Service Design Attributes Affecting Diabetic Patient Preferences of Telemedicine in South Korea

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Abstract

Objective: *Attempts to introduce telemedicine in South Korea have failed mostly, leaving critical questions for service developers and providers about whether patients would be willing to pay for the service and how the service should be designed to encourage patient buy-in. In this study, we explore patients' valuations and preferences for each attribute of telemedicine service for diabetes management and evaluate patient willingness to pay for specific service attributes.* ***Materials and Methods:*** *We conducted a conjoint survey to collect data on patients' stated preferences among telemedicine service alternatives. The alternatives for diabetes-related service differed in 10 attributes, including those related to price, type of service provider, and service scope. To estimate the relative importance of attributes, patients' willingness to pay for each attribute, and their probable choice of specific alternatives, we used a rank-ordered logit model. A total of 118 respondents participated in the survey.* ***Results:*** *All 10 attributes significantly affected patients' valuations and preferences, and demographic and disease characteristics, such as existence of complications and comorbidities, significantly affected patients' valuations of the attributes. Price was the most important attribute, followed by comprehensive scope of service, the availability of mobile phone-based delivery, and large general-hospital provided services.* ***Conclusions:*** *The study findings have significant implications for adoption policy and strategy of telemedicine in diabetes management care. Further, the methodology presented in this study can be used to draw knowledge needed to formulate effective policy for adoption of the necessary technology and for the design of services that attract potential beneficiaries.*

Key words: *telemedicine, ubiquitous healthcare, patient preferences, diabetes management, conjoint analysis*

Introduction

Telemedicine is the convergence of telecommunication and information technologies with medicine. It has the potential to innovate healthcare service delivery by improving accessibility of care through elimination of the spatial and time gaps between care providers and patients, improving quality through enhanced continuity of care, and bettering efficiency of care through savings in overall healthcare expenses.[1,2] The application of telemedicine to the management of chronic conditions in an aging population is of particular interest.

Since the early 1990s, telemedicine pilot programs, mostly funded by the Korean government, have been tried with various scopes and aims. The first three programs were launched in 1990 to solve the accessibility problem of residents living in underserved areas, such as islands and rural regions with low population density. However, none survived beyond the pilot phase.[3] Telecommunication technology was not sophisticated enough to replace the traditional offline-based delivery of care in the early stage of telemedicine, and regulatory issues hindered the adoption of the technology as well. In recent years, those issues have been resolved with technology advancements and the government's push to adopt them. The Korean government has been eager to benefit from technology in healthcare as well as to develop a new industry in which technology convergence would invigorate the economy with new services, products, and jobs. Implementation of sustainable revenue model and patients' willingness to buy the service remain key issues in the adoption of technology in South Korea.

The entire population of South Korea has health insurance coverage, mainly through a uniform insurance policy administered by a government-controlled agency. Thanks to the national health insurance, patients can use medical services at low prices and have unlimited access to specialists in hospitals and clinics. However, this lowered economic barrier to healthcare results in overcrowding of healthcare facilities, particularly those affiliated with medical schools and large teaching hospitals that patients prefer. Patients' waiting time is long, and consultation with doctors is often insufficient. Often outpatient visits for diabetes management are scheduled every 2–3 months, and telemedicine technology could certainly improve patient care in this circumstance.

In this study, we attempt to answer the following questions: How do patients value and what are their preferences for each attribute of telemedicine service for diabetes management? Do patients' characteristics influence their valuation of telemedicine services? What is the relative importance of each service attribute and patients' willingness to pay for it? What would constitute successful service

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designs of telemedicine service for diabetes management? Using data obtained from a conjoint survey questionnaire, we analyzed a rank-ordered logit model to answer the study questions.

Diabetes management care is a frequently studied target area of telemedicine, and numerous studies have addressed the clinical and economic outcomes of such care.[4–12] Although studies have examined patients' perspectives of telemedicine, a few can guide service design and pricing decisions as noted by Or and Karsh.[13] In U.S. studies, researchers examined the percentages of preportal and postuser groups who favorably rated the functionality of a Web-based portal for diabetes management,[14] and they looked at the usage of Web-based portals by people with diabetes and the patient characteristics associated with this usage.[15] Also, some studies used the health belief model[16] and the technology acceptance model to examine factors that affect patient's/family's adoption of telemedicine.[17–19] Other studies attempted to estimate the amount which patients were willing to pay for care through telemedicine that replaced traditional offline-based care.[20–23]

