UTCC International Journal of Business and Economics (UTCC IJBE)
Volume 12 Number 1, April 2020

ARTIFICIAL INTELLIGENCE HEALTHCARE: AN EMPIRICAL STUDY ON USERS' ATTITUDE AND INTENTION TO USE TOWARD A PERSONAL HOME HEALTHCARE ROBOT TO IMPROVE HEALTH AND WELLNESS CONDITIONS IN BANGKOK, THAILAND

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Article info

Article history:
Received
28 August 2018
Revised
4 November 2018
Accepted
6 March 2020

Keywords:
Artificial Intelligence, Health and Wellness, Home Healthcare, Healthcare Robot, Robotics, Elderly care, Attitude, Intention to use

Abstract

A while ago, taking pills used to be something which senior people did. But, it is not like that anymore as everyone at all ages seems "to talk pills" for their allergies, vitamins, and supplements, or treatments. This study is identifying the perception of innovation acceptance in healthcare and wellness sector. While a number of this technology is yet fairly undeveloped at the moment, we can anticipate sophisticated Artificial Intelligence to one day significantly influence our everyday lives. This study designed to take the user's attitudes and intention to use a personal home healthcare robot into account. This study applies the Technology Acceptance Model (TAM) and exploratory variables, including perceived enjoyment, the need to belong, and household size, to analyze users' attitudes and intention to use a personal home healthcare robot. Notwithstanding, a total of 403 respondents, who lived in Bangkok with at least one elderly in a family are focused, are participating in this study. The major findings are the perceived enjoyment when using a robot and the need to belong to the user to have an impact on perceived ease of use and perceived usefulness of a robot. In particular, the perceived ease of use and perceived

usefulness have a strong impact on the user attitude which significance to the intention to use. The insight derived from people who have high health consciousness and one of their family members has carried a congenital disorder. The study has provided the unique contribution which is people of different household size have a different attitude and intention to use a home healthcare robot. By encouraging people to use a home healthcare robot, therefore, the study confirms to convince people with its feature function benefits, its advantage benefits, and feasibilities of its ease of use of a home healthcare robot.

Introduction

Artificial intelligence (AI) is a fast-growing technology that focuses on building intelligent machines which be able to act and think humanly and rationally (Rouse, 2010). For decades, many computer scientists encompass AI to act and react in the same way similar to humans. It mimics the process of real neural networks to deeply learn how doing a sophisticated information processing which enables them to execute complex functions in a friendly way such as voice and facial recognition (Frank, 2016). An article from Ayers (2016), also mentions the stimulation of human intelligence is moving quickly along with big data integration. In the near future, AI will visibly impact to human everyday activities, such as an automated transportation, performing dangerous jobs with high accuracy, medical diagnostics, and improved elderly care.

A numerous of home robots have been developed to perform a particular function. A service robot is able to provide utilitarian helps collaboratively to users such as vacuum cleaning, dishwashing (Dautenhahn, 2007), and helping the elderly and disabled (Shimp & Kavas, 1984). One example of robotic assistance is in a medical and healthcare sector. A home robot can interact with patients and check their health conditions. This helps the doctor increase their time efficiency by reducing time spent on non-emergency home visits (Bertalan, 2018). Notwithstanding, health conditions of 4 million patients around the world will be remotely investigated by 2020 (Chamberlin, 2016). Furthermore, the healthcare and wellness services are especially demanding in the future. A study of "The Future of Thailand's Healthcare Industry" (2018) reveals Thailand will become an aging society by 2020 and counted as 30% of all population by 2050. Thus, home healthcare robot can considerably improve people a better life.

This study will interpret a personal home healthcare robot powered by AI technology. As claimed by Pillo Health team (2016), a personal home healthcare robot is a smart pills dispenser that encourages people of all ages to have an improved health management. It capable of voice and facial recognition system for an unlimited number of family members. It safely organizes human medications and supplements by holding up to 250 pills at a time, distributing the precise

pills for each family members at the proper time, and automatically re-ordering. They also claimed a personal home healthcare robot is combined with Siri service to answer and provide the medical advice from latest and verified sources. Additionally, the healthcare companion is able to directly connect with healthcare professionals, and syncs with smart connected objects to notify reminders.

Literature review

Perceived enjoyment (PE)

Perceived enjoyment is defined as the degree of using technology or appliance to fulfill particular activities which provide joy and fun aside from normal outcomes (Arkin, Fujita, Takagi & Hasegawa, 2003). Similarly, the study of Venkatesh (2000) reveals that perceived enjoyment has a positive effect on user's technology acceptance. In particular, perceived enjoyment is an integral motivation that impacts the perceived usefulness through perceived ease of use. Another research by Li (2011) explains the intention to use the online social network is strongly influenced by perceived enjoyment. Likewise, another study confirms that the higher the perceived usefulness and perceived ease of use, the greater impact to the perceived enjoyment (Teo & Noyes, 2011).

