvements in patient ratings from unfavorable to favorable. Compared with poor ratings, patients were willing to pay an additional RMB 612.796 per visit for telemedicine services provided by physicians with good ratings. The second highest WTP was associated with physician seniority. Compared with attending physicians, patients were willing to pay an additional RMB 370.287 per visit for services led by chief physicians. For associate chief physicians, the corresponding additional WTP was RMB 194.382.

In terms of consultation modality, patients demonstrated a stronger preference for voice-based consultations, with an average additional WTP of RMB 126.799 per visit. In addition, patients were willing to pay RMB 119.956 more for telemedicine services that provide access to EMRs and diagnostic test results, and RMB 92.766 more for platforms with simplified user interface processes. The lowest WTP was observed for health monitoring data upload with abnormal value alerts, for which patients were willing to pay only an additional RMB 85.201 per visit.

3.5 Subgroup Analysis Results

To examine heterogeneity in patients' preferences for telemedicine service configurations, subgroup analyses were conducted according to gender, age, region, education level, household income, type of health insurance, prior telemedicine utilization, and primary purpose for telemedicine use. Within each subgroup, WTP for telemedicine attributes was estimated. The results are presented in Fig. 2, and detailed tables are provided in Appendix 3.

Overall, WTP estimates across subgroups were largely consistent with those of the main model. Most cancer patient groups showed a stronger preference for services with higher patient ratings and higher physician titles, and correspondingly higher WTP for these attributes. Compared with lower platform usability (i.e., more complex interface design), patients were more willing to pay for improved platform usability (i.e., simplified interface processes), likely because simplified processes reduce time costs associated with healthcare utilization. Compared with text/image-based consultation, cancer patients demonstrated a significantly higher willingness to pay for audio consultation, whereas the willingness to pay for video consultation was not statistically significant in most subgroups. In addition, patients were willing to pay more for telemedicine services offering access to EMRs and diagnostic test results, as well as functions such as health data upload and abnormal value alerts. However, the magnitude and statistical significance of these estimates varied across different population subgroups.

Specifically, patients with different sociodemographic characteristics exhibited distinct preference patterns, as shown in Figures a, b, and c. First, in terms of gender, male cancer patients demonstrated higher willingness-to-pay (WTP) than female patients for services provided by chief physicians, associate chief physicians, and physicians with good patient ratings. Second, regarding age, younger patients showed a stronger preference for abnormal value alert functions, whereas middle-aged and older patients exhibited higher WTP for consultations with chief physicians. Third, with respect to geographic distribution, preference patterns differed across eastern, central, and western regions. Patients in eastern China showed stronger WTP for higher physician titles, audio consultation, and abnormal value alert functions. Patients in central China demonstrated a relatively stronger preference only for access to diagnostic test results. In contrast, patients in western China placed greater value on high patient ratings, with the highest WTP reaching RMB 1,064.184 for this attribute.

In terms of socioeconomic characteristics, education level and household income showed relatively consistent patterns. Compared with patients with lower education levels and lower income, those with higher education and higher income generally exhibited stronger WTP for higher physician titles and good patient ratings. Notably, a distinct finding was that high-income patients showed a particularly strong WTP for video consultation, which differed from the full-sample results, with an estimated WTP of RMB 468.139 for this service. From the perspective of insurance type, preference structures also varied across groups. Patients covered by the Urban Employee Basic Medical Insurance showed stronger preferences for chief physicians, audio consultation, and abnormal value alert functions. Compared with this group, those enrolled in the Urban–Rural Resident Basic Medical Insurance demonstrated higher WTP for access to diagnostic results and good patient ratings. In contrast, patients with commercial health insurance showed stronger preferences for simplified interface processes and associate chief physician services. See Figures d, e, and f.

