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Factors that Drive the Adoption of Telemedicine in Older People

Valentina Mancilla Fernández
Faculty of Economy and Management
Universidad Católica del Norte
Antofagasta, Chile
valentina.mancilla@ce.ucn.cl

Patricio Ramírez-Correa
Director of the School of Engineering
Universidad Católica del Norte
Coquimbo, Chile
patricio.ramirez@ucn.cl

Francisco Javier Rondán-Cataluña
Professor of Marketing
Business Administration and Marketing Department
Universidad de Sevilla
Seville, Spain
rondan@us.es

Abstract

Due to the geographical characteristics of Chile, which make it difficult for people to access health services, in addition to the consequences of the global pandemic COVID-19, telemedicine has emerged as a solution to the gaps in access to medical services. This technology requires specific knowledge and skills for using the platforms, which can bring problems for older people. This study seeks to explain the factors that can drive the adoption of telemedicine in the Chilean context, looking to establish a model for the adoption of telemedicine in older people. This proposal is developed with a combination of PLS-SEM and fsQCA to test the relevance of the proposed determinants in adopting this technology and to analyse whether these factors are necessary or sufficient for this behaviour to occur. After the analysis, it was possible to observe through PLS-SEM analysis that Effort Expectancy, Performance Expectancy, Social Influence, and Price affect the intention to use telemedicine. On the other hand, the fsQCA analysis highlighted the importance of Performance Expectancy when adopting telemedicine, with its presence being a necessary condition. Subsequently, the sufficiency analysis supports what was found in the necessary condition analysis. With these results, the study seeks to contribute to the literature on the relationship between the elderly and information technologies through these methodologies and empirical conclusions.

Keywords
Telemedicine, UTAUT, PLS-SEM, QCA, Older people.

1. Introduction

According to the National Telehealth Program carried out by the Ministry of Health of Chile, in the country, "due to its geographical characteristics where distance and access barriers are a critical factor for the attention of the beneficiary population, the incorporation of information and communication technologies is essential. (Narváez et al. 2018). In this challenging scenario, information technologies, specifically the emerging Telemedicine platforms, seem to be helpful in this situation. This ministry also affirms that Telemedicine represents an innovative strategy that allows for optimising specialised human resources, complementing actions and solutions that will enable the beneficiary population to experience a substantial improvement in access to care by the health team, becoming a strategy for

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addressing the gaps in access and opportunity of care, since it allows access to medical care and other health professionals, for those populations that are remote or that have problems with the supply of specialists (Narváez et al. 2018).

On the other hand, in the global context, the COVID-19 pandemic has forced most providers to implement online services in addition to their face-to-face services, resulting in a change in patient care in the health system. (Wosik et al. 2020).

Because of both situations, the adoption of Telemedicine platforms is a phenomenon that has a high level of importance today. Long-distance health appointments are a 21st-century approach that allows most patients to be evaluated efficiently and protects patients and physicians from exposure (Hollander and Carr, 2020). This giant and sudden leap at the technological level can bring problems to a sector of the population: the elderly.

Consultations via Telemedicine generally require patients to have the knowledge and skills to connect to a computer or telephone, operate and test their audio-visual equipment, and communicate efficiently. Many older people may be unable to do this due to abilities or inexperience with technology (Lam et al., 2020).

In the Chilean context, there are studies regarding the topic of Telemedicine seen from different perspectives; be it an ethical analysis (Echeverría B. et al., 2021), suggestions for efficient implementation protocols (Mertens Folch, 2021), and the challenges that it can bring to the Chilean reality (Mendoza-Alonzo, 2021). When carrying out this search in the literature, no study was found that analyses the adoption of this type of technology in the country's older citizens.

To finish the introduction of this research, it is worth briefly highlighting the methodologies used; PLS-SEM and fsQCA. PLS-SEM is a modelling method that allows quantitatively estimating the cause-effect relationship of the elements that compose it through the variance between them (Ihtiyar, A. and Aras, O. N, 22020) On the other hand, fsQCA is a mixed methodology that seeks to obtain the condition configurations of a data set, aiming to find logical connections between the combinations of said conditions and an event resulting from them. This methodology delivers a list of combinations of conditions that can cause the studied result. (Martín, M. G. Castaño, M. and Picazo, M. T, 2021).