Need to belong (NtB)

Need to belong is defined as a desire for acceptance from the society which can be fulfilled by repeated interaction with the same people (Baumeister & Leary, 1995). Another study indicates the need to belong is an extent of acceptance in a group of people that have interpersonal attachments (Utz, Tanis & Vermeulen, 2012). A study of the relation between human and robot explains people are excited about building a positive relationship with others for their well-being (Eimler, Kramer & Von der Putten, 2010). In particular, people are going to use and maintain a service robot for their lives when there was a positive association between people and a service robot. Furthermore, the artificial agent technologies can motivate the need to belong. There has a significant impact on the need to belong toward the intention to use in technologies (Read, Robertson & McQuilken, 2011).

Perceived usefulness (PU)

Perceived usefulness is defined as the extent to which users have a confidence in a certain level of using a specific technology to improve their job performance (Davis, 1989). Perceived usefulness is the value expected by people from using a specific technology. It is an important factor for people to adopt a technology (Venkatesh & Davis, 2000). During the technology acceptance procedure, perceived usefulness is an initial determinant (Mou, Shin & Cohen, 2016). A study of telemarketing found perceived usefulness has a positive impact on the user's attitude and real adopters are more likely to believe in technology advantages (Curran & Meuter, 2005). Also, salespeople have a more positive attitude to the specific technology when they perceived technology's usefulness (Robinson, Marshall & Stamps, 2005). Thus, Davis (1989) confirms the perceived usefulness

has a strong association with variables such as attitude and satisfaction.

Perceived ease of use (PEOU)

Perceived ease of use is defined as the degree to which human perceived a technology requires free effort to use such as time and resources (Davis, 1989). Importantly, the system should be easy to understand and simple to operate (Rogers, 2005). This related to the concept of Chao & Zipf (1950) explains people will adopt the technology that needs the least effort. Davis (1989) also stated perceived ease of use as one of the factors for the user's technology acceptance, which has an impact on users attitudes and behavior. According to Wu (2011), a study of developing an explorative model for Software as a Service (SaaS) adoption reveals that perceived ease of use and perceived usefulness are main factors that form user's attitude and intention to use technology. Comparably, perceived ease of use and perceived usefulness have a significant impact on readiness to use mobile commerce (Thakur & Srivastava, 2013).

Attitude (ATT)

Attitude is defined as the term which generally used to indicate the behavior intention (Schwarz, Wdowiak, Almer-Jarz & Breitenecker, 2009). Attitude is indicated as a prominent factor of people to start their activities (Kremer-Hayon & Tillema, 1999). Attitude also described as positive or negative feelings of people about doing an action (Hill, Fishbein & Ajzen, 1977). As claimed by Davis (1989), there is an impact of people attitude toward intention to use new technology. Also, one empirically found the positive relationship between attitude and intention to use credit cards (Kaynak & Harcar, 2001). As well as Robinson, Marshall & Stamps (2005) found the positive attitude encourages salespeople to use the new technology. It means an attitude toward service provider has a positive impact toward intention to use (Shimp & Kavas, 1984).

Intention to use (IU)

Intention to use is defined as an indicator that takes a motivational attribute affecting the future technology use (Lopez-Nicolas, Molina-Castillo & Bouwman, 2008). Also, people have a behavioral intention which desires to do a particular action, also an intention to use can predict an action to use in order to fulfill their activity (Ajzen & Fishbein, 1980). One study found behavioral intention directly impact actual behavior, whereas behavioral intention is influenced by two factors including attitude toward objects and subjective norm (Ajzen & Fishbein, 1980). A positive attitude toward the technology has a direct impact on behavioral intention to use the technology (Davis, 1989). Based on TAM, behavioral intention is influenced by users attitude because a study of consumer acceptance of virtual store found there is the relationship among attitude, belief, intention, and behavior (Chen, Gillenson & Sherrell, 2004).

A difference in household size (HS) and elderly care

Elderly care becomes a big market. Referring to Phillipson (2015), a family

is the main responsible people to senior people, but in the present day, most elderly people are left alone at home or cared in a retirement home. Phillipson (2015) continue to mention key proofs for this includes family size is shrinking, dual-career family in which both parents have to work, and people are living longer, changes in social value and attitude to family obligations. According to World Health Organization (WHO), United Nations (UN) stated on "Health statistics and information systems" (2002) that people in the age over 60 years old are referred to the older population. A survey of "Household Size & Composition in Thailand" (2017) had revealed by United Nations (UN) Population Division Department of Economic and Social Affairs that there is a continuous upward trend of a share of household with member ages over 60 years old. Based on United Nations (UN), an average household size is 3.7 while an average number of children per household is 1.6. Therefore, this study will classify household size into 3 groups including an average household size with 3-4 family members living together. Secondly, a below average household size with less than 3 family members living together, Lastly, an above average household size with more than 4 family members living together.