Table 1. Service Attributes and Definitions of Independent Variables in the Rank-Ordered Logit Model

SERVICE QUALITY DOMAIN	SERVICE ATTRIBUTE INDEPENDENT VARIABLE	LEVELS	DEFINITION	RELATED PREVIOUS RESEARCH
	Monthly fee[a]	10,000; 30,000; 50,000	Monthly fee for service	
	Monthly fee			
Ease of use	Type of service platform	0; 1	Mobile phone = 1, Internet = 0	Zeithaml et al.[29]
	Mobile phone			
Tangibles, Assurance	Type of service provider		Distinguishing large general hospitals from medium and small hospitals and clinics	Parasuraman et al.[28]
	General hospital-based provider[b]	0; 1	General hospital-based provider = 1, 0 otherwise	
	Hospital-based provider	0; 1	Hospital-based provider = 1, 0 otherwise	
Information availability and content	Service scope	0; 1	Glucose management only; comprehensive diabetes management	Trocchia and Janda,[30] Zeithaml et al.[29]
	Comprehensive diabetes care		Comprehensive diabetes care = 1, 0 otherwise (for glucose management only)	
Empathy	Personalization of consultation	0; 1	Personalized consultation = 1, 0 otherwise (for personalized consultation not available)	Parasuraman et al.[28]
	Personalized consultation			
Accessibility	Service hour	0; 1	24-h service accessibility = 1, 0 otherwise (for office-hour only accessibility)	Trocchia and Janda[30]
	24-h service accessibility			
Responsiveness	Reply time	0; 1	Within 1 day reply = 1, 0 otherwise (for reply within 3 days)	Parasuraman et al. [28]
	Within 1 day reply			
Assurance	Assurance of service	0; 1	High assurance through direct contact = 1, 0 otherwise (for low assurance)	Parasuraman et al. [28]
	High assurance			
Reliability	System failure	0; 1	Almost none (less than 1%) system down = 1, 0 otherwise (for rare, 1%–5%)	Trocchia and Janda,[30] Zeithaml et al.[29]
	Less than 1% system down			
Privacy and security	Confidentiality	0; 1	Almost none (less than 1%) confidentiality breach = 1, 0 otherwise (for rare, 1%–5%)	Trocchia and Janda,[30]Zeithaml et al. [29]
	Less than 1% confidentiality breach			

[a]Korean Won.

[b]General hospital: hospitals with more than 100 beds and specialty care in internal medicine, general surgery, pediatrics, obstetrics and gynecology, neuropsychiatry, anesthesiology, diagnostic radiology, pathology, and dentistry.

Materials and Methods

STUDY DESIGN

Using data collected through a questionnaire developed in this study, we conducted a conjoint analysis, which is often used in marketing to assess the demand of services and products that feature new technology. This stated-preference evaluation method provides a hypothetical choice situation to respondents, who choose among alternative products or services, which do not presently exist, in a way that maximizes each individuals' utility under identified budget constraints. Analysis results reveal the value of various attributes that define the alternative service or product designs.[24–26] We used conjoint analysis to estimate patients' valuation of and preference for each attribute of telemedicine service for diabetes management in a situation where respondents have not experienced the service and cannot adopt the various types of service simultaneously. The survey protocol was approved by the IRBs of the participating hospitals.

QUESTIONNAIRE DEVELOPMENT

We constructed a survey instrument to collect data for the conjoint analysis. The questionnaire consisted of four sections: Section 1 provides respondents with brief descriptions of telemedicine and terminology; Section 2 obtains information about respondents' current regime of diabetes management; Section 3, the conjoint survey, records respondents' stated preference of hypothetical diabetes management care; and Section 4 solicits information concerning respondents' socioeconomic situation, demographic status, and disease states.

To develop the conjoint survey, we first reviewed literature on the frameworks for quality evaluations of services in general, healthcare services, and information technology services. Then, we finalized the list of quality domains to be included in the construction of the hypothetical alternatives of telemedicine-based diabetes management care.[27–32] Next, through study team discussions and advisory sessions with diabetes-care practitioners, we defined the service attributes that match the selected quality domains and we determined the levels of the attributes. We completed the instrument through an iterative process of review, revision, and pretest. The attributes of diabetes management care studied, levels of attributes, and matching quality domains are presented in *Table 1*.