Regarding prior telemedicine utilization, cancer patients who had previously used telemedicine services exhibited a higher willingness-to-pay (WTP) for the “good patient ratings” attribute, whereas non-users were more sensitive to the availability of access to diagnostic test results. In terms of primary preferred online service needs, compared with patients whose first preference was online consultation, those whose primary intention was follow-up prescription refills or diagnostic testing demonstrated a higher WTP for physicians with good patient ratings. See Figures g and h.

3.6 Scenario Simulation Results

This study further conducted probability prediction simulations of cancer patients’ choice of telemedicine services under different hypothetical scenarios. The baseline scenario (Base) was defined as follows: out-of-pocket (OOP) cost of RMB 1,000, complex platform usability, consultation provided by an attending physician, text/image-based consultation, no access to EMRs or diagnostic test results, no health data upload with abnormal value alerts, and poor patient ratings. Due to the long-term heterogeneity and clinical complexity of cancer, patients often have higher demands for quality of life and health management. They generally prefer to seek care and long-term follow-up in healthcare settings with more concentrated medical resources and higher clinical expertise, and demonstrate relatively strong willingness-to-pay in order to improve treatment outcomes and survival quality. Therefore, in the analysis of service bundle scenarios, the out-of-pocket cost was set at RMB 200 for simulation purposes. Insignificant variables were excluded from the modeling process. The results are presented in Fig. 3. (see Appendix 4).

First, the results indicate that price remains a key determinant of cancer patients’ choice of telemedicine services. Out-of-pocket (OOP) cost is negatively associated with the probability of selecting telemedicine: the higher the OOP cost, the lower the probability of choosing telemedicine services, and vice versa. When the OOP cost decreases to RMB 10, the predicted probability of selecting telemedicine increases to 73.79%.

Second, among non-price attributes, replacing poor patient ratings in the baseline scenario with good patient ratings increases the probability of selecting telemedicine to 65.49%. Regarding physician title, services provided by chief physicians yield a higher choice probability than those provided by associate chief physicians, with an increase of approximately 4.5 percentage points. When text/image consultation in the baseline scenario is replaced with audio consultation, the probability of choosing telemedicine increases to 53.31%. Similarly, introducing access to EMRs and diagnostic test results increases the probability to 53.13%. If complex platform usability is replaced with simplified usability, the probability rises to 52.42%. Finally, adding health data upload with abnormal value alerts increases the probability to 52.23%.

In addition, we found that cancer patients are more likely to prefer combined attribute scenarios than single-attribute improvements. When the service bundle consists of simplified interface processes and associate chief physician, the predicted probability of choosing telemedicine is 71.78%, which is already higher than that observed for any single non-monetary attribute level. When the bundle further includes simplified interface processes, associate chief physician, access to EMRs and diagnostic test results, and audio consultation, the predicted probability increases to 80.13%, representing a 2.19 percentage point increase compared with the scenario without audio consultation (i.e., simplified interface processes + associate chief physician + EMRs access). Next, when patient ratings (good) are additionally included in this combination, the probability rises to 88.45%, which is nearly 77 percentage points higher than the baseline scenario. Finally, the highest predicted probability of selecting telemedicine (89.33%) is observed when all seven optimal attribute levels are simultaneously present, including an out-of-pocket cost of RMB

200, simplified interface processes, associate chief physician, EMRs and diagnostic test access, audio consultation, abnormal value alert functions, and good patient ratings. This probability is 15.54 percentage points higher than that associated with the most favorable single-attribute level (OOP cost of RMB 10).