Research methodology

The study aims to determine the perception of technology acceptance toward a personal home healthcare robot. It is to investigate the attitude and intention to use of a family with elderly people but has a different household size. One article explains the demand for home healthcare service will increase as 80 percent of help will be supported by family caregivers (Kaplan & Berkman, 2016). The number of the family member who available to care elderly people has declined which caused by the changes in demographics and social values such as a lifespan of the number of elders has increased as well as the number of independent and very sick elderly people. And, the number of women in the workforce has increased which they previously may provide care for the elderly family members. Likewise, the family structure and relationship quality can indicate the degree and kind of care. The article also mentions the willingness of family members can be reinforced by supportive and supplemental services such as a personal care, home health care, adult daycare (Kaplan & Berkman, 2016). According to Ayers (2016), which claim the study of a computer scientist at Washington State University, Matthew Taylor, which explains the elderly people will possibly stay at home as independently long as a home robot can assist in their daily activities.

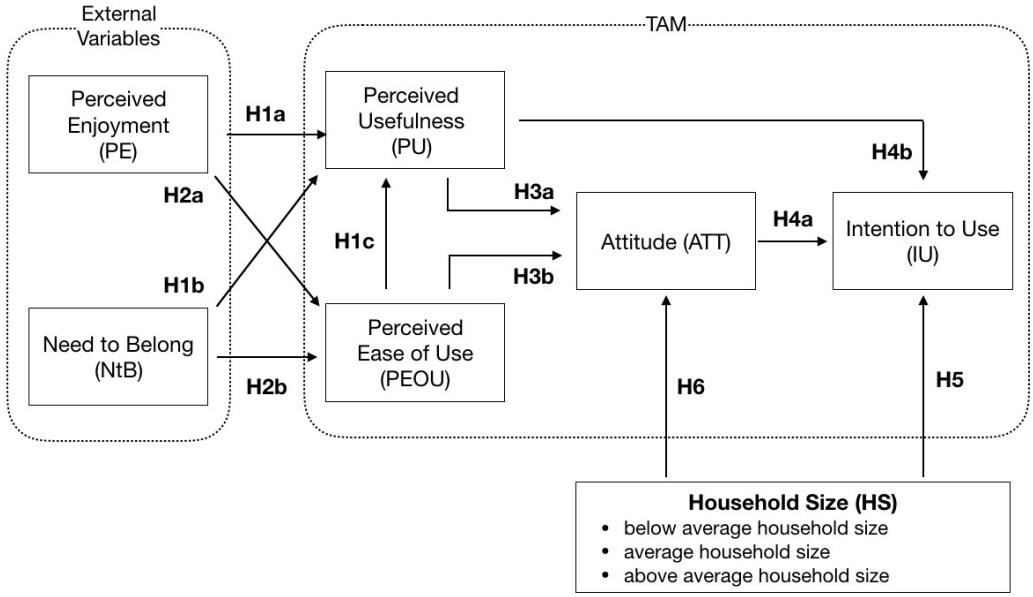

Figure1 The research model

This study conducts a quantitative research analysis. A total of 403 users responded and individual attitude was evaluated by the Five-Likert scales structured questionnaires, with responses ranging from 1 (strongly disagree) to 5 (strongly agree). The distribution of the online survey was on the Internet and social networking. The online survey was collected through the non-probability technique which is convenience sampling, also quota sampling to investigate mean difference among different household size toward intention to use a home healthcare robot.

Based on the previous research paper on users' attitudes toward service robots in South Korea, the total of 904 respondents participated in the study (Park & del Pobil, 2013). Comparably, the total of 609 respondents was conducted from another study of the adoption of teaching assistant robot and a technology acceptance model approach (Park & Kwon, 2016). In this study, the total Bangkokian population is approximately 8.28 million people ("Bangkok Population", 2017). Thus, the data of 403 qualified respondents will construct, which is efficient to represent the Bangkokian population who lived in Thailand at least 6 months and have at least one elderly person in the family, at a confidence level of 95%, the margin of error of 5%. Furthermore, demographic information of respondents such as gender, age, education, household size and structure, health-conscious perception, and congenital disorder condition were collected. The demographic profile of samples is exhibited in Table 2.

Based on Figure 1, the research model was designed to study of users' attitude of a personal home healthcare robot could determine by investigated

parameters of perceived enjoyment, the need to belong, perceived usefulness, perceived ease of use, attitude, intention to use, and household size. The research model and scales of measurement were adopted from the previous research paper on users' attitudes toward service robots in South Korea (Park & del Pobil, 2013). Referring Davis (1993), there have four factors of TAM including four items of perceived usefulness, four items of perceived ease of use, three items of the user's attitude, and three times of user's intention to use. Besides, four items of perceived enjoyment are adapted from the study of Igbaria, Iivari & Maragahh (1995) and Koufaris (2002), also five items of the need to belong are adapted from the study of Leybman, Zuroff, Fournier, Kelly & Martin (2010) and Leary, Kelly, Cottrell & Schreindorfer (2013). Eventually, the research scales of measurement in Appendix A were used to specifically create an online survey to understand users' attitude to improve health and wellness conditions in Bangkok, Thailand.

