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Survey on the willingness to pay for tele-health consultation

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ABSTRACT

Background: We previously conducted a survey on users of tele-health consultations system to investigate their willingness to pay (WTP). To assess the economic value of the tele-health system, we need to investigate the demand and value of the tele-health in another way. Therefore, the purpose of this study is to submit basic information to create a sustainable business model and to investigate the economic value of the tele-health consultation system.

Methods: The 480 respondents were instructed to assume an environment where a tele-health consultation system is implemented in a region with no prior experience with such a service. This study adopted a Contingent Valuation Method to measure the demand and value of tele-health. A WTP fee for using the tele-health consultation system for 10 min was calculated using a Double-Bounded Dichotomous Choice and a Random Utility Logit Model.

Results: The median and average amount of the WTP fee for using the tele-health consultation system for 10 min was ¥ 367 (US$ 3.30) and ¥ 495 (US$ 4.40) respectively. Further analysis indicates that the WTP fee tends to be higher when a certain factor is present, namely, intention to use the service.

Conclusion: To gather basic information concerning the economic value of the tele-health consultation system, we clarified the appropriate WTP fee and the factors leading to a higher WTP fee. In future research, we will conduct follow-up research and consider adding more information concerning the advantages and limitations of implementing remote health consulting to build a clearer scenario.

Introduction

To maintain and promote the health of citizens in Japan, cooperation between the medical field, the public health sector, and welfare departments is crucial. The demand for a tele-health consultation system that utilizes next generation network services such as optical fiber and information and communication technology has increased in recent times. However, not much consideration has been given to the effectiveness of a tele-health consultation system from clinical, infrastructure, or economic perspectives.

We previously developed a tele-health consultation system that combines a sphygmomanometer with a television conference system. These systems were installed in pharmacies and tele-health consultation rooms at Hokkaido University [1,2].

Tele-health consultation rooms were set up in five specific pharmacies: one in a rural area, two in suburban areas, and two in an urban area. Nurses and public health nurses with more than five years of clinical experience were assigned as consultants. These consultants offer assistance with the tele-health consultation but do not practice medicine, recommending that clients visit medical institutions if medial intervention is required. Fig. 1 presents a flow-chart of the tele-health consultation system.

Approximately 430 consultations have been completed by the tele-health consultation system in the four years since its inception in March 2010. Of these consultations, 19% were classified as medical problems and these patients were referred to a medical institution.

Concerning the level of satisfaction with the consultation, 50% of users were “very satisfied” and 40% were “moderately satisfied” [3].

As most tele-medicine systems are funded by public subsidies, many of the systems are terminated once the subsidies cease. Therefore, to continue the tele-health consultation system, both an initial investment and the payment of running expenses are required. While subsidies could fund the initial investment, ongoing operational expenses for the day-to-day management of

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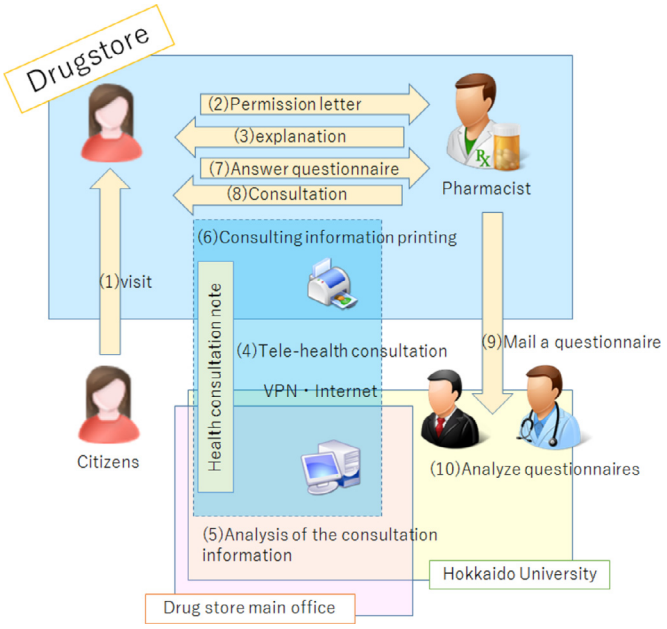

Fig. 1. Tele-health consultation system flow.

the operation need to be covered. Our research funds currently fund our tele-health consultation system, allowing us to perform these experiments. However, our ongoing activities will need to be supported by an additional revenue source. Tsuji et al. reported on the economic viability of home health management systems [4–8]. However, no research has been conducted on the economic viability of a tele-health consultation system.