Using both methodologies in the investigated data is to conduct a more exhaustive and in-depth analysis of the phenomenon. Firstly, with PLS-SEM we seek to explore the effect of the factors to be investigated in the adoption of telemedicine, to delve with fsQCA into the possible variables that are sufficient or necessary for the result. (Rasoolimanesh, 2021).

The structure of this research is in the exclusive search to explain the adoption of telemedicine platforms in the elderly population in Chile through a proposed model, combining the methodologies of PLS-SEM and fsQCA.

1.1 Objectives

The main objective of the research is to explain the adoption of telemedicine services in older people in Chile through a mixed approach based on an information technology acceptance model. To achieve this objective, three specific goals are sought: To establish a model for the adoption of telemedicine for the elderly, to empirically validate the said model, and finally, to analyse the need and sufficiency of the determinants of the acceptance of telemedicine in the elderly based on the validated model.

2. Literature Review

Firstly, the most crucial concept of the study is Telemedicine. The current idea of Telemedicine refers to health services delivered by doctors, especially activity monitoring and clinical diagnosis through technology (Doraiswamy, 2020). On the other hand, the American Telemedicine Association (ATA) details stating that “Telemedicine is the exchange of medical information between two actors who are not located in the same space, which can be doctor/patient or doctor/doctor; through electronic communications, through any means of electronic communication, to improve the health status of a patient. It includes various applications and services that use video conferencing, email, smartphones, wireless communications, and other telecommunications technology”. (Barrios, 2018).

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On the other hand, the relationship the study seeks to investigate is about the adoption of telemedicine in older people. According to previous research carried out on telemedicine, the results have varied regardless of the methodologies used. While there are studies which observe that there is no apparent difference regarding the preference for telemedicine between young people and the elderly (Orellana Echeverría and Villacrés Velasco, 2021), there are others that observe the existence of different barriers from the point of view of older people when creating an intention to use this technology (Cimperman et al. 2016; Loza et al. 2021).

To be able to study this relationship, a research model was created. The research model proposed for the study is based on the Unified Theory of Acceptance of Technology Use (UTAUT), presented by Venkatesh (2003), and the Price construct. This is due to past studies that had conclusive results when applying this model or some variation of it (Cimperman et al., 2016; Huang and Lin, 2014; Napitupulu et al., 2021; Tsai, 2014), so it is expected that at least part of its variables or constructs, in general, are significant in the Chilean context. Figure 1 presents the research model proposed for this study.

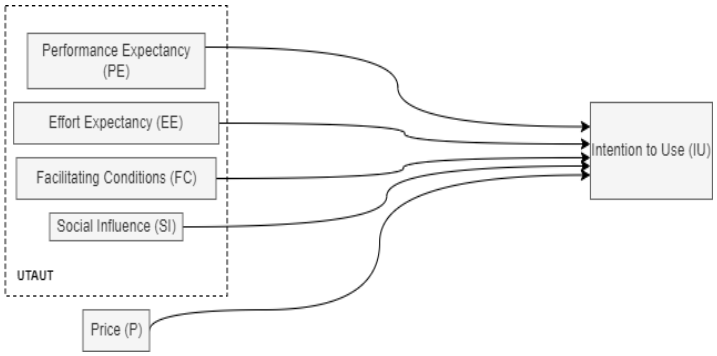

Figure 1. Proposed research model

Based on previous literature, the following hypotheses were proposed:

H1: An increase in Performance Expectancy will increase the Intention to Use Telemedicine platforms in older people.
H2: An increase in the Expectancy of Effort will increase the Intention to Use Telemedicine platforms in older people
H3: An increase in the number of Facilitating Conditions will increase the Intention to Use Telemedicine platforms in older people.
H4: An increase in Social Influence will increase the Intention to Use Telemedicine platforms in older people.
H5: The Price is significant when explaining the Intention to Use Telemedicine platforms in older people.
H6: An increase in the Price will increase the Intention to Use Telemedicine platforms in older people.
H7: The seven dimensions of the proposed model are not necessary to influence the Intention to Use Telemedicine platforms in older people.
H8: The seven dimensions of the model are insufficient to influence the Intention to Use Telemedicine platforms in older people.