Table1 The scale of statistics (n=31)

Variables	Cronbach's Alpha	Number of Items
Perceived enjoyment	0.951	4
Need to belong	0.908	5
Perceived usefulness	0.959	4
Perceived ease of use	0.916	4
Attitude	0.928	3
Intention to use	0.893	3

Referred Nunnally (1978), the Cronbach's alpha should be greater than 0.7 to determine the reliability of the items in the questionnaire. The scale statistic of the Cronbach's alpha on the pilot study is closely internal consistency which exhibited in Table 1.

Therefore, these constructed items of measurement are rationally accepted to conduct further processes of data collection and analysis. Based on the Figure1, it consists of 6 models and 11 developed hypotheses are aligning with the research model. Model 1 has PU as the dependent variable which includes H1a - H1c. Model 2 has PEOU as the dependent variable which includes H2a - H2b. Model 3 has ATT as the dependent variable which includes H3a - H3b. Model 4 has IU as the dependent variable which includes H4a - H4b. Model 5 has IU as the dependent variable which includes H5. Below are details of the ten hypotheses statement. Model 6 has ATT as the dependent variable which includes H6. Below are details of the 11 hypotheses statement.

Model 1

Hypotheses	Statement
H1a	Perceived usefulness (PU) of a home healthcare robot is positively impacted by perceived enjoyment (PE) of a home healthcare robot.
H1b	Perceived usefulness (PU) of a home healthcare robot is positively impacted by the level of need to belong (NtB) of users.
H1c	Perceived usefulness (PU) of a home healthcare robot is positively impacted by perceived ease of use (PEOU) of a home healthcare robot.

Model 2

Hypotheses	Statement
H2a	Perceived ease of use (PEOU) of a home healthcare robot is positively impacted by perceived enjoyment (PE) of a home healthcare robot.
H2b	Perceived ease of use (PEOU) of a home healthcare robot is positively impacted by the level of need to belong (NtB) of users.

Model 3

Hypotheses	Statement
H3a	The user attitude (ATT) toward using a home healthcare robots is positively impacted by perceived usefulness (PU) of a home healthcare robot.
H3b	The user attitude (ATT) toward using a home healthcare robots is positively impacted by perceived ease of use (PEOU) of a home healthcare robot.

Model 4

Hypotheses	Statement
H4a	The user intention to use (IU) a home healthcare robot is positively impacted by the users' attitude (ATT) toward using a home healthcare robot.
H4b	The user intention to use (IU) a home healthcare robot is positively impacted by perceived usefulness (PU) of a home healthcare robot.

Model 5

Hypotheses	Statement
H5	There is a significant mean difference in household size (HS) on user's intention to use (IU) a home healthcare robot.

Model 6

Hypotheses	Statement
H6	There is a significant mean difference in household size (HS) on user's attitude (IU) toward a home healthcare robot.

Results and discussions

Sample demographic profile

As exhibited in Table 2, which summarized the demographic characteristics of 403 respondents who have lived in Bangkok at least 6 months and have at least one elderly person in the household. Majority of respondents is female at 50.9% and male at 49.1%. The respondents who participated in this study are Boomer II (26.8%), Gen X (35.2%), Gen Y (30.3%), and Gen Z (7.7%). Boomer II are people who were born in 1955-1965. Gen X are people who were born in 1966-1976. Gen Y is people who were born in 1977-1994. Gen Z is people who were born in 1995-2012. As reported by American Express, Gen X has greater purchasing power than any other generations (Peralta, 2015). More than half of respondents hold Bachelor's degree (73.9%) followed by Master's degree or higher (26.1%). Additionally, a greater number of respondents considers revealing that they have at least one of their family members carry a congenital disorder (58.6%) and none of the family members carry a congenital disorder including themselves (41.4%). With reference to sample health-consciousness, 18.4% of the total respondent are always self-aware of a healthy lifestyle. 2.7% of total respondents often concern about a healthy lifestyle. 42.7% of total respondents sometimes consider about health-consciousness. 6.7% of the total respondents seldom determine their healthy lifestyle, and 29.5% of the total respondents never realize health-consciousness. With regard to household size, the majority have an average household size with 3-4 people in the family (32.8%), followed by an above average household size (33.5%) and a below average household size (33.7%).