To ensure the continuous operation of our tele-health system, we need to ascertain the system's demand and value. In a past study, we conducted a survey on the willingness to pay (WTP) for the services among the users and attained an average of ¥ 350 (US$ 3.10). However, the sample size was deemed too small [9].

The purpose of this study is to gather basic information to assist in creating a sustainable business model and to investigate the economic value of our tele-health consultation system.

Methods

Data and participants

By applying "The Guideline on CVM application" [10] from the Japanese Ministry of Land, Infrastructure, Transport and Tourism, we calculated that a sample size of 356 data points would attain a 95% accuracy and ± 5% credibility for Hokkaido prefecture. Despite online surveys' disadvantage of having potentially skewed sample populations, these types of surveys have many advantages, such as their feasibility to attain sufficient sample sizes, lower costs than face-to-face interviewing methods, and being less time-consuming than other survey methods. Considering these advantages, we adopted an online survey, setting the sample population base as residents of Hokkaido. We asked the internet research company Rakuten Research Ltd. to conduct the online survey. The company has 87,236 registered monitors in Hokkaido prefecture (Table 1).

We adjusted the distributions for age and region to reduce bias [11,12]. Next, we categorized the monitors into five age groups; "below 29 years old," "30s," "40s," "50s," and "60 years old and above." Concerning regions, we categorized the monitors into three groups; "Sapporo city," "Hub cities with a population of 50,000 residents and more (Hakodate city, Otaru city, and Asahikawa city, among others)," and "Provincial cities with a population of less than 50,000 residents (Yubari city, Abashiri city, Rumoi city, and Wakkanai city, among others)." Moreover, we screened each group to even the sample size. We assumed a 100% collection and an 80% valid response rate and set the sample size at 480. The survey period was set for October 13–17, 2011.

Table 1
Gender and age of surveyed monitor.

Age	Male	%	Female	%
29-	6357	7.26%	7524	8.60%
30-	13,761	15.73%	17,782	20.32%
40-	13,590	15.53%	12,152	13.89%
50-	7381	8.43%	4136	4.73%
60-	3323	3.80%	1230	1.41%
	44,412	50.75%	42,824	48.94%

Table 2
Design of suggested fees.

1st. suggested fees	High suggested fees	Low suggested fees
300 JPY (2.7USD)	500JPY (4.5USD)	100JPY (0.9USD)
500JPY (4.5USD)	700JPY (6.3USD)	300JPY (2.7USD)
700JPY (6.3USD)	900JPY (8.0USD)	500JPY (4.5USD)
900JPY (8.0USD)	1,200JPY (10.7USD)	700JPY (6.3USD)

Questionnaire

The chosen respondents were residents that have never used a tele-health consultation system and therefore we needed to explain the system and the hypothetical situation to them. We explained that tele-health consultations are conducted by nurses and do not include medical treatment. We then described the "current status of operation," the "advantages and disadvantages of the tele-health consultation," and "alternative services available and their costs." The hypothetical situation assumed that we introduced the system in regions where tele-health consultation systems did not exist. We created a scenario to match this, which included visual aids such as snapshots of users receiving consultations.

After explaining these circumstances, we asked respondents for a WTP amount for using the tele-health consulting system for ten minutes, applying Double-Bounded Dichotomous Choice. For the fee range, we provided four patterns of suggested fees and set the maximum at ¥ 1200 JPY (US$ 10.70), as shown in Table 2.

To ensure that we received valid answers concerning the WTP for the tele-health consulting system, we asked those who answered each question with "not willing to pay" to explain their answer choice using the following options:

(1) I would pay if the consultation fee was cheaper.
(2) I am satisfied with this health consultation service.
(3) I do not find enough monetary value in this system.
(4) I consider this is to be a service that should be covered by taxes and social security.
(5) I cannot respond with this limited amount of information.

A respondent answer using option 1, 2, or 3 was judged to be an opinion on the WTP for remote health consultations and these were included as valid answers. Answering option 4 was judged as expressing an objection to the idea of paying for the health consultation but not to the concept of a remote health consultation. For that reason, we included this as a "protest response."

Answering with option 5 was judged as not fully understanding the question. For that reason, and to avoid any misanalysis, we included this as a "protest response" as well. After these questions, we asked some open-ended questions to confirm the consistency of the Dichotomous-Choice (Yes or No) answers.

This online survey assumes that the survey period ends when the requisite number of responses have been collected. Therefore,

Table 3
Influences on the WTP.

