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Behavioral intention to use mobile health (mHealth) technologies among caregivers of cancer patients

Authors: Yulita Hanum P. Iskandar[1,*]; Au Chia Yen[1]

Affiliations: *[1]Universiti Sains Malaysia, Penang, Malaysia*

ABSTRACT

INTRODUCTION: According to an analysis by the World Health Organization (WHO), the number of deaths caused by cancer has increased every year from 1990 to 2017. Mobile health (mHealth) technologies are powerful tools to improve cancer awareness by providing educational information. Therefore, the aim of this study was to examine factors affecting the behaviors among caregivers of cancer patients in Malaysia using mHealth technologies.

METHODS: The study applied the Unified Theory of Acceptance and Use of Technology 2 (UTAUT2) model as a theoretical framework, with the I-Change Model (ICM) to extend the UTAUT2. The population element in this research study focused on caregivers of cancer patients who own a smartphone capable of accessing the internet and can download mobile applications. SmartPLS was used for model and construct testing. A total of 131 sets of valid data were collected from the target population through an online survey.

RESULTS: Results showed Effort Expectancy (EE), Facilitating Condition (FC), Habit (HT), Awareness Factor (AWN), and Perceived Privacy Risk (PPR) were found to be significant constructs. Performance Expectancy (PE), Social Influence (SI), Hedonic Motivation (HM), and Price Value (PV) were not significant constructs.

CONCLUSION: This study provided baseline data on the use of mHealth technologies to the caregivers of cancer patients in Malaysia to reduce their caregiving burden.

Keywords: mHealth, Telehealth, Caregivers, Mortality, Malaysia

INTRODUCTION

The World Health Organization (WHO) reported cancer as the second leading cause of death globally, ultimately leading to 9.6 million deaths [1]. Trend analysis from 1990 to 2017 by Lin et al. shows that the number of deaths caused by cancer is increasing yearly, with Asia having the heaviest cancer burden due to its large population density [2]. Therefore, according to the data resources and report review, cancer is a leading cause of death worldwide and the number of deaths caused by cancer is drastically growing.

Technology plays an important role as a new era of innovation t has led to more advanced technology, especially in the healthcare industry. Charalambous suggested that health technologies have the ability to help caregivers and patients save time on paperwork, monitor patients' progress, and follow up with patients' current health before and

***Corresponding author:** Yulita Hanum P. Iskandar, Graduate School of Business, Universiti Sains Malaysia, 1180 USM, Penang, Malaysia, yulita@usm.my; **Potential Conflicts of Interest (CoI):** All authors: no potential conflicts of interest disclosed; **Funding:** All authors: no funding has been sought or gained for this project; **Academic Integrity.** All authors confirm that they have made substantial academic contributions to this manuscript as defined by the ICMJE; **Ethics of human subject participation:** The study was approved by the local Institutional Review Board. Informed consent was sought and gained where applicable; **Originality:** All authors: this manuscript is original has not been published elsewhere; **Review:** This manuscript was peer-reviewed by three reviewers in a double-blind review process; **Type-editor:** Harrison (USA).

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after treatment [3]. As technology continues to evolve and improve, health technologies have the potential to help reduce the cancer burden. Mobile health (mHealth) technologies have been found to help users improve their cancer awareness, provide educational information on cancer, and more. Furthermore, mHealth technologies are integrated with multiple useful functions, such as providing different types of cancer prevention, cancer care, cancer symptoms references, and medical treatment advice.

However, the functional development of mHealth technologies may lack maturity since software developers may not have sufficient medical knowledge to fully develop healthcare technologies with specific features to support cancer education, care, and prevention. Thus, the best approach to benefit cancer patients is for software developers to develop mHealth technologies with integrative, enriching and quality educational content [4]. Additionally, cancer patients are less likely to use the internet and may not have access to a smartphone, especially elderly patients (more than 65 years old), in which there is specifically expected to be an increasing rate of cancer [4]. Last but not least, having good cancer awareness, knowledge, and attitude on prevention, screening practices and early detection are more cost-effective outcomes than treatment.

Overall, the invention of mHealth technologies makes life easier and more convenient as users can manage their health using their mobile devices [5]. However, not all users are utilizing these technologies or are aware of the usefulness of mHealth technologies. Thus, this study examined factors affecting the behavioral intention among caregivers of cancer patients in Malaysia to use mHealth technologies by applying the UTAUT2 model [6] and the I-Change Model. Due to the theoretical limitation of the UTAUT2 model, extended constructs are essential to this study to get more measurement variables to examine the behavioral intention among caregivers of cancer patients in Malaysia to use mHealth technologies.