The respondent has a total of 2,304 alternatives associated with the hypothetical situations, which are too many to ask respondents to rate in a survey. Also, some alternatives were shown to be insignificant in statistical terms. We extracted the 16 statistically significant hypothetical alternatives through the orthogonal test available through SPSS version 11.5 (SPSS, Chicago, IL), and the alternatives are presented in *Appendix 1*. These hypothetical alternatives are randomly categorized into four groups with four alternatives each, and to make the ranking manageable, we asked respondents to rank four alternatives in each group.

SUBJECTS AND SURVEY IMPLEMENTATION

We surveyed patients who visited the outpatient clinics of the Departments of Endocrinology and Metabolism at two medical school–affiliated tertiary-care hospitals for diabetes during a 5-week period in October and November 2009 and three physician practices during a 2-week period in January 2010. One of the participating hospitals and two practices are located in Seoul, and the others are located in Seongnam-Si, adjacent to southeast Seoul. Hospital-based physicians are employees of a hospital in South Korea, and practicing physicians in the community do not have the privilege of seeing patients in a hospital.

The survey was implemented through face-to-face interviews by a member of the study team who had trained on the conjoint survey. The survey interviewer approached patients and explained the objectives, contents, and expected time needed to complete the survey and then asked whether the patient (or patient guardian) would be interested in participating in the survey. A total of 153 patients, or the guardians who accompanied them, agreed to participate, and 118 completed questionnaires were used in the analysis: 74 (63%) from general hospitals and 44 (37%) from physician practices. Guardians answered the questions in cases of patients too young or too old to answer (11, 9%). The number of items left unanswered varied by survey item, and the highest nonresponse rate related to monthly household income (22, 19%).

ANALYSIS

We analyzed respondents' preferred alternatives with the rank-ordered logit model based on the random utility model; details are presented in *Appendix 2*. The dependent variable of the logit model was the stated preference of alternatives as ranked 1 to 4, with 1 given to the most favored among the 4 alternatives presented and 4 given for the least favored alternative.

Independent variables were generated from the 10 attributes selected to define the hypothetical situations of diabetes management care. The operational definitions of the independent variables are presented in *Table 1*. To examine whether subject characteristics influenced patients' choices, we analyzed the base model with the independent variables and with the independent variables and interaction terms. Among the variables for subject characteristics, such as social-demographic characteristics (age, gender, household income, and education level) and disease characteristics (duration of diabetes management care, type of diabetes management care, existence of diabetes complications, and comorbidities), we included interaction terms of the variables for age, gender, education level, existence of diabetes complications, and existence of comorbidities. We used LIMDEP version 8.0 (Econometric Software, Plainview, NY) to estimate coefficients of the model.

With the estimation results of the conjoint analysis, the relative importance of attributes for use in constructing a specific service design can be investigated, and the partial value of each attribute can be found. Partial value is calculated by multiplying the estimated coefficient and the scale (difference between the largest and the smallest values) of the attribute. The relative importance of a specific attribute is estimated by a ratio: the partial value of a specific attribute divided by the sum of partial values of all attributes in the model. Marginal willingness to pay is the monetary value of consumer utility when one unit of a specific attribute increases or

decreases. It can be estimated by multiplying −1 to the following ratio: coefficient estimate of a specific attribute divided by the coefficient estimate of the attribute related to price. Finally, to identify successful designs, we estimated, per the coefficient estimates of the base model, the market share of each hypothetical diabetes management care service presented to respondents in the conjoint survey. The market share can be interpreted as the choice probability of a specific item among 16 independent alternatives.

Results

SUBJECT CHARACTERISTICS

Characteristics of the study subjects are presented in *Table 2*. Respondents received diabetes management care for a mean of 8.6 years. Also, the majority of respondents regularly visited a healthcare provider for diabetes management, and 26% have been hospitalized due to diabetes. As the table shows, only a few respondents knew telemedicine very well, and the majority knew about neither telemedicine nor telemedicine-based diabetes management.