4 Discussion

4.1 Attribute Preferences of Cancer Patients in Telemedicine Utilization

The mixed logit model results indicate that OOP cost is the most important determinant influencing cancer patients' choice of telemedicine services. This may be attributed to the fact that most cancer patients are highly sensitive to the reimbursement proportion of telemedicine services. When services are not covered by health insurance or are only partially reimbursed—resulting in higher OOP costs—patients are more likely to prefer in-person hospital visits. This finding is consistent with the study by Chen et al.[45]. The WTP results further show that cancer patients exhibit the highest WTP for improving physician ratings from unfavorable to favorable, with an additional payment of RMB 612.796 per visit. Compared with attending physicians, patients are willing to pay an additional RMB 370.287 and RMB 194.382 for services provided by chief physicians and associate chief physicians, respectively. These are followed by consultation modality and access to diagnostic test results. The lowest WTP is observed for health monitoring data upload with abnormal value alerts (RMB 85.201). Taking Shanghai—the city with the highest per capita GDP in China in 2025—as an example, the typical fee for an in-person specialist outpatient visit is approximately RMB 50. However, cancer patients are willing to pay an additional RMB 85.201 for telemedicine services even at the lowest attribute level. This suggests that the low time cost, convenience, and accessibility of specialist resources provided by telemedicine are highly valued by cancer patients, indicating substantial market potential. Nevertheless, price remains a critical factor in influencing telemedicine adoption. Therefore, it is necessary to establish standardized pricing mechanisms for telemedicine services and rational pricing strategies for medications, while progressively incorporating relevant services and drugs into health insurance reimbursement schemes to facilitate online consultation and follow-up care.

Among non-price attributes, patient ratings emerged as the most influential factor in telemedicine choice among cancer patients, which is consistent with the findings of Pei et al. [46]. Patient ratings refer to patients' subjective evaluations of physicians after online consultations, including professional competence, communication quality, and service attitude, typically reflected through both numerical scores and textual feedback[47]. Patients can rate physicians on a three-level scale (good, moderate, poor) and provide qualitative comments on treatment effectiveness, communication quality, service efficiency, information transparency, and overall experience. In general, patient satisfaction reflects perceived service quality, and higher ratings indirectly indicate higher perceived physician competence.

Physician title is the second most important non-price attribute. From patients' perspective, physician title is an intuitive indicator of clinical experience and technical competence. Higher-ranked physicians are generally perceived as more experienced, with greater clinical workload and expertise. Therefore, cancer patients tend to place higher trust in physicians with better ratings and higher professional titles. Telemedicine platforms based on oncology specialty hospitals or tertiary hospitals should prioritize high-quality physician participation in online consultations and follow-ups to attract more cancer patients.

Compared with text/image-based consultation, cancer patients showed a stronger preference for audio consultation, consistent with the findings of Wei et al. [48]. Audio consultation does not require disclosure of facial images or surrounding environments, which helps reduce psychological burden and better protects privacy, particularly for patients with sensitive health concerns, thereby enhancing willingness to communicate. The non-significant result for video consultation may also be related to patients' strong concerns about privacy protection. Furthermore, access to EMRs and diagnostic test results, simplified interface processes, and health data upload with abnormal value alerts all had significant positive effects on telemedicine utilization. EMR access allows patients, especially those in remote areas, to avoid the inconvenience of losing paper-based test reports and enables real-time access to clinical information, thereby improving care continuity and convenience. Compared with complex interfaces, simplified interface processes is more acceptable to patients with limited mobility, low digital literacy, or those requiring frequent postoperative follow-up [49].

In addition, health data upload and abnormal value alert functions showed the lowest relative importance among attributes. This may be because automated alerts generated by telemedicine platforms are sometimes overly frequent and insufficiently targeted, leading to a large number of “false or non-actionable alerts” on patients’ mobile devices[50], which may increase anxiety and concern about disease progression. Moreover, many abnormal value notifications only display numerical changes without adequate explanation, emotional support, or recommended actions, potentially leaving patients uncertain about how to respond to warning signals.