Table 2 Sample demographic profile

Demographic	Characteristic (n=403)	Frequency	%
Gender	Male	198	49.1
	Female	205	50.9
Year of birth	Boomer II	108	26.8
	Gen X	142	35.2
	Gen Y	122	30.3
	Gen Z	31	7.7
Education	Above bachelor's degree	105	26.1
	Bachelor's degree	298	73.9
Congenital disorder	Yes	236	58.6
	No	167	41.4
Health consciousness	Always	74	18.4
	Often	11	2.7
	Sometimes	172	42.7
	Seldom	27	6.7
	Never	119	29.5
Household size	Below average household size	132	32.8
	Average household size	135	33.5
	Above average household size	136	33.7

Hypotheses 1

Pearson's correlations

Table 3 Correlation matrix for hypotheses 1

Variable	Mean	SD	Perceived enjoyment	Need to belong	Perceived ease of use	Perceived usefulness
Perceived enjoyment	3.7246	0.89887	1			
Need to belong	3.5787	0.86550	0.826*	1		
Perceived ease of use	3.6179	0.83013	0.661*	0.739*	1	
Perceived usefulness	3.8083	0.89655	0.817*	0.818*	0.692*	1

** Correlation is significant at the 0.01 level (1-tailed)*

According to the Table 3 of the Pearson's Correlation Matrix, which indicates Perceived Enjoyment, The Need to Belong, Perceived Ease of Use, and Perceived Usefulness have a positive relationship with each other with P-value less than 0.05. The Kent State University has described the correlation coefficient can imply the direction of the relationship, which -1 has a negative linear relationship, 0 has no relationship, and +1 has a positive linear relationship. Although, the magnitude of the correlation implies the strength of the relationship, which $0.1 < |r| < 0.3$ has a weak correlation, $0.3 < |r| < 0.5$ has a

moderate correlation, and 0.5 < | *r* | has strong correlation ("LibGuides: SPSS Tutorials: Pearson Correlation", 2018). Therefore, all hypotheses in model 1 have a positive and strong relationship, which includes Perceived Enjoyment (PE) and Perceived Usefulness (PU) at 0.817 correlation, Need to Belong (NtB) and Perceived Usefulness (PU) at 0.818 correlation, and Perceived Ease of Use (PEOU) and Perceived Usefulness (PU) at 0.692 correlation.

Inferential analysis and multicollinearity validation

Table 4 Multiple linear regression for hypotheses 1

Hypotheses	Variable	Standardized Coefficient (β)	Sig.	VIF	Result
H1a	**Perceived enjoyment**	0.423	0.000	3.203	Supported
H1b	**Need to belong**	0.360	0.000	3.983	Supported
H1c	**Perceived ease of use**	0.146	0.000	2.245	Supported
R square			0.741		
Adjusted R square			0.739		

Additionally, the Variance Inflation Factors (VIFs) were verified to validate the multicollinearity problem. The Table 4 reveals VIFs are less than 5.00, which implies that no critical issues exist for the data analysis. Therefore, the regression equitation for Perceived Usefulness (PU) is 0.331+(0.422*PE) + (0.373*NtB) + (0.158*PEOU). Also, R Square point out that 74.1% of all three independent variables including Perceived Enjoyment (PE), the Need to Belong (NtB), and Perceived Ease of Use (PEOU) could well explain the dependent variable of Perceived Usefulness (PU) of using a home healthcare robot at 95% of confidence level or 0.05 significance level. The P-value of all three independent variables, including Perceived Enjoyment (PE), the Need to Belong (NtB), and Perceived Ease of Use (PEOU), are less than 0.05 which can indicate H1a, H1b, and H1c are supported. In consequence, Perceived Enjoyment (PE), the Need to Belong (NtB), and Perceived Ease of Use (PEOU) have statistically significant positive influenced on Perceived Usefulness (PU) of using a home healthcare robot at the Standardized Coefficient (β) of 0.423, 0.360, 0.146 respectively. By this, Standardized Coefficient (β) also confirms that Perceived Enjoyment (PE) of using a personal home healthcare robot has the strongest impact to the Perceived Usefulness (PU), followed by the Need to Belong (NtB) and Perceived Ease of Use (PEOU) of a home healthcare robot.

Hypotheses 2

Pearson's correlations

Table 5 Correlation matrix for hypotheses 2

Variable	Mean	SD	Perceived enjoyment	Need to belong	Perceived ease of use
Perceived enjoyment	3.7246	0.89887	1		
Need to belong	3.5787	0.86550	0.826*	1	
Perceived ease of use	3.6179	0.83013	0.661*	0.739*	1

**Correlation is significant at the 0.01 level (1-tailed)*

According to the Table 5 of the Pearson's Correlation Matrix, which indicates Perceived Enjoyment, The Need to Belong, and Perceived Ease of Use have a positive relationship with each other with P-value less than 0.05. As prior mentioned about the correlation coefficient, it can conclude that all hypotheses in model 2 have a positive and strong relationship, which Perceived Enjoyment (PE) and Perceived Ease of Use (PEOU) at 0.661 correlation, Need to Belong (NtB) and Perceived Ease of Use (PEOU) at 0.739 correlation.