PREFERENCES AND MARGINAL WILLINGNESS TO PAY FOR SERVICE ATTRIBUTES

Table 3 presents coefficient estimates of the rank-ordered logit model, the relative importance of service attributes, and respondents' marginal willingness to pay for each service attribute. Coefficients may be interpreted as the utility gained through the existence or an increase (decrease) of a specific attribute (as represented by each variable). For example, the statistically significant positive coefficient of the variable, mobile phone, implies that respondents preferred mobile phone-based service to Internet-based service. The only insignificant variable was the one for hospital-based providers, which implies that respondent preferences on hospital- and physician practice-based services are indistinguishable. All significant coefficients except for the variable monthly fee in the base model were positive, thus indicating that respondents preferred mobile phone-based service to Internet-based service, general hospital-based provider to hospital- or physician practice-based providers, comprehensive care to glucose management only, and 24-h service

Table 2. Characteristics of Study Subjects ($N = 118$)

CHARACTERISTICS	MEAN/FREQUENCY (%)	CHARACTERISTICS	MEAN/FREQUENCY (%)
Mean age (years)	57		
Gender		Diabetes-related complications	
Male	49 (42)	Yes	30 (26)
Female	69 (58)	No	85 (74)
Education		No response	3
High school graduate or lower	51 (49)	Comorbidities	
College graduate and higher	53 (51)	Yes	47 (41)
No response	14	No	68 (59)
Monthly household income		No response	3
4 million Korean Won or fewer	53 (55)	Knowledge of telemedicine	
More than 4 million Korean Won	43 (45)	Know very well	5 (4)
No response	22	Know to a certain extent	44 (37)
Mean duration of diabetes care (months)	103	Do not know	69 (59)
Regular visit to care providers for diabetes care		Knowledge of mobile phone-based diabetes care	
Yes	107 (91)	Know very well	4 (3)
No	10 (9)	Know to a certain extent	33 (28)
No response	1	Do not know	81 (69)
History of hospitalization for diabetes care		Knowledge of Internet-based diabetes care	
Yes	31 (26)	Know very well	3 (3)
No	86 (74)	Know to a certain extent	38 (32)
No response	1	Do not know	77 (65)

Table 3. Coefficient Estimates of the Ranked-Order Logit Model and the Relative Importance and Marginal Willingness to Pay for the Attributes

VARIABLE	COEFFICIENT		RELATIVE IMPORTANCE (RANK)	MARGINAL WILLING. TO PAY[a]
	BASE MODEL	WITH INTERACTIONS		
Monthly fee	−0.03***	−0.03***	29% (1)	
Mobile phone	0.42***	1.63***	12% (3)	15,899
General hospital-based provider	0.40***	0.70***	11% (4)	15,143
Hospital-based provider	0.00	0.00	0% (11)	−33
Comprehensive diabetes care	0.45***	0.47***	12% (2)	16,957
Personalized consultation	0.22***	0.23***	6% (7)	8,309
24-h service accessibility	0.19***	0.61**	5% (8)	7,183
Within 1 day reply	0.16**	0.15*	4% (10)	5,915
High assurance	0.34***	0.87***	9% (5)	13,025
Less than 1% system down	0.23***	0.27***	6% (6)	8,873
Less than 1% confidentiality breach	0.16**	0.17**	4% (9)	6,144
High assurance × Male		−0.50***		
24-h service accessibility × Age (in years)		−0.01*		
Mobile phone × College graduate and higher		−0.20***		
Mobile phone × w/comorbidity		−0.43***		
Mobile phone × w/complication		−0.37**		
General hospital-based provider × W/complication		−0.37**		
High assurance × w/complication		−0.40***		

[a]Korean Won.

***$p < 0.01$, **$p < 0.05$, *$p < 0.1$.

accessibility to office-hour only accessibility. They also prefer receiving replies within 1 day over 3 days, a high degree of service assurance through direct contact with providers over low assurance, the system down less than 1% of the time to it being inaccessible 1% to 5% of the time, less than 1% probability of confidentiality breach over a slight (1% to 5%) probability of a breach, and a low monthly fee over a high fee.

Although the directions of some preferences may be intuitively obvious, the following finding is important: All studied attributes of diabetes management care, except for hospital-based service, significantly affect respondents' preference of the service. Also, study findings indicate that respondents' demographic and disease characteristics affect their preference: Men cared less about assurance than women did; older respondents were more accepting of office-hour only service than their younger counterparts did; college graduates and those with postgraduate education preferred Internet-based service more than other respondents did. Patients with complications or comorbidities, indicators of severe cases of diabetes, were more sensitive to the type of telecommunication platform (mobile phone-based services) and the assurance of service (general hospital-based service and service with high levels of assurance through direct contact to providers).