4.2 Preference Heterogeneity Across Different Cancer Patient Subgroups

The subgroup analysis indicates that cancer patients with different sociodemographic characteristics, socioeconomic status, and telemedicine utilization experience exhibit substantial heterogeneity in willingness-to-pay (WTP) for telemedicine attributes. From a sociodemographic perspective, compared with younger patients, middle-aged and older cancer patients showed higher WTP for services provided by chief physicians. In general, higher physician titles tend to enhance trust among older patients, thereby increasing their likelihood of selecting telemedicine services[51]. Compared with central and western regions, patients in eastern China demonstrated stronger WTP for higher physician titles, audio consultation, and abnormal value alert functions. This variation may be associated with regional economic disparities. According to data from the National Bureau of Statistics of China, the national per capita disposable income in 2025 was RMB 43,377. The eastern region substantially exceeded the national average, with Shanghai ranking first at RMB 91,987. The central region was at an intermediate level, while the western region remained below the national average, with Inner Mongolia reaching RMB 41,921 and Gansu Province the lowest at RMB 28,224. These findings suggest that faster economic development in eastern China may contribute to stronger WTP for multiple telemedicine service attributes among patients in this region.

From the perspective of socioeconomic status, compared with patients with lower education and income levels, those with higher education and higher household income generally exhibited greater WTP for higher physician titles and good patient ratings. This may be explained by the fact that improved socioeconomic status is often associated with higher healthcare expectations, leading to stronger demands for service quality in telemedicine settings[52]. Notably, high-income patients showed particularly strong WTP for video consultation. This may be because video consultation allows physicians to directly observe patients’ facial expressions and non-verbal cues, enabling more accurate clinical assessment. High-income patients may place greater emphasis on diagnostic precision and thus prefer video-based communication to reduce the risk of misdiagnosis. In addition, video consultation facilitates real-time, bidirectional communication, reducing repeated questioning and information loss caused by poor communication efficiency, thereby improving service efficiency and reducing time costs for high-income patients. Differences were also observed across insurance types, which may be related to differences in the insured population. Urban Employee Basic Medical Insurance mainly covers employed urban residents, whereas Urban–Rural Resident Basic Medical Insurance mainly covers non-employed urban and rural populations. Patients enrolled in Urban Employee Basic Medical Insurance demonstrated stronger preference for abnormal value alert functions, possibly because many of them remain in active employment and therefore place greater value on timely health alerts that can help them adjust work arrangements according to disease status [53].

In terms of telemedicine utilization experience, patients who had never used telemedicine showed higher WTP for access to diagnostic test results, whereas those with prior telemedicine experience were more willing to pay for services with good patient ratings. This suggests that access to diagnostic results may attract first-time or inexperienced users, while perceived service quality—reflected by patient satisfaction—becomes a key factor in building trust, promoting continued use, and enhancing service loyalty [54]. Regarding primary service demand, compared with patients whose main preference was online consultation, those whose primary purpose was follow-up prescriptions or examinations demonstrated higher WTP for physicians with good patient ratings. This preference may be associated with the fact that such patients are more likely to reside in areas with relatively limited medical resources, and therefore rely more heavily on overall service quality signals when selecting physicians for follow-up care and prescriptions[55]. Accordingly, telemedicine platforms should tailor and dynamically adjust service offerings according to heterogeneous patient needs to improve utilization rates.

Furthermore, scenario simulation analysis revealed that, when only a single attribute is modified, the highest probability of telemedicine selection occurs when OOP cost is reduced to RMB 10, while the lowest probability is observed when only abnormal value alert functions are introduced. Importantly, patients showed the strongest preference for a comprehensive service bundle combining RMB 200 OOP cost, simplified interface processes, associate chief physician, access to diagnostic test results, audio consultation, abnormal value alerts, and good patient ratings. This may be because cancer is a complex and high-risk disease, and patients tend to evaluate telemedicine services holistically in terms of usability, clinical expertise, and safety. A combination of multiple attributes forms a more complete, reliable, and user-friendly service pathway, better aligning with patients' expectations for convenience, professional quality, and safety in follow-up and prescription refill scenarios. Therefore, telemedicine platform design should emphasize systematic integration of service attributes rather than optimizing individual features in isolation.