3. Methods

The methodology of the present research consists of the exploratory type, through the previously proposed model, with a combination of the methods of structural equations (SEM) and a comparative qualitative analysis (QCA), specifically PLS-SEM and QCA of diffuse sets (fsQCA). Therefore, quantitative, and qualitative methods will be used. For the application of PLS-SEM, the SmartPLS3 software was used, while for fsQCA, the FSQCA3.0 software was used.

4. Data Collection

Initially, a survey was created to perform on older people who have used telemedicine previously in Chile, in which their data were collected through physical and telephone calls. The inclusion criteria were that the person is 60 years old or older and has used a telemedicine platform before. In contrast, the exclusion criteria would only be that the person has cognitive problems since it can affect the poll result.

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The total sample of the study was 103 people, and after removing the data that did not enter the study due to their age being under 60 years old, the test sample was of 100 data to be analysed.

The survey was evaluated on a Likert scale from 1 to 5, where 1 is the minimum score, and five is the maximum (Table 1).

Table 1. Measurement items

Constructs	Items		Source
Performance Expectancy (PE)	PE1	I would find telemedicine in my life useful	Cimperman et al.(2016), Napitupulu et al.(2021), Venkatesh et al.(2012).
	PE2	Telemedicine use could increase my ability to manage my health.	
	PE3	Telemedicine could improve my quality of life.	
	PE4	In general, I find that telemedicine can be beneficial.	
Effort Expectancy (EE)	EE1	I find that the use of telemedicine would be simple.	Cimperman et al.(2016), Napitupulu et al.(2021)
	EE2	I find that telemedicine would be easily understandable to me.	
Facilitating conditions (FC)	FC1	I have the necessary resources to use telemedicine.	Cimperman et al.(2016), Napitupulu et al.(2021), Venkatesh et al.(2012)
	FC2	I have the necessary knowledge to use telemedicine.	
Social influence (SI)	SI1	People who influence my behaviour would think that I must use telemedicine.	Cimperman et al.(2016), Napitupulu et al.(2021), Venkatesh et al.(2012)
	SI2	People who I value their opinion would prefer that I use telemedicine.	
Price (P)	P1	The price of telemedicine is reasonable.	Venkatesh et al.(2012)
	P2	Telemedicine service is worth the money that it costs.	
	P3	At the current price, telemedicine delivers a good value.	
Intention to Use (IU)	IU1	Assuming that I have telemedicine access, I intend to use it.	Cimperman et al.(2016)
	IU2	I intend to use a telemedicine platform in the future.	
	IU3	I predict I will use telemedicine platforms regularly in the future.	
	IU4	Given that I can access a telemedicine platform, I would use the service.	

5. Results and Discussion

5.1 PLS-SEM Analysis results

Based on the literature on the subject (Hair, 2017), the evaluation of the measurement model and the structural model is carried out. To obtain the parameters to be analysed, the PLS Algorithm processes were carried out in the SmartPLS3 program, in addition to a Bootstrap procedure using 5000 subsamples.

For the measurement model analysis, the latent variables were evaluated according to the reliability of internal consistency, reliability of the indicators, convergent validity, and discriminant validity.

For internal consistency reliability, Cronbach's Alpha and Composite Reliability were evaluated, most of which, except for the Facilitating Conditions, had values more significant than the limit of 0.7, which suggests an acceptable internal consistency (Table 2). Then, to check the reliability of the indicators, the external loads of the constructs were analysed, all of which are greater than the limit of 0.708 established in the literature (Table 3), which indicates the

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optimal reliability of variables. To evaluate the convergent validity of the variables, the average variance extracted (AVE) was used, which in all the constructs is greater than the established limit of 0.5, which means that on average, each latent construct explains more than 50% of the variance of the observed variables and an acceptable convergent validity of the constructs is suggested (Table 2).