Inferential analysis and multicollinearity validation

Table 6 Multiple linear regression for hypotheses 2

Hypotheses	Variable	Standardized Coefficient (β)	Sig.	VIF	Result
H2a	**Perceived enjoyment**	0.157	0.008	3.148	Supported
H2b	**Need to belong**	0.610	0.000	3.148	Supported
R Square			0.555		
Adjusted R Square			0.552		

Additionally, the Variance Inflation Factors (VIFs) were verified to validate the multicollinearity problem. The Table 6 reveals VIFs are less than 5.00, which implies that no critical issues exist for the data analysis. Therefore, the regression equitation for Perceived Ease of Use (PEOU) is 0.985+(0.145*PE)+(0.585*NtB). Also, R Square point out that 55.5% of all two independent variables including Perceived Enjoyment (PE) and the Need to Belong (NtB) could well explain the dependent variable of Perceived Ease of Use (PEOU) of using a home healthcare robot at 95% of a confidence level or 0.05 significance level. The P-value of all two independent variables, including Perceived Enjoyment (PE) and the Need to Belong (NtB) are less than 0.05 which

can indicate H2a and H2b are supported. In consequence, Perceived Enjoyment (PE) and the Need to Belong (NtB) have statistically significant positive influenced on Perceived Ease of Use (PEOU) of using a home healthcare robot at the Standardized Coefficient (β) of 0.157, 0.610 respectively. By this, Standardized Coefficient (β) also confirms that the Need to Belong a personal home healthcare robot of users has the strongest impact to the Perceived Ease of Use (PEOU), followed by Perceived Enjoyment (PE) of using a home healthcare robot.

Hypotheses 3

Pearson's correlations

Table 7 Correlation matrix for hypotheses 3

Variable	Mean	SD	Perceived ease of use	Perceived usefulness	Attitude
Perceived ease of use	3.6179	0.83013	1		
Perceived usefulness	3.8083	0.89655	0.692*	1	
Attitude	3.5997	0.86334	0.620*	0.759*	1

**Correlation is significant at the 0.01 level (1-tailed)*

According to the Table 7 of the Pearson's Correlation Matrix, which indicates Perceived Ease of Use, Perceived Usefulness, and Attitude have a positive relationship with each other with a P-value less than 0.05. As prior mentioned about the correlation coefficient, it can conclude that all hypotheses in model 3 have a positive and strong relationship, which Perceived Usefulness (PU) and Attitude (ATT) at 0.759 correlation, and Perceived Ease of Use (PEOU) and Attitude (ATT) at 0.620 correlation.

Inferential analysis and multicollinearity validation

Table 8 Multiple linear regression for hypotheses 3

Hypotheses	Variable	Standardized Coefficient (β)	Sig.	VIF	Result
H3a	Perceived usefulness	0.181	0.000	1.918	Supported
H3b	Perceived ease of use	0.635	0.000	1.918	Supported
R square			0.594		
Adjusted R square			0.592		

Additionally, the Variance Inflation Factors (VIFs) were verified to validate the multicollinearity problem. The Table 8 reveals VIFs are less than 5.00, which implies that no critical issues exist for the data analysis. Therefore, the regression equitation for Attitude (ATT) is 0.593+(0.188*PEOU)+(0.611*PU).

Also, R Square point out that 59.4% of all two independent variables including Perceived Usefulness (PU) and Perceived Ease of Use (PEOU) could well explain the dependent variable of Attitude (ATT) toward using a home healthcare robot at 95% of a confidence level or 0.05 significance level. The P-value of all two independent variables, including Perceived Usefulness (PU) and Perceived Ease of Use (PEOU) are less than 0.05 which can indicate H3a and H3b are supported. In consequence, Perceived Usefulness (PU) and Perceived Ease of Use (PEOU) have statistically significant positive influenced on user's attitude (ATT) toward using a home healthcare robot at the Standardized Coefficient (β) of 0.181, 0.635 respectively. By this, Standardized Coefficient (β) also confirms that Perceived Ease of Use (PEOU) has the strongest impact to the user's attitude (ATT), followed by Perceived Usefulness (PU) of using a home healthcare robot.

Hypotheses 4

Pearson's correlations

Table 9 Correlation matrix for hypotheses 4

Variable	Mean	SD	Perceived usefulness	Attitude	Intention to use
Perceived usefulness	3.8083	0.89655	1		
Attitude	3.5997	0.86334	0.759*	1	
Intention to use	3.6940	1.00967	0.856*	0.793*	1

**Correlation is significant at the 0.01 level (1-tailed)*

According to the Table 9 of the Pearson's Correlation Matrix, which indicates Perceived Usefulness, Attitude, and Intention to Use have a positive relationship with each other with a P-value less than 0.05. As prior mentioned about the correlation coefficient, it can conclude that all hypotheses in model 4 have a positive and strong relationship, which Perceived Usefulness (PU) and Intention to Use (IU) at 0.856 correlation, and Attitude (ATT) and Intention to Use (IU) at 0.793 correlation.