Factors		Expected influences
Age	+	Problem for health will increase with age
Sex	±	
Household size	−	When the household size increases, less income per capita
Household composition	±	WTP is higher if the respondents have children and the elderly
Resident area	+	If it is not good access to medical institutions, WTP is higher
Access to medical institution	+	If it is good access to medical institutions, WTP is smaller
Annual income	+	People of higher annual income presents high WTP
Number of clinic visits	±	People more times to go to the hospital, because they don't feel the usefulness of this system, presents a low WTP
Use intent	+	People who have intention of use presents a high WTP.
Awareness	+	People who have high awareness about this system presents a high WTP

the response ratio is 100% and there will not be any "unanswered" questions. Personal information questions were included in the questionnaire to analyze influential factors on the WTP. There are nine of these questions: "sex," "age," "number of members per household," "annual income," "frequency of visits to medical institutions," "accessibility to remote health consultation systems," and "residence." We also included "awareness of the system" and "willingness-to-use."

Estimating WTP

To estimate the WTP, we employed a Random Utility Logit Model and calculated the average and median WTP. We assumed that the probability function (acceptance probability) Pr (Yes) varies to a lesser degree as the sum increases and follows the logit model.

Furthermore, we estimated parameters α and β using a maximum likelihood method and calculate the demand curve.

The median of WTP is set at (Pr [Yes] = 0.5), where the acceptance probability of the demand curve halves, indicating the price that half of the respondents agree upon. The average WTP equals the integral of the bottom area of the demand curve. Multiplying the average by the number of households determines the total benefit. There are different opinions on whether the median or average WTP are more appropriate [12]. The median, to some degree, remains uninfluenced by the probability function, whereas the average is strongly affected by the function. Therefore, the median is arguably more stable than the average. For the benefit estimates, however, the average is more appropriate. Therefore, we calculate both the median and the average.

Factor analysis

To validate the logical suitability of the survey, we included the personal attribute questions and conducted a factor analysis based on the results. We assumed that if the attribute logically fits the WTP, it would have a positive or negative influence on the WTP. We then verified the logical validity of the WTP.

Table 3 shows the factors that are considered to have an influence on the WTP as well as their respective expected impacts.

The factor analysis was conducted by setting the seven influencing attributes as explanatory variables and the WTP as a criterion variable. We then conducted a logistic regression analysis. To estimate the WTP and to perform the logistic regression analysis, we used the software R ver. 2.7.1 and CVM ver. 3.1.

Results

Simple tabulation of the survey

The collection rate of the samples was 100% with a sample size of 480. Table 4 shows the grand total of the survey.

Table 4
Grand total of the survey.

	Category	*n*	Rate
Age	≦29 y	96	20.0%
	≧30 y	96	20.0%
	≧40 y	96	20.0%
	≧50 y	96	20.0%
	≧60 y	96	20.0%
Sex	Male	240	50.0%
	Female	240	50.0%
Household number	1	87	18.2%
	2	176	36.8%
	3	132	27.6%
	4 or more	83	17.4%
Household composition	Children	82	17.2%
	Elderly	50	10.4%
Annual income	≦2.99 million JPY (≦26,722USD)	216	45.0%
	3.00–4.99 million JPY (26,811–44,596USD)	113	23.5%
	5.00–7.49 million JPY (44,685–66,938USD)	97	20.2%
	≧7.50 million JPY (≧67,028USD)	54	11.3%
Resident area	Sapporo city	160	33.3%
	Major urban area	160	33.3%
	Local region	160	33.3%
Access to medical institution	<10 min	175	36.5%
	10–30 min	239	49.8%
	≧30 min	66	13.8%
Number of clinic visits	No visits	118	24.6%
	Once half a year	159	33.1%
	Once 3 months	95	19.8%
	Once a month	64	13.3%
	More than once a month	44	9.2%
Use intent	Strongly agree, Agree	220	45.8%
	Disagree, Strongly disagree	260	54.2%
Awareness	I know	43	9.0%
	I have heard of it	117	24.4%
	I don't know	320	66.7%

As the age and geographic distributions were equalized, we had to adjust the sample numbers for the survey. Approximately half of the respondents reported an annual income of ¥ 2.99 million (US$ 26,722) or less. As the income level increased, the weight in the sample base declined. There were only a few single person households, with many households consisting of two or three members. Regarding the frequency of visiting medical institutions, most answered "none" or "once semi-annually," indicating that many of the respondents are relatively healthy. Regarding accessibility to medical institutions, 90% answered "less than 30 min." Approximately half of the respondents answered positively to "willingness-to-use" regarding the system. Lastly, less than 10% of the respondents answered that they were very familiar with our remote system while about two thirds of the sample indicated that they did not know of it at all.

Table 5
The pattern of responses.