Table 2. Parameters for internal consistency and convergent validity

Independent Variable	Cronbach's Alpha	Composite Reliability	AVE
Facilitating Conditions (FC)	0,626	0,840	0,724
Effort Expectancy (EE)	0,849	0,930	0,868
Performance Expectancy (ER)	0,945	0,960	0,858
Social Influence (IS)	0,799	0,907	0,830
Price (P)	0,909	0,943	0,847
Intention to Use (IU)	0,914	0,940	0,796

Table 3. Outer loadings of construct items

Items	Facilitating Conditions	Effort Expectancy	Performance Expectancy	Social Influence	Intention to Use	Price
EE1		0,923				
EE2		0,940				
PE1			0,915			
PE2			0,900			
PE3			0,942			
PE4			0,947			
FC1	0,805					
FC2	0,894					
SI1				0,884		
SI2				0,937		
IU1					0,899	
IU2					0,923	
IU3					0,832	
IU4					0,911	
P1						0,865
P2						0,951
P3						0,942

Finally, the discriminant validity was evaluated through the Fornell-Larcker and HTMT criteria. Regarding the first one, the square root of the AVE of each construct is greater than the correlation with other constructs or variables. At the same time, in the HTMT, the values obtained do not exceed the upper limit of 1 in all the combinations of the constructs. Or variables (Table 4). Due to this, it can be suggested that there is discriminant validity in the variables and items of the investigated model, which means that the constructs are valid and reliable.

Once the reliability and validity parameters of the model are confirmed, you can proceed to analyse the structural model.

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Table 4. Discriminant validity assessment

Fornell-Larcker

Constructs	**FC**	**EE**	**PE**	**SI**	**IU**	**P**
1.FC	0,851					
2.EE	0,608	0,932				
3.PE	0,278	0,568	0,926			
4.SI	0,111	0,098	0,452	0,911		
5.IU	0,252	0,526	0,834	0,542	0,892	
6.P	0,234	0,369	0,550	0,423	0,603	0,920

HTMT

FC	**EE**	**PE**	**SI**	**IU**	**P**
0,803					
0,362	0,630				
0,168	0,146	0,510			
0,328	0,595	0,897	0,624		
0,301	0,421	0,586	0,494	0,654	

For the evaluation of the structural model, the R^2, VIF, SRMR, and Q^2, the coefficients of the constructs and their significance were analysed.

Following the steps for evaluating the structural model proposed in the literature (Hair, 2017), the first step is to assess the collinearity of the model. Table 5 shows that all the VIF values are below the limit of 5, indicating no multicollinearity problems in the model variables.

Then, we analyse the coefficients of the relationships between the constructs and their p-value. According to what is presented in Table 6, all relationships are statistically significant ($p<0.05$) except for the Facilitating Conditions ($p= 0.407$), which means that this variable is not relevant in older people in the situation of adopting telemedicine. All other constructs positively affect the adoption of said technology. According to its coefficients in Figure 2, Performance Expectancy is what affects the most in the moment of adopting telemedicine. These findings support hypotheses 1 through 6, except for hypothesis number 3, which relates to Facilitating Conditions.

Next, R^2 is evaluated. In the case of this research, the R^2 is 0.758, meaning that the model variables explain 75.8% of the variation in the Intention to use telemedicine in an older person (Table 5).

Subsequently, the model is evaluated by examining the predictive relevance value Q^2. When a model has predictive relevance, it accurately predicts data not used in estimating the model. In the case of this study, a Q^2 of 0.59 was obtained in the Intention to Use, which means that it has an acceptable predictive relevance (Table 5). Finally, to check the fit of the model, an evaluation of the effectiveness of the standardised root mean square residue (SRMR) was conducted. In this research, the SRMR is 0.061, thus confirming the general fit of the path model analysed.