4.3 Strengths and Limitations

As one of the first studies focusing on cancer patients' preferences for telemedicine utilization, this study specifically examined patients' preference structures for telemedicine service attributes. The topic is relatively novel and innovative, providing important empirical evidence and complementary insights for the existing literature on telemedicine services. Second, the study was conducted in oncology outpatient departments of multiple tertiary general hospitals across China, covering eastern, central, and western regions. The wide geographic coverage and relatively large sample size enhance the representativeness of the findings, enabling a more comprehensive reflection of Chinese cancer patients' preference structures and heterogeneity in telemedicine utilization. From a methodological perspective, this study strictly followed the design principles and standard procedures of a Discrete Choice Experiment (DCE). The process included expert consultation, attribute selection, questionnaire refinement, estimation using a mixed logit model, subgroup analysis, and scenario simulation. Overall, the study design and analytical framework were systematic and methodologically rigorous.

However, several limitations should be acknowledged. First, although the survey covered multiple tertiary hospitals nationwide, the final sample was still predominantly composed of patients from eastern China and urban tertiary hospitals. Patients from rural areas and primary healthcare institutions remain underrepresented. Second, although the DCE design was based on literature review and multiple rounds of expert consultation, it may not fully capture all factors influencing cancer patients' telemedicine utilization decisions. Third, the Internet Hospital Management Measures (2018) explicitly define two types of internet hospitals: (1) internet hospitals established by physical healthcare institutions, and (2) platform-based internet hospitals relying on physical medical institutions, such as JD Health, Haodf, and DXY. However, the present study only included the former type (i.e., hospital-based telemedicine platforms), which may limit generalizability. Finally, the DCE method is based on hypothetical scenarios; therefore, discrepancies may exist between stated preferences and actual payment or behavioral decisions. In addition, this study adopts a cross-sectional design, which does not allow for examination of dynamic changes in patient preferences over time in response to evolving policy environments and medical technologies. Future research should consider incorporating qualitative interviews and longitudinal follow-up studies in real-world clinical settings to further explore patient behavior and support the sustainable development of telemedicine services.

5 Conclusion

In summary, this study employed a DCE to investigate cancer patients' preferences for telemedicine services. Several key findings were identified. First, OOP cost, physician title, audio consultation, platform usability, access to EMRs and test results, health data upload with abnormal value alerts, and patient ratings were the seven most important determinants influencing cancer patients' telemedicine choices. Among these, OOP cost was the most influential attribute, highlighting the necessity of incorporating telemedicine services and related medications into health insurance reimbursement schemes. Moreover, among all attribute levels, the highest WTP was observed for good patient ratings, indicating that perceived service quality plays a critical role in patients' decision-making regarding telemedicine utilization.

Second, subgroup analyses revealed significant heterogeneity in preferences across patients with different sociodemographic characteristics, socioeconomic status, and telemedicine utilization experience. Unlike previous studies, this study found that middle-aged and older patients exhibited higher WTP for services provided by chief physicians compared with younger patients.

Patients who had never used telemedicine showed higher WTP for access to diagnostic test results. In addition, patients whose primary purpose was follow-up prescriptions or diagnostic examinations demonstrated stronger preference for physicians with good patient ratings.

Furthermore, unlike prior evidence, high-income patients showed a relatively strong WTP for video consultation. In addition, compared with single attribute improvements, a bundled configuration comprising all seven optimal attribute levels was identified as the most preferred telemedicine service design for cancer patients. These findings fill important gaps in the literature regarding telemedicine preferences among different groups of cancer patients. They provide valuable evidence for optimizing telemedicine service design and contribute to the advancement of digital health development strategies and the broader national “Digital China” initiative.

Declarations

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Ethical Statement

This study has been approved by the Ethics Committee of the Shanghai Research Centre for Health and Health Development (Shanghai Institute of Medical Science and Technology Information) (Ethics Approval No. : 2025003) and adheres to the principles of the Declaration of Helsinki in the anonymisation of the data collected. All participants signed an informed consent form and received appropriate compensation.