1st suggested fee	The pattern of responses			
	Yes–Yes	Yes–No	No–Yes	No–No
300JPY (2.7USD)	28	14	41	23
500JPY (4.5USD)	20	16	27	34
700JPY (6.3USD)	19	11	20	42
900JPY (8.0USD)	15	9	7	55

Estimation of the WTP

We collected 480 questionnaires. However, after removing 97 non-logical or protest answers, there were 383 questionnaires available for the analysis (Ratio of valid response: 79.8%). Due to the nature of online surveys, there were no invalid responses.

Table 5 shows the pattern of responses. It can be seen that the number of respondents who object to paying increases as the suggested price increases.

It can also be noted that the proportion of respondents who answered "Yes" to the first suggested price and then "No" to the second price was relatively small. Therefore, we conclude that there are no occurrences of downward bias.

Factor analysis

To analyze the factors, we use the same sample base (383) used for the WTP estimation. The correlation between the factors is shown in Table 6. Low correlations are recognized between "WTP," "number per household," and "age," as well as between "number per household" and "household with children or childless." Other than these, none of the factors have high correlations.

Table 7 shows the outcome of the logistic regression analysis. In this survey, a significant difference is observed in "willingness-to-use" at the 1% level.

Discussion

Factors that influence WTP

The WTP survey on the citizens of Hokkaido produced a median and average WTP amounts estimated at ¥ 367 (US$ 3.30) and ¥ 495 (US$ 4.40) respectively. The results of the logistic regression analysis indicate "willingness-to-use" impacts at a 1% level. We expected a higher demand for a tele-health consultation system in provincial areas. However, no such phenomenon was recognized. Below, we will review three factors; "annual income level," "willingness-to-use," and "childless or not."

Annual income level

In previous research, "annual income" had the strongest impact on the WTP. Kaambwa et al. measured WTP for the use of self-managing devices for hypertension and reported that WTP was associated with high household income [13].

This is not confirmed by our survey. Household income was positively associated with WTP, indicating that a higher annual income indicates a higher WTP.

As demonstrated in Table 8, the median WTP amount increases by ¥ 147 (US$ 1.30) when a household's annual income is greater than ¥ 7.5 million (US$ 7028).

Willingness-to-use

The WTP is also higher when the respondents demonstrate a willingness-to-use. The survey's outcome reveals that those with high willingness-to-use evaluate this system higher than those not displaying this factor. This outcome confirms our assumptions and validates the logic. As demonstrated in Table 9, The median of the WTP for those with a willingness-to-use (¥ 581/US$ 5.20) is more than double that of those who do not have a willingness-to-use (¥ 370/US$ 3.30).

These responses are in line with our expectations, leading us to conclude that a few respondents may have misread the survey or answered without reading it. In a previous study, Kaga et al. calculated the WTP by investigating the availability of digital broadcast services using television for elderly people's telecare and the age group is WTP in the elderly group, which is the middle age group. And higher than WTP for young people [14]. In the case of the proposed telecare system for the elderly, the use intention is considered to be higher in the elderly group and therefore the result of this study is considered to show a reasonable tendency.

Limitations

In this survey, 99 protest bids were received among the original 477 respondents (protest bids rate 20.6%). The questions set as protest bids are the following two: question 4; "I think this is a service that should be covered by taxes and social security" (34 cases) and question 5; "I cannot respond with this limited amount of information" (65 cases).

The reason for the protest answers to question 4 may be that for the "health consultation service," the idea that the residents "pay for it and use money" is not wide spread. Health consultation services are often provided as "added value" provided together with "main services" and health consultations themselves are often conducted free of charge. Therefore, it is considered that the residents who were not actually using it could not imagine "paying for it and using their money." Concerning question 5, it may be that the explanation of the scenario was not sufficient, leading to the protest answers.

In this study, respondents explained the "advantages/limitation points of introducing remote health consultation" in a scenario,

Table 6
Coefficient of correlation between each factors.

	WTP	Awareness	Use intent	Household number	Children	Elderly	Annual income	Number of clinic visits	Access	Resident area	Sex	Age
WTP	1	0.15	0.29	0.05	−0.01	0.00	0.17	0.14	0.12	0.09	0.05	0.30
Awareness		1	0.07	0.08	−0.04	−0.07	0.12	−0.05	0.05	−0.01	0.05	0.15
Use intent			1	0.00	−0.02	−0.09	−0.08	0.06	0.07	0.01	−0.02	−0.03
Household number				1	−0.38	−0.16	0.06	−0.03	−0.07	0.05	0.01	−0.01
Children					1	0.09	0.07	−0.10	0.14	−0.05	0.01	−0.06
Elderly						1	−0.03	0.01	0.00	−0.10	0.03	−0.07
Annual income							1	−0.01	−0.02	−0.04	0.04	0.00
Number of clinic visits								1	−0.04	−0.05	−0.13	0.03
Access									1	−0.09	0.03	−0.06
Resident area										1	0.01	−0.04
Sex											1	0.03
Age												1