Inferential analysis and multicollinearity validation

Table 10 Multiple linear regression for hypotheses 4

Hypotheses	Variable	Standardized Coefficient (β)	Sig.	VIF	Result
H4a	Attitude	0.600	0.000	2.363	Supported
H4b	Perceived usefulness	0.337	0.000	2.363	Supported
R square			0.781		
Adjusted R square			0.779		

Additionally, the Variance Inflation Factors (VIFs) were verified to validate the multicollinearity problem. The Table 10 reveals VIFs are less than 5.00, which implies that no critical issues exist for the data analysis. Therefore, the regression equitation for Intention to Use (IU) is -0.297+(0.676*PU)+(0.394*ATT). Also, R Square point out that 78.1% of all two independent variables including Perceived Usefulness (PU) and Attitude (ATT) ould well explain the dependent variable of Intention to Use (IU) a home healthcare robot at 95% of a confidence level or 0.05 significance level. The P-value of all two independent variables, including Perceived Usefulness (PU) and Attitude (ATT) are less than 0.05 which can indicate H4a and H4b are supported. In consequence, Perceived Usefulness (PU) and Attitude (ATT) have statistically significant positive influenced on Intention to Use (IU) a home healthcare robot at the Standardized Coefficient (β) of 2.363, 2.363 respectively. By this, Standardized Coefficient (β) also confirms that user's attitude (ATT) has the strongest impact to Intention to Use (IU), followed by Perceived Usefulness (PU) of using a home healthcare robot.

Hypotheses 5

One-way ANOVA

Table 11 One way ANOVA for hypotheses 5

Intention to use	ANOVA				
	Sum of squares	**df**	**Mean square**	**F**	**Sig.**
Between groups	22.927	2	11.463	11.852	0.000
Within groups	386.884	400	0.967		
Total	409.811	402			

Table 12 Scheffe's post hoc test for hypotheses 5

Household size (I)	Household size (J)	Mean difference (I-J)	Sig.
Below average household size	Average household size	-.45875	.001
	Above average household size	-.54590	.000
Average household size	Below average household size	.45875	.001
	Above average household size	-.08715	.767
Above average household size	Below average household size	.54590	.000
	Average household size	.08715	.767

According to the Table 11 which compares an effect of different household size levels (HS) on the intention to use (IU) a home healthcare robot. An analysis of variance shows that the effect of different household size levels (HS) on the intention to use (IU) a home healthcare robot is significant, F (2, 400) = 11.852, p = 0.000.

Likewise, the table 12 of the Scheffe's Post hoc Test indicates that there are statistical differences in mean scores of intention to use (IU) a home healthcare robot among different household size. Multiple Comparisons shows which group is specifically different from one another, $P \leq 0.05$. There is a difference between a below average household size and an average household size, also a difference between a below average household size and an above average household size at 95% confidence level. Therefore, H5 is supported.

Hypotheses 6

One-way ANOVA

Table 13 One way ANOVA for hypotheses 6

ANOVA

Attitude

	Sum of squares	df	Mean square	F	Sig.
Between groups	10.992	2	5.496	7.616	0.001
Within groups	288.644	400	0.722		
Total	299.636	402			

Table 14 Scheffe's post hoc test for hypotheses 6

Household size (I)	Household size (J)	Mean difference (I-J)	Sig.
Below average household size	Average household size	-.19860	.163
	Above average household size	-.40501	.001
Average household size	Below average household size	.19860	.163
	Above average household size	-.20641	.137
Above average household size	Below average household size	.40501	.001
	Average household size	.20641	.137

According to the Table 13 which compares an effect of different household size levels (HS) on the user's attitude (ATT) toward a home healthcare robot. An analysis of variance shows that the effect of different household size levels (HS) on user's attitude (ATT) toward a home healthcare robot is significant, $F(2, 400) = 7.616$, $p = 0.001$.

Likewise, the table 14 of the Scheffe's Post hoc Test indicates that there are statistical differences in mean scores of user's attitude (ATT) toward a home healthcare robot among different household size. Multiple Comparisons shows which group is specifically different from one another, $P \leq 0.05$. There is a difference between a below average household size and an average household size at 95% confidence level. Therefore, H6 is supported.

Conclusions, limitations and recommendations

The empirical quantitative study is to discover and analyze the perception of users toward a personal home healthcare robot which is a smart pills dispenser powered by Artificial intelligence technology that encourages people of all ages to have an improved health management. The research model was fine-tuned from a paper of users' attitudes toward service robots in South Korea (Park & del Pobil, 2013). The research model consists of the TAM model and exploratory variables. The TAM model by Davis (1993) includes four factors: Perceived Usefulness, Perceived Ease of Use, Attitude, and Intention to Use. The exploratory variables include Perceived Enjoyment, The Need to Belong, also the Household Size. Besides, a family with an elderly where different in household size was concentrated as Phillipson (2015) confirmed the key proof of changes in social value and attitude to family obligations, while Ayers (2016) mentioned that the seniors can stay at home as independently long as a home robot can assist in their daily activities.