Table 5. Structural model evaluation

Independent Variables	**VIF(IU)**	**R^2**	**Q^2**	**SRMR**
Facilitating Conditions (FC)	1,636			
Effort Expectancy (EE)	2,359			
Performance Expectancy (PE)	2,183			
Social Influence (SI)	1,434			
Intention to Use (IU)		0,758	0,590	
Price (P)	1,548			
				0,061

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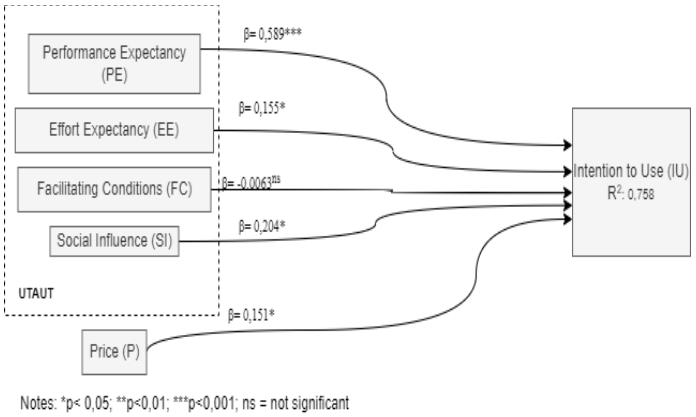

Figure 2. PLS-SEM results

Table 6. Coefficients and p-value in the structural model

Hypothesised Path	β	Confidence interval 2,5%	Confidence interval 97,5%	P-value	Has an effect?
FC->IU	-0,063	-0,205	0,098	0,407	NO
EE->IU	0,155	-0,003	0,296	0,049	YES
PE->IU	0,589	0,416	0,754	0,000	YES
SI->IU	0,204	0,041	0,378	0,020	YES
P->IU	0,151	0,003	0,293	0,043	YES

5.2 fsQCA Analysis results

For the evaluation of the model through the fsQCA method, data calibration, analysis of necessary conditions, analysis of sufficient conditions, and predictive validity tests were included.

The first and most crucial step in fsQCA analysis is the calibration of variables on fuzzy sets with a continuous range of values from 0 (no membership) to 1 (full membership). In this step, three matters have to be established for the calibration process: the crossover point (0.5), the membership point (0.95) and the non-membership point (0.05).

For the present study, this process was based on the guide by Rasoolimanesh and Ringle (2021), in which calibration is applied to the scores of the latent variables resulting from the PLS-SEM analysis in SMARTPLS3. Said calibration takes the values of 3 (full membership), 0 (crossover point) and -3 (non-membership point). These values have been chosen due to the statistical empirical rule, which assumes that 99.73% of the collected data fall within 3 standard deviations of the set mean in a normal distribution.

Then the analysis of necessary conditions was carried out. For this analysis, the consistency score and the coverage of said condition are calculated. According to Schneider and Wagemann (2010), a condition is considered necessary when its consistency score is equal to or greater than 0.90. The more coverage the condition has, the more empirically relevant it will be considered. To get the most out of the data collected, necessity analysis was performed for both presence and negation of Intention to use.

According to the results obtained, the Performance Expectancy variable is a necessary condition for the adoption of telemedicine with a consistency of 0.91. This finding does not support hypothesis number 7 of the research, which established that no single model variable was necessary to create an intention to use telemedicine platforms. On the other hand, for the negation of intention to use, the negation of Performance Expectancy is a necessary condition, with a consistency of 0.90 (Table 7).

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Table 7. Necessary conditions analysis

Condition	IU (Intention to Use)			~IU (negation of Intention to Use)	
	Consistency	**Coverage**		**Consistency**	**Coverage**
FC	0,827	0,826		0,747	0,704
~FC	0,704	0,747		0,816	0,817
EE	0,843	0,846		0,724	0,685
~EE	0,686	0,725		0,838	0,834
PE	**0,917**	0,914		0,687	0,646
~PE	0,644	0,686		**0,908**	0,912
SI	0,866	0,875		0,699	0,666
~SI	0,670	0,702		0,869	0,859
P	0,842	0,865		0,690	0,669
~P	0,677	0,698		0,860	0,837

Then, the analysis of sufficient conditions was performed. This analysis aims to determine the configurations of variables sufficient for a result through the truth table. For its execution, the present study considered limits for three parameters: frequency of cases, raw consistency, and the PRI score.