Table 7
Results of logistic regression analysis.

	variable	Coefficient	SEs	*p*-value
Intercept	Constant	1.01	0.63	0.11
Age		−0.02	0.01	0.86
Sex	Male	0		
	Female	−0.29	0.23	0.19
Annual income	Under 3.0million JPY(26,811USD)	0		
	3.0–4.99 million JPY (26,811–44,596USD)	0.18	0.29	0.54
	5.0–7.49 million JPY (44,685–66,938USD)	−0.11	0.29	0.70
	Over 7.5million JPY (≧67,028USD)	−0.19	0.36	0.60
Household number	1	0		
	2	0.20	0.30	0.50
	Over 3	0.21	0.31	0.51
Household composition	Children	0.37	0.33	0.27
	Elderly	−0.02	0.37	0.97
Resident area	Sapporo city	0		
	Major urban city	0.02	0.26	0.95
	Local region	0.11	0.26	0.69
Access to medical institution	Under 10 min	0		
	10–30 min	0.23	0.24	0.33
	Over30 min	0.30	0.34	0.39
Number of clinic visits	No visits	0		
	Less than once a month	0.26	0.27	0.33
	More than once a month	−0.29	0.32	0.37
Willingness to Use	Strongly agree, Agree	0		
	Disagree, Strongly disagree	−1.75	0.37	0.00 ***
Awareness	I know	0		
	I have heard of it	−0.51	0.43	0.23
	I don't know	−0.09	0.37	0.81

Table 8
WTP by annual income.

	Under 7.5 million JPY (67,028USD)	Over 7.5 million JPY (67,028USD)
n	335	46
Median	353JPY (3.2USD)	500JPY (4.5USD)
Average	480JPY (4.3USD)	606JPY (5.4USD)

Table 9
WTP by use intent.

	Willingness to use	Don't have willingness to use
n	190	191
Median	581JPY (5.2USD)	211JPY (1.9USD)
Average	653JPY (5.8USD)	346JPY (3.1USD)

because remote health consultation cannot actually be used. However, the explanation was insufficient and difficult to understand, as an image point is considered to be the cause. In the future, when conducting follow-up surveys, it is necessary to investigate further the benefits and limitations of introducing remote health consultations and create clearer scenarios.

Donelan et al. worked to calculate the WTP for various community-based care programs, including various telecare programs that help older people to receive medical care while staying at home. Their findings indicate that family support is important for programs for the elderly [15]. Although the service in this study is not a service specializing in care for the elderly, it is necessary to provide information on family support when it is assumed that the elderly will use it. Therefore, in future research, it may be necessary to classify the content of the user's consultation before conducting the survey.

How can decision-makers use these results?

The purpose of this research is to provide the basic data for constructing a business model to raise income for a sustainable tele-health system and various characteristics of the respondents with high WTP constitute important information for decision makers. The median value of WTP for those who are willing to use this system is ¥ 581 (US$ 5.20) and we recommend that decision makers consider pricing with reference to this amount. Moreover, it is also recommended to set the main target of this system as "a family with children," because families with children have a greater demand for distance health consultations.

Conclusions

The objective of this research was to identify a demand for and an economic value of a tele-health consultation system for the residents of Hokkaido using an online survey to estimate the WTP for the use of the system. The results showed the WTP to have a median of ¥ 367 (US$ 3.30) and an average of ¥ 495 (US$ 4.40). The factor analysis showed that the following the factor have a positive impact on the WTP: "willing to use."

CRediT authorship contribution statement

Teppei Suzuki: Conceptualization, Data curation, Formal analysis, Investigation, Methodology, Validation. **Tamotsu Abe:** Conceptualization, Data curation, Formal analysis, Investigation, Methodology, Validation. **Shintaro Tsuji:** Writing - review & editing, Validation. **Tomoko Shimoda:** Writing - review & editing, Validation. **Sadako Yoshimura:** Writing - review & editing, Validation. **Katsuhiko Ogasawara:** Supervision, Validation.

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Author statements

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None.

Competing interests

None declared.

Ethical approval

This study was approved in writing at the local ethics committee of the Graduate School of Health Sciences at Hokkaido University. All procedures performed in studies involving human participants were in accordance with the ethical standards of Ethics Committee for the Graduate School of Health Sciences at Hokkaido University and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards. Informed consent was obtained from all individual participants included in the study.

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