The conceptual research model postulates that the seven core constructs from the UTAUT2 model and the two core constructs from I-Change Model, which include performance expectancy, effort expectancy, social influence, facilitating condition, hedonic motivation, price value, habit, awareness factor, and perceived privacy risk, are factors that affect behavioral intention among caregivers of cancer patients in Malaysia to use mHealth technologies.

Performance expectancy (PE) is defined as the usage of mHealth technologies that can provide caregivers of cancer patients the benefit of performing specific activities using MHealth. Tarver and Haggstrom found that performance expectancy positively influences the behavioral intention of users to use and accept mHealth technologies [7].

Effort expectancy (EE) is defined as the level of ease of use of mHealth technologies among caregivers of cancer patients in Malaysia. Previous studies have found that perceived ease of use significantly influences the intention to use mHealth technologies for the early detection of cancer [8]. Chao illustrated that effort expectancy significantly and positively influences behavioral intention [9].

Social influence (SI) is defined as the importance recognized by others to using mHealth technologies. In another study, Lipson-Smith found that subjective norms, beliefs, and perceived behavioral control significantly influenced the intention to use a mHealth application [10]. Tarver and Haggstrom also revealed that social influence positively influences the behavioral intention of users to use and accept mHealth technologies [7].

Facilitating condition (FC) is defined as the propensity to believe mHealth technologies will play an effective function in the organizational and technical structure among caregivers of cancer patients in Malaysia. Heynsbergh previously found that facilitating condition significantly influences the intention to use the mHealth application [11]. Additionally, Zhang found that the facilitating condition positively influences the behavioral intention of users to use the mHealth application [12].

Hedonic motivation (HM) is defined as the degree of perceived enjoyment while using mHealth technologies. Tarver and Haggstrom found that hedonic motivation significantly influences the intention to use mHealth technologies [7]. Alazzam also illustrated that hedonic motivation positively influences the behavioral intention of users to use mHealth technologies [13].

Price value (PV) is defined as the benefits of the mHealth technologies being greater than the actual cost of purchasing the mHealth technologies. Tarver and Haggstrom revealed that the price value significantly impacts the intention to use mHealth

technologies in an African American population [7]. Palau-Saumell demonstrated that price value positively influences the behavioral intention of users to use mHealth technologies [14].

Habit (HT) is defined as the frequently repeated behavior by the use of MHealth among caregivers of cancer patients. Tarver and Haggstrom have found habit significantly affects the intention to use mHealth technologies in an African American population [7]. Alazzam also found that habit positively influences the behavioral intention of users to use mHealth technologies [13].

The awareness (AWN) factor is defined as the degree of awareness of medical care principles using mHealth technologies. Chen found that efficacy significantly influences the intention to use mHealth technologies for preventing breast cancer [15]. Jattamart and Leelasantitham demonstrated that the awareness factor positively influences the behavioral intention of users to use mHealth technologies [16].

Perceived privacy risk (PPR) is defined as the degree of perceived privacy risk pertaining to sharing personal information with mHealth technologies. Chen illustrated that the perceived threat significantly influences the intention to use mHealth technologies to prevent breast cancer [17]. Jattamart and Leelasantitham found that the perceived privacy risk negatively influences the behavioral intention of users to use mHealth technologies [16].

METHODS

Sample: Caregivers of cancer patients in Malaysia were the targeted population in this research study and, specifically, caregivers of cancer patients who own individual smartphones available for accessing the internet with the ability to download a mobile application such as the mHealth application. G*Power is a calculation software program used to compute the number of sample sizes required for the research study. Regarding an acceptable measurement, the effect size was set at 0.15 as the medium level, and the power was set at 0.80. 118 is the minimum number of sample size required for this study.

Data Collection: Online survey instrument was the data collection method used in this study. The questionnaire was given to social groups, healthcare centers, and hospitals specializing in cancer care. In addition, the questionnaire was posted to social media pages, including Facebook and Instagram, related to these. Table 1 shows the list of social groups, healthcare centers, and hospitals that have been involved in distributing the questionnaire.