For the frequency of cases, it was decided to follow what is recommended by the literature (Fiss, 2011; Pappas, 2021), which indicates that for samples less than 150, the frequency limit can be 2. On the other hand, the limit value for the raw consistency was set at 0.75 (Ragin, 2006) and finally, the PRI score at 0.75, to produce configurations relevant and exclusive to the result to be analysed. (Greckhamer, 2018).

When performing the truth table in fsQCA 3.0, the complex, parsimonious and intermediate solutions are delivered. The intermediate solution was used to report the sufficient conditions in this investigation, which is the best indicated for theoretical interpretations (Fiss, 2007).

Table 8 reports the necessary combinations for the presence of the result. Regarding the presence of Intention to Use, the analysis produced two possible solutions that lead to an intention to use telemedicine by older people. The first solution indicates that if the person has the presence of Facilitating Conditions, a high-Performance Expectancy, and a high Social Influence, it is more likely that he intends to use telemedicine platforms. The second solution indicates the importance of a high-Performance Expectancy, in combination with the influence of acquaintances and perceived positive benefits concerning the price of care, also causes the Intention to use to exist.

Regarding the solution in general, the consistency and the total coverage of the solution are evaluated. In this case, the complete consistency of the solution is 0.980, which exceeds the limit of 0.75 (Pappas, 2021), which means that the subsets present are considered sufficient to obtain the result. On the other hand, the total coverage of the solution is 0.790, which means that both configurations explain 79% of the intention to use telemedicine in older people.

As it was possible to analyse, none of the conditions alone is sufficient to achieve an intention to use, so hypothesis number 8 is supported, which established this.

Table 8. Sufficient conditions analysis for the presence of Intention to Use

Condition	Solution 1	Solution 2
Facilitating Conditions (FC)	●	
Effort Expectancy (EE)		
Performance Expectancy (PE)	●	●
Social Influence (SI)	●	●
Price (P)		●

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Consistency	0,982	0,986
Raw Coverage	0,722	0,746
Unique Coverage	0,044	0,068
Total Consistency of the Solution	0,980	
Total Coverage of the Solution	0,790	
Notes: Black circles indicate the presence, while white circles indicate negation. Blank spaces indicate that it is not relevant. This table is based on the intermediate solution.		

On the other hand, considering fsQCA's ability to deal with asymmetric causality, sufficient conditions for the negation of the result, such as the absence of intention to use telemedicine platforms, were also analysed.

Applying the same parameters, the analysis that resulted in the solution of Table 9 was carried out. What can be highlighted from these solutions is that all have the negation of Performance Expectancy, which means that in most cases where the older person believes that telemedicine will not improve their quality of life in general, they will not be intended to use such technology.

In general, the total consistency of the solution being 0.960 exceeds the minimum of 0.75 and has total coverage of 0.799, which means that the three solutions can explain almost 80% of the negation of telemedicine platforms in older people.

Table 9. Sufficient conditions analysis for the negation of Intention to Use

Condition	**Solution 1**	**Solution 2**	**Solution 3**
Facilitating Conditions (FC)	○		
Effort Expectancy (EE)	○	○	●
Performance Expectancy (PE)	○	○	○
Social Influence (SI)	○	●	○
Price (P)		○	○
Consistency	0,981	0,978	0,972
Raw Coverage	0,685	0,586	0,604
Unique Coverage	0,088	0,043	0,068
Total Consistency of the Solution	0,960		
Total Coverage of the Solution	0,799		
Notes: Black circles indicate the presence, while white circles indicate negation. Blank spaces indicate that it is not relevant. This table is based on the intermediate solution.			