The most important attribute of the service was the cost: The relative importance was estimated at 29%. It was followed by the comprehensiveness of service scope and type of telecommunication platform. The next two most important attributes concerned general hospital-based providers and assurance of services through direct contact. Without appropriate quality measures of healthcare providers, patients associate large general hospitals, particularly medical school–affiliated hospitals, with high, assured quality of care in South Korea. The study result indicates that respondents were less concerned about the reply time and information security than the other attributes.

The magnitude of the estimated marginal willingness to pay for comprehensive service was the largest, 16,957 Korean Won (KRW), the equivalent of 14 USD (at the exchange rate on August 24, 2010). This result implies that respondents would be willing to pay this amount per month to receive comprehensive diabetes management

Table 4. Estimated Market Share of 16 Alternative Service Designs

CARD NO.	PRICE (MONTHLY FEE[a])	TYPE OF TELECOMMUNICATION PLATFORM	TYPE OF SERVICE PROVIDER[b]	SERVICE SCOPE	PERSONALIZED CONSULTATION	SERVICE HOURS	REPLY TIME	ASSURANCE OF SERVICE	SYSTEM DOWM	CONFIDENTIALITY BREACH	MARKET SHARE (%)
2-1	10,000	Internet	General hospital	Glucose	Available	24 h	Within 3 days	High	Rare	Rare	20.2
3-3	10,000	Mobile phone	Hospital	Comprehensive	Available	24 h	Within 3 days	High	Almost none	Rare	12.6
1-1	10,000	Internet	General hospital	Glucose	Not available	Office hour	Within 3 days	Low	Rare	Rare	9.5
1-4	30,000	Mobile phone	General hospital	Comprehensiv.	Available	Office hour	Within 3 days	Low	Rare	Almost none	8.7
4-4	50,000	Mobile phone	General hospital	Comprehensive	Not available	24 h	Within 3 days	High	Rare	Almost none	7.0
4-1	10,000	Internet	Clinic	Comprehensive	Available	Office hour	Within 1 day	High	Rare	Almost none	6.7
4-3	10,000	Mobile phone	Clinic	Comprehensive	Not available	Office hour	Within 3 days	Low	Almost none	Rare	6.0
2-4	30,000	Mobile phone	Hospital	Glucose	Not available	Office hour	Within 1 day	High	Rare	Rare	5.9
3-1	10,000	Internet	Hospital	Comprehensive	Not available	24 h	Within 1 day	Low	Rare	Almost none	4.6
2-3	10,000	Mobile phone	General hospital	Glucose	Available	Office hour	Within 1 day	High	Almost none	Almost none	3.8
1-2	30,000	Internet	General hospital	Comprehensive	Not available	24 h	Within 1 day	Low	Almost none	Rare	3.8
3-4	50,000	Mobile phone	Clinic	Glucose	Available	24 h	Within 1 day	Low	Rare	Rare	3.7
4-2	50,000	Internet	General hospital	Comprehensive	Not available	Office hour	Within 3 days	High	Almost none	Rare	2.9
1-3	10,000	Mobile phone	General hospital	Glucose	Not available	24 h	Within 1 day	Low	Almost none	Almost none	2.6
2-2	30,000	Internet	Clinic	Glucose	Not available	24 h	Within 3 days	High	Almost none	Almost none	1.3
3-2	50,000	Internet	Hospital	Glucose	Available	Office hour	Within 3 days	Low	Almost none	Almost none	0.6

[a]Korean Won.

[b]General hospital: hospitals with more than 100 beds and specialty care in internal medicine, general surgery, pediatrics, obstetrics and gynecology, neuropsychiatry, anesthesiology, diagnostic radiology, pathology, and dentistry; Hospital: hospitals with more than 30 beds; Clinics: physician practices.

service instead of a service limited to glucose management, which includes glucose management and other wellness services. They would be willing to pay 15,899 KRW per month to get mobile phone-based service instead of Internet-based services, and 15,143 KRW per month for general hospital-based service instead of either hospital- or physician practice-based service. Considering patients' copayment for a consultation visit at tertiary care hospitals (7,000 KRW), the magnitude increase that patients were willing to pay to get certain attributes of the service was not small.

MARKET SHARE

We estimated the market shares of 16 service designs, presented to the respondents as alternative cards, using coefficient estimates from the base model. The results are shown in *Table 4*. The estimation results can be used to compare a completely new set of service designs and to predict the service designs that would be successful if service is launched in the market.