Questionnaire: The questionnaire was designed with three sections. The first section asked preliminary questions, such as the participants' prior experience of using mHealth apps and the duration of their uses; the second section asked for the demographic profile of respondents, including gender, age, race, educational background, and monthly household income; the third section asked nine constructs, related to the suggested constructs, affecting behavioral intention to use mHealth technologies among caregivers of cancer patients in Malaysia. This was done by adopting a 5-point Likert Scale with the scale ranging from strongly disagree with (1), disagree with (2), neutral (3), agree with (4), and strongly agree with (5). Respondents were required to answer all questions in all sections.

Any aspect of the work covered in this manuscript has been conducted with the ethical approval of the Graduate School of Business, Universiti Sains Malaysia, Malaysia.

RESULTS

The demographic profiles of the respondents are provided in Table 1. A total of 131 out of 182 sets of valid data were collected. The majority of the targeted respondents were female (58.80%). Lung cancer was the top type of cancer (26.70%), followed by breast cancer (21.4%) and kidney cancer (15.3%). These top three types of cancer are similar to the report in the Malaysia Fact Sheet on the most frequent types of cancer in Malaysia in 2018 (Malaysia Fact Sheet, 2019). A majority of targeted respondents are in the age group of 26 to 35 years old (69.50 %) with educational attainment of bachelor degrees (68.7%).

Table 2 shows the Hetrotrait-Monotrait Ratio (HTMT), also known as discriminant validity, for measuring cross-loadings to verify the reliability of those questions designed for the questionnaire.

Below, table 3 shows five supported Model contructs out of nine in total. The five supported

Table 1: Demographic Profiles of Respondents (N = 131)

Demographic Features		Frequency	Percent (%)
Type of Cancer	Bladder Cancer	5	3.8
	Blood Cancer	1	0.8
	Breast Cancer	28	21.4
	Cervical Cancer	2	1.5
	Colorectal Cancer	14	10.7
	Hepatitis Cancer	1	0.8
	Kidney Cancer	20	15.3
	Liver Cancer	9	6.9
	Lung Cancer	35	26.7
	Lymphoma Cancer	1	0.8
	Oral Cancer	2	1.5
	Ovary Cancer	6	4.6
	Pancreatic Cancer	1	0.8
	Prostate Cancer	1	0.8
	Stomach Cancer	3	2.3
	Thyroid Cancer	2	1.5
Gender Group	Male	54	41.2
	Female	77	58.8
Age Group	18- 25	1	0.8
	26 – 35	91	69.5
	36 – 45	36	27.5
	46- 55	3	2.3
Race Group	Indian	35	26.7
	Chinese	43	32.8
	Malay	53	40.5
Background of Study Group	Secondary Education	1	0.8
	Diploma Education	15	11.5
	Bachelor Degree	90	68.7
	Master Degree	23	17.6
	Ph.D.	2	1.5
Salary Group	RM 1,000 – RM 2,000	1	0.8
	RM 2,001 – RM 3,000	8	6.1
	RM 3,100 – RM 4,000	80	61.1
	RM 4,100 – RM 5,000	38	29
	Above RM 5,000	4	3.1

constructs are effort expectancy, facilitating condition, habit, awareness factor, and perceived privacy risk. Thus, they had a significant relationship ($p<0.05$) towards behavioral intention among caregivers of cancer patients in Malaysia to use mHealth technologies. The significance value of those five supported were shown as EE ($p > 0.036$, $\beta = -0.25$), FC ($p > 0.018$, $\beta = 0.217$), HT ($p > 0$, $\beta = 0.434$), AWN ($p > 0.026$, $\beta = 0.183$), and PPR ($p > 0.004$, $\beta = 0.263$).

Table 2: Hetrotrait-Monotrait Ratio (HTMT)

	AWN	BI	EE	FC	HT	HM	PPR	PE	PV	SI
AWN										
BI	0.47									
EE	0.429	0.336								
FC	0.526	0.54	0.394							
HT	0.436	0.63	0.515	0.589						
HM	0.454	0.362	0.146	0.49	0.321					
PPR	0.382	0.559	0.596	0.523	0.57	0.307				
PE	0.298	0.417	0.882	0.411	0.532	0.181	0.684			
PV	0.292	0.321	0.306	0.539	0.701	0.289	0.418	0.35		
SI	0.607	0.551	0.581	1.079	0.981	0.427	0.707	0.597	0.896	