Data Availability Statement

All data generated or analyzed during this study are included in this paper and the supplementary information file. Should any researchers require these data in the future, they may contact our team through the appropriate channels.

Author Contribution

He Da and Gu Yichun were responsible for developing the research framework, organizing the data and drafting the paper. Yang Huiyun was responsible for the literature review and data conversion. Tian Botao was responsible for data extraction and drafted the paper. Yang Xin and Jin Shengyong contributed to the drafting and review of the paper. Dong Feng was responsible for reviewing and revising the paper.

Data Availability

This study was approved by the Ethics Committee of the Shanghai Health Development Research Center (Shanghai Institute of Medical Science and Technology Information), with approval number 2025003. All procedures adhered to the principles of the Declaration of Helsinki. Data were anonymized to ensure participant confidentiality. All participants provided written informed consent prior to participation and received appropriate compensation.

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Figures

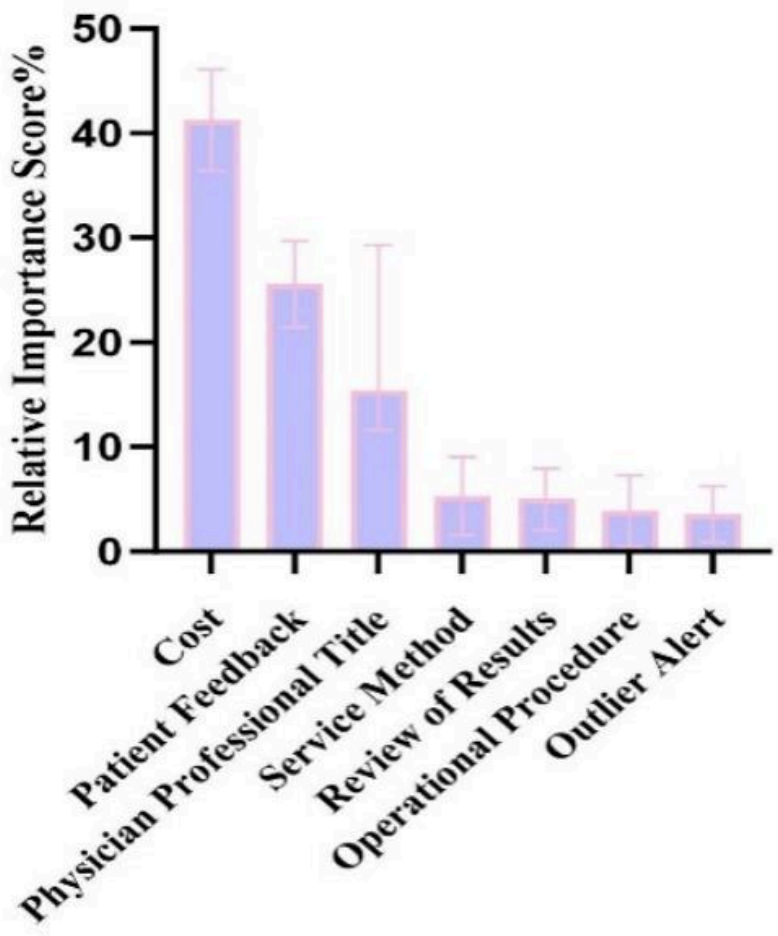


Figure 1

Relative Importance Scores (RIS) of Telemedicine Attributes

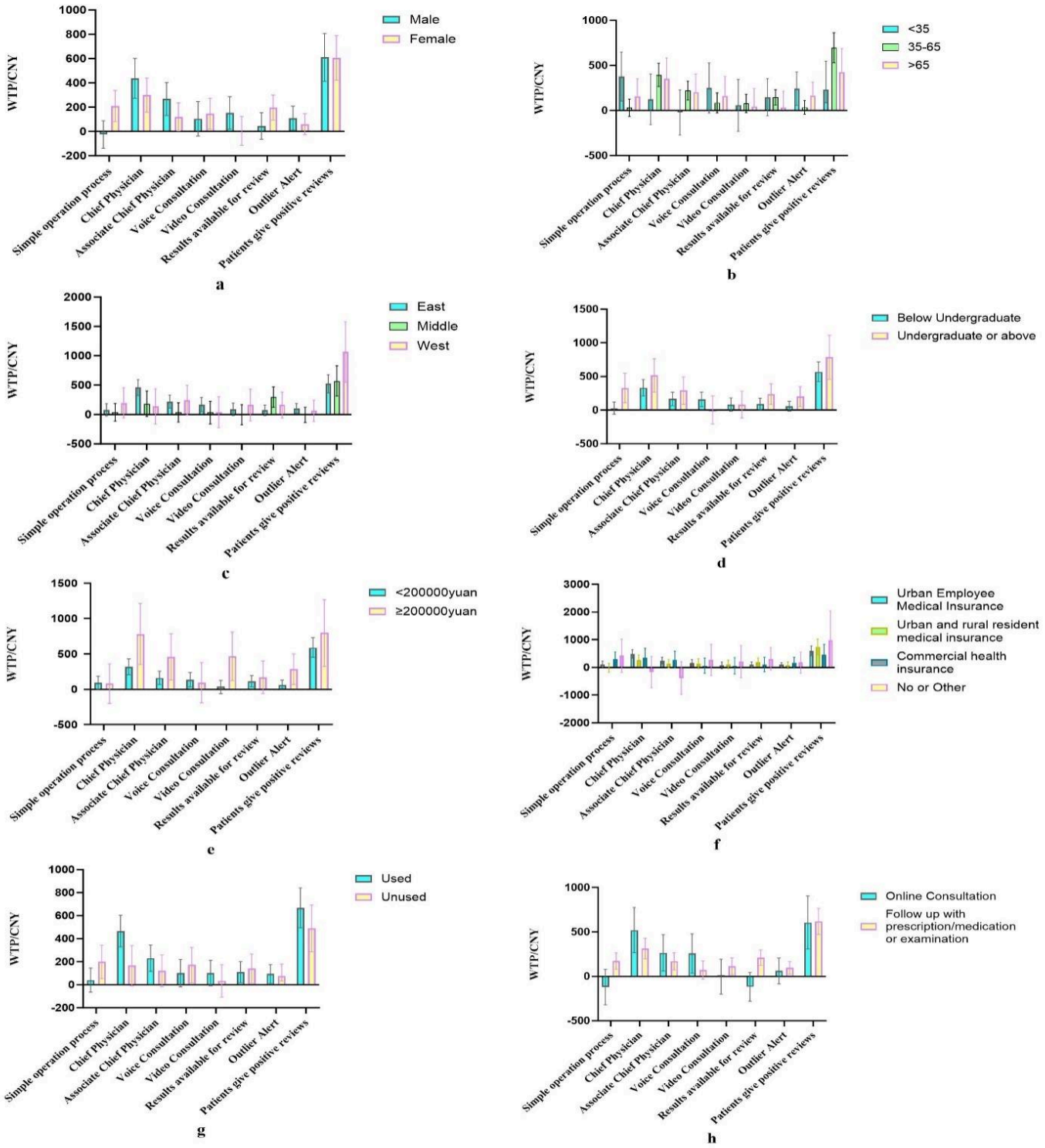


Figure 2

Subgroup analysis of willingness-to-pay (WTP) for telemedicine service attributes among cancer patients

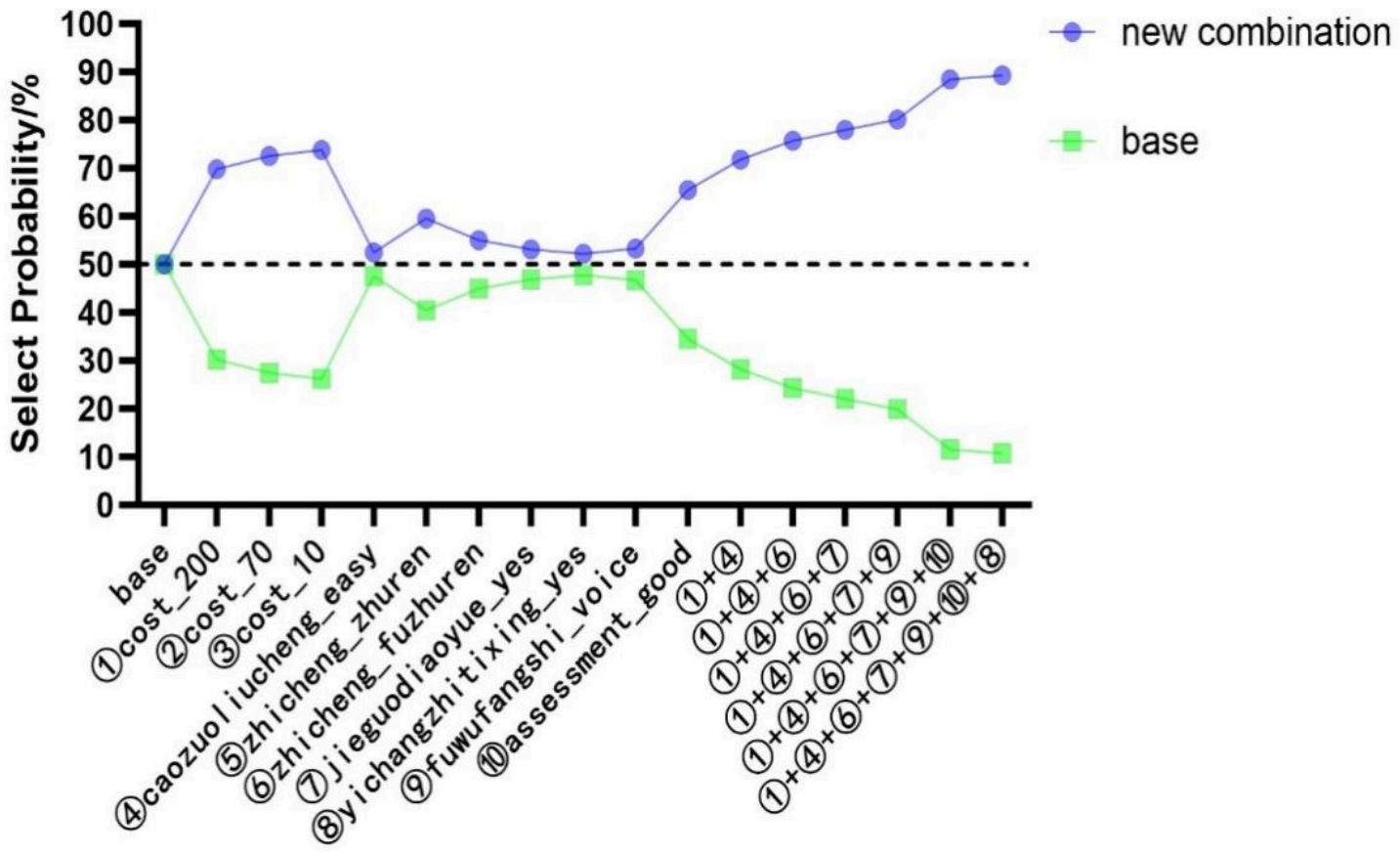


Figure 3

Scenario simulation results of cancer patients' telemedicine utilization probability

Supplementary Files

This is a list of supplementary files associated with this preprint. Click to download.

- Appendix1FilteringbyAttributeLevel.docx
- Appendix2Scoresfortherelativeimportance.docx
- Appendix3Resultsofthesubgroupanalysisofcancer.docx
- Appendix4ScenarioSimulation.xlsx
- AttachmentS1.docx