Consistent with the preferences finding, the services with the monthly fee of 10,000 KRW, the lowest price alternative, swept the top three market shares. The service design with a monthly fee of

30,000 KRW (Card no. 1-4 in *Table 4*) was the fourth most favored, and the next most favored design was characterized by a monthly fee of 50,000 KRW, mobile phone-based services, general hospital-based providers, comprehensive service scope, and 24-h service accessibility (Card no. 4-4). The gap between the market shares of the most favored design (Card no. 2-1) and the next favored design (Card no. 3-3) was the largest: The second favorite design was less than two-thirds the share of the most favored.

Discussion

In this study, we examined patients' valuations and preferences of service attributes for telemedicine-based diabetes management care, so that we can draw implications for telemedicine service design and policy for technology diffusion. All 10 attributes of the service we studied significantly affected patients' valuation and preference for service, and demographic and disease characteristics, such as existence of complications and comorbidities, significantly affected their preferences.

Consistent with findings in previous studies, price was the most important attribute,[14,20,33,34] but subjects were willing to pay a considerable amount of monthly fees to attain certain attributes of the service, such as comprehensive diabetes management care, mobile phone-based service, and general hospital-based service. With evidence of cost effectiveness of service, the government or insurer may need to consider covering services that promote the adoption of technology.

Consumer choice and purchase behavior in healthcare is known to be complex due to well-recognized issues such as information asymmetry and uncertainties,[35,36] and providers' reputation is one of the attributes that patients value in their purchasing decision. Further, other studies have reported the significance of assurance and trust in e-business that substitutes face-to-face transactions with encounters through information and communication technology-based mediums.[37–40] It appears that the indirect delivery of care through telecommunication devices strengthens the importance of the quality domain of service assurance. We found that respondents highly value two attributes: general hospital-based providers, which can be viewed as high in reputation and assurance, and direct contact, which can be viewed as a form of trust building. They were willing to pay 15,143 KRW and 13,025 KRW per month, respectively, to get these attributes. Service developers may need to consider ways to build up patients' trust in the design of telemedicine services.

Scholars indicated that information safety and confidentiality are important factors that influence patients' adoption of the information and communication technology in healthcare.[2,41] However, we found that the ranked importance of privacy and confidentiality was relatively low. Perhaps responses reflect less about patients' concern with these attributes than the way questions were constructed. We presented respondents with two levels of confidentiality thresholds: less than 1% failure and 1% to 5% failure, in confidentiality that they could choose as acceptable to them. This finding indicates the need for a quantitative approach in patients' preference studies so that the results can be used in designing services.

The study has a couple of limitations. The sample was drawn from the population in the Seoul metropolitan area who visited university teaching hospitals and physician practices for diabetes care. Study findings may not be generalizable to rural populations with limited accessibility to healthcare providers and those with little interest in caring for diabetes (however, the sample represented potential buyers of the service). Another limitation is that the majority of respondents knew neither telemedicine- nor telemedicine-based diabetes care and they answered questions based on their knowledge from the description of the service provided by surveyors. Although the conjoint analysis and the rank-ordered logit model are popular approaches to estimating consumer preference for prelaunch services and products and they are known to reduce strategic bias in such situation, findings need to be interpreted with acknowledgment of this limitation.[24,25]

In summary, we investigated the stated preference of potential users of telemedicine-based diabetes management services and found they cared about all 10 service attributes we derived from dimensions of service quality. According to the result, price was the most important attribute, even though the respondents indicated a willingness to pay a monthly fee to attain attributes important to them. In addition, the magnitudes of willingness to pay were influenced by patient demographic and disease characteristics. The preference ranks and estimates of willingness to pay may be different among populations in countries with different healthcare policies and regulations than South Korea; however, the methodology presented in this study can be used to draw knowledge needed to formulate effective policy for adoption of telemedicine technology and to design services that can benefit from the use of the telemedicine technology.

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Disclosure Statement

No competing financial interests exist.

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Appendix 1.