PE: Performance Expectancy, EE: Effort Expectancy, SI: Social Influence; FC: Facilitating Condition; HM: Hedonic Motivation; PV: Price Value; HT: Habit; BI: Behavioral Intention; AWN: Awareness Factor, PPR: Perceived Privacy Risk

Table 3: Results of the Structural Model Analysis (Construct Testing)

Contructs	Relationship	Path Coefficient	Std. Dev.	t-values	p values	Decision
PE	PE > BI	0.186	0.142	1.304	- 0.096	Not Supported
EE	EE > BI	- 0.25	0.138	1.803	0.036	Supported
SI	SI > BI	- 0.127	0.101	1.253	- 0.105	Not Supported
FC	FC > BI	0.217	0.103	2.106	0.018	Supported
HM	HM > BI	0.046	0.066	0.69	- 0.245	Not Supported
PV	PV > BI	- 0.126	0.089	1.41	- 0.079	Not Supported
HT	HT > BI	0.434	0.11	3.938	0	Supported
AWN	AWN > BI	0.183	0.094	1.952	0.026	Supported
PPR	PPR >BI	0.263	0.1	2.634	0.004	Supported

PE: Performance Expectancy, EE: Effort Expectancy, SI: Social Influence; FC: Facilitating Condition; HM: Hedonic Motivation; PV: Price Value; HT: Habit; BI: Behavioral Intention; AWN: Awareness Factor, PPR: Perceived Privacy Risk

The significance value of the four rejected constructs was shown as negative values. Thus, four unsupported constructs had no significant relationship towards behavioral intention among caregivers of cancer patients in Malaysia to use mHealth technologies. The significance value of those four unsupported were shown as PE (p > -0.096, β = 0.186), SI (p >-0.105, β =-0.217), HM (p >-0.245, β = 0.046), and PV (p >-0.079, β =-0.126).

DISCUSSION

To summarize the study's findings, the results of an online survey of 131 caregivers of cancer patients demonstrated the fundamental determinants of behavioral intention. Based on the results, effort expectancy (EE), awareness factor (AWN), facilitating condition (FC), perceived privacy risk (PPR), and habit (HT) are found to have a positive effect on behavioral intention. While performance expectancy (PE), social influence (SI), hedonic motivation (HM), and price value (PV) had no significant relationship.

The caregivers of cancer patients are concerned about the ease of use to adopt the mHealth technologies. Based on the findings by Chao, effort expectancy showed a significant relationship with behavioral intention [9]. Chao discussed that people would adopt the software application when it is easy to use. Hence, the caregivers of cancer patients in Malaysia are more likely to adopt mHealth technologies if they are user-friendly.

The second factor considered is the caretakers' perceived awareness of the cancer patient's health. Jattamart and Leelasantitham previously showed a significant relationship between awareness factors and behavioral intention [16]. This study discussed that people will adopt the software application if they are aware of its functionalities. Therefore, the caregivers of cancer patients in Malaysia may be more likely to adopt mHealth technologies that provide enhanced awareness, such as implementing an alert notification or a message to improve the health awareness of cancer patients.

The facilitating condition also has been found to have a significant relationship with behavioral intention. Alam also discussed that the facilitating condition of a software application affects behavioral intention to adopt the software application.[18]. According to this review, caregivers of cancer patients in Malaysia are more likely to adopt the mHealth technologies as an assisting tool when the mHealth technologies effectively function to improve health outcomes in cancer patients

The degree of perceived privacy risk while using the mHealth technologies was significantly related to behavioral intention. Jattamart and Leelasantitham also previously discussed that perceived privacy risk affects motivation and behavioral intention to adopt a software application [16]. Thus, caregivers of cancer patients in Malaysia will be more likely to adopt mHealth technologies that are secure and safe.

The habit of learning or experiencing new technology is a factor for caregivers of cancer patients in Malaysia in adopting the mHealth technologies. This is supported by previous findings by Alazzam that habit positively influences behavioral intention [13]. Personal habit is crucial to the adoption of a software application.

The degree of performance and of the mHealth technologies are not significantly considered by caregivers of cancer patients. While this study did not find a significant relationship, a previous study showed that performance expectancy showed a significant relationship towards behavioral intention [9]. Therefore, caregivers of cancer patients may adopt the mHealth technologies, which is developed with useful functions that meet users' need and want as minimum requirements.

Next, the degree of belief in the functionalities of mHealth technologies that others have used