Giving a care to elderly people is a focused task, not everyone can perform well in a similar way to family members do. Unfortunately, the changes in social value have impacted to the elderly care. Essentially, it is fundamental to develop an awareness of elderly care issue which Thailand will become an aging society by 2020 ("The Future of Thailand's Healthcare Industry", 2018). Thus, the

government or Ministry of Social Development and Human Security should emphasize on educating people to cope with elderly cares and improving well-being conditions. With the innovation revolution and technology advancement, Artificial Intelligence technology has gradually developed to improve people life, of course, health condition and elderly care.

Therefore, there are six hypotheses to be analyzed, and the analysis derived from the Pearson's Correlation, Multiple Linear Regression, and One-Way ANOVA have resulted in a conclusion of this study. Eventually, the data of 403 respondents, who participated in the online survey, was collected through the non-probability techniques which are convenience sampling and quota sampling. The analysis results of this study obtained from Bangkokian who lived in Thailand at least 6 months and have at least one elderly person in the family. By means of this, roughly half of men and female was evaluated by Five-Likert scales structured questionnaires. All of them possess a bachelor's degree or higher. The greater part of them aged 60 years and over whose health-consciousness is generally high and at least one family member carries a congenital disorder.

The below details are theoretical contributions of study:

- Intention to use of a home healthcare robot was well explained by user's attitude and perceived usefulness at 78.1%. In particular, uses' attitude has a larger impact on intention to use than the perceived usefulness of a home healthcare robot.
- Perceived usefulness of a home healthcare robot was well explained by perceived enjoyment, the need to belong, perceived usefulness at 74.1%. In particular, perceived enjoyment has a larger impact on perceived usefulness than the need to belong and perceived ease of use respectively.
- User's attitude toward a home healthcare robot was explained by perceived ease of use and perceived usefulness at 59.4%. In particular, perceived ease of use has a larger impact on attitude than the perceived usefulness of a home healthcare robot.
- Perceived ease of use a home healthcare robot was explained by the need to belong and perceived enjoyment at 55.5%. In particular, the need to belong has a larger impact on perceived ease of use than the perceived enjoyment of a home healthcare robot.
- There is a significant mean difference in household size on the user's intention to use a home healthcare robot. In particular, there is a difference between a below average household size and average household size, and between a below average household size and above average household size.
- There is a significant mean difference in household size on the user's attitude toward a home healthcare robot. In particular, there is a difference between a below average household size and average household size.

According to "Ageing population in Thailand" (n.d.) states Thai government provides health service through networks of Health Centers and Primary Care Units (PCU). These centers are organized by The Ministry of Public Health (MoPH) and Community Health Centers. They provide curative, preventive and promotive services which are normally staffed by one to three health professionals and community health workers who trained to assist health professionals in interacting with people in the community. The study has provided insights to supportively introduce a personal home healthcare robot to the market. It can assist professional health personnel to give a care to all elderly people. Likewise, elderly people would not stay at the health center or retirement home if they had a choice. A personal home robot enables elderly people to independently stay at home as long as it can assist in their daily activities. Therefore, by encouraging people to use a home healthcare robot, it is to convince people with its feature function benefits, its advantage benefits, and feasibilities of its ease of use. It is to create demand by showing the enjoyment of using home healthcare robot while the need to belong a home healthcare robot is another consideration to put in the communication messages. Both of the logical and emotional sides should be applied when developing marketing campaigns or design the communication messages. For example, providing video tutorials on how to use, generating a content about product trails and reviews from users, showing its ease of use and its benefits to people as individual and family. Moreover, the marketing and campaigns should be clear and understandable. It should be separately designed for two groups of users. The result of this study confirms that people with different household size have a different attitude and intention to use a home healthcare robot. It is to consider to have different campaigns to a below an average household size, which has least than 3 people, and an average household size and over (more than three people liven together).

Limitations and future directions

This study primarily conducted under the Technology Acceptance Model (TAM) to examine the perception of technology acceptance and to fulfill the research objectives. Notwithstanding, there are other technology adoption models to be considered on the future studies. Moreover, the context of study concentrated only in Bangkok. It is the capital city and the population is closed to 13% of the country's population (Thailand population, 2018). The future studies can, therefore, expand the context of study to cover the respondents in different provinces or regions of Thailand. Meanwhile, this research emphasized only household size. Other demographic factors, such as occupation, specific congenital disorder, can be considered to gain more upscale insights. According to Liu, Hao & Zhang (2016) mentioned the factors impacted by aging care such as family size, economic, culture, social status, and the accessibility of community resources. Eventually, future studies are to perform more detailed analyses should consider these limitations.

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