And finally, to know how well the solutions can predict the Intention to Use in additional data, a predictive validity analysis is carried out (Rasoolimanesh and Ringle, 2021; Pappas, 2021). To do so, the sample is divided into two equal parts (subsample one and subsample 2), and the coverage and consistency results are compared. This predictive validity test was carried out for the presence and negation of the Intention to Use telemedicine, in which it can be verified that the values are similar in consistency and coverage (Tables 10 and 11), which means that the results, in general, are reliable and valid.

Table 10. Predictive validity analysis for the presence of Intention to Use

Subsample 1			
Solution	**Raw Cov.**	**Unique Cons.**	**Consistency**
1. PE*SI*P	0,745	0,745	0,992
Solution's Coverage 0,745			
Solution's Consistency 0,992			
Subsample 1 in Subsample 2			
Solution	**Coverage**	**Consistency**	
1. PE*SI*P	0,747	0,981	

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Table 11. Predictive validity analysis for the negation of Intention to Use

Subsample 1			
Solution	**Raw Cov.**	**Unique Cons.**	**Consistency**
1. ~FC*~PE*~SI*~P	0,671	0,118	0,970
2. EE*~PE*~SI*~P	0,589	0,035	0,979
Solution's Coverage 0,707			
Solution's Consistency 0,971			
Subsample 1 in Subsample 2			
Solution	**Coverage**	**Consistency**	
1. ~FC*~PE*~SI*~P	0,645	0,978	
2. EE*~PE*~SI*~P	0,620	0,965	

5.3 Proposed Improvements

Regarding future ideas, it is suggested that other studies could apply the model to a more significant number of people or apply the combination of methodologies to another technology's adoption model, either established (TAM, UTAUT, UTAUT 2) or some model based on them, seeking to explain the behaviour of older people against technology.

6. Conclusion

The objective of the present study was to explain the adoption of telemedicine services in older people in Chile through a model of acceptance of information technologies, combining methodologies that have not been used in the research of this thematic area.

Through the proposed model and thanks to PLS-SEM, it was determined that the factors that may affect older people to create the behaviour of Intention to Use telemedicine are Effort Expectancy when using telemedicine, Performance Expectancy, Social Influence, and the subjective value of the price of the service of these platforms.

On the other hand, according to the analysis of necessary conditions through fsQCA, the importance of Performance Expectancy at the time of adopting telemedicine is highlighted; this means that according to the reality of the sample, we must ensure that the person has the belief that using telemedicine will improve their quality of life in general, resulting in the Intention to Use these platforms in most cases. Finally, according to the results of the sufficient conditions, no exogenous variable is enough by themselves to create the intention of use in older people. Still, all are sufficient in some solutions to reach this result, except for the Effort Expectancy.

One of the contributions of this study is methodological; the fact of being able to investigate older people and telemedicine using a combination of methodologies that can be considered relatively new in the literature of this age group and its interaction with new information technologies can motivate researchers to do more studies of this type in the future. The present investigation delivers an example of the combination of methodologies for its possible replicability.

This research provides an example of applying the combination of PLS-SEM and fsQCA, in which the importance of Effort Expectancy, Performance Expectancy, Social Influence and Price in the Intention to Use Telemedicine in older people is highlighted in general.

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Biography

Valentina Mancilla Fernández is a graduate of Information and Management Control Engineering from Universidad Católica del Norte, Antofagasta, Chile, who is currently completing her master's degree in Information Management and Technology from the same institution.

Patricio Ramírez-Correa is a professor and researcher in Information Systems and Director of the School of Engineering at the Universidad Católica del Norte, Coquimbo, Chile. He earned his master's degree in Management with a mention in Control at the Pontificia Universidad Católica de Valparaíso, Chile, and a PhD in Economy and Business Administration from the Universidad de Sevilla in Spain. He holds an h index of 23 and more than 2000 citations to his publications, associate editor in Q1 journals and director of research projects with national and international funds.

Francisco Javier Rondán-Cataluña is a professor and researcher in Commercialization and Market Research at the Universidad de Sevilla, Spain and he holds a PhD in Marketing from the same University. He has an h index of 30 and more than 3100 citations to his publications.

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