Alternative Cards Presented in the Conjoint Questionnaire

CARD NO.	PRICE (MONTHLY FEE[a])	TYPE OF TELECOMMUNICATION PLATFORM	TYPE OF SERVICE PROVIDER[b]	SERVICE SCOPE	PERSONALIZED CONSULTATION	SERVICE HOURS	REPLY TIME	ASSURANCE OF SERVICE	SYSTEM DOWM	CONFIDENTIALITY BREACH
1-1	10,000	Internet	General hospital	Glucose	Not available	Office hour	Within 3 days	Low	Rare	Rare
1-2	30,000	Internet	General hospital	Comprehensive	Not available	24 h	Within 1 day	Low	Almost none	Rare
1-3	10,000	Mobile phone	General hospital	Glucose	Not available	24 h	Within 1 day	Low	Almost none	Almost none
1-4	30,000	Mobile phone	General hospital	Comprehensiv.	Available	Office hour	Within 3 days	Low	Rare	Almost none
2-1	10,000	Internet	General hospital	Glucose	Available	24 h	Within 3 days	High	Rare	Rare
2-2	30,000	Internet	Clinic	Glucose	Not available	24 h	Within 3 days	High	Almost none	Almost none
2-3	10,000	Mobile phone	General hospital	Glucose	Available	Office hour	Within 1 day	High	Almost none	Almost none
2-4	30,000	Mobile phone	Hospital	Glucose	Not available	Office hour	Within 1 day	High	Rare	Rare
3-1	10,000	Internet	Hospital	Comprehensive	Not available	24 h	Within 1 day	Low	Rare	Almost none
3-2	50,000	Internet	Hospital	Glucose	Available	Office hour	Within 3 days	Low	Almost none	Almost none
3-3	10,000	Mobile phone	Hospital	Comprehensive	Available	24 h	Within 3 days	High	Almost none	Rare
3-4	50,000	Mobile phone	Clinic	Glucose	Available	24 h	Within 1 day	Low	Rare	Rare
4-1	10,000	Internet	Clinic	Comprehensive	Available	Office hour	Within 1 day	High	Rare	Almost none
4-2	50,000	Internet	General hospital	Comprehensive	Not available	Office hour	Within 3 days	High	Almost none	Rare
4-3	10,000	Mobile phone	Clinic	Comprehensive	Not available	Office hour	Within 3 days	Low	Almost none	Rare
4-4	50,000	Mobile phone	General hospital	Comprehensive	Not available	24 h	Within 3 days	High	Rare	Almost none

[a]Korean Won.

[b]General hospital: hospitals with more than 100 beds and specialty care in internal medicine, general surgery, pediatrics, obstetrics and gynecology, neuropsychiatry, anesthesiology, diagnostic radiology, pathology, and dentistry; Hospital: hospitals with more than 30 beds; Clinics: physician practices.

Appendix 2. Random Utility Model

In the random utility model, U_{ij}, the indirect utility gained when a consumer *i* purchases the service *j*, is defined by the deterministic term V_{ij} and the stochastic term e_{ij} as presented in equation (1). The stochastic term of the logit model used in this study is assumed to be a type I extreme value distribution, which is independent and identically distributed. The model also assumes independence from irrelevant alternatives, which implies that an individual is allowed to choose an alternative among more than two choices without being affected by any unchosen alternative.

$$U_{ij} = V_{ij} + e_{ij} = \beta X_{ij} + e_{ij} \tag{1}$$

In this study, we used the rank-ordered logit model to analyze respondents' responses to the survey. When a respondent ranks *J* alternatives from 1 to *J*, the probability of each alternative to be chosen is defined as in equation (2) based on the rank-ordered logit model.

$$\begin{aligned} &\text{Prob}(\textit{ranking } r_1, \ldots, r_J) \\ &= \text{Prob}[U(r_1), \ldots > U(r_J)] \\ &= \frac{e^{V_{r1}}}{\sum_{j=r_1,\ldots,r_J} e^{V_j}} \cdots \frac{e^{V_{rJ-1}}}{\sum_{j=r_{J-1},r_J} e^{V_j}} = \prod_{h=1}^{J-1} \frac{e^{V_h}}{\sum_{m=h}^{J} e^{V_m}} \end{aligned} \tag{2}$$

Additionally, assuming that a total of *N* choice probability exists, the log-likelihood function necessary for maximum likelihood estimation of β can be drawn out as in the equation (3):

$$\ln L(\beta) = \sum_{i=1}^{N} \ln \left[\prod_{h=1}^{J-1} \frac{e^{V_h}}{\sum_{m=h}^{J} e^{V_m}} \right] \tag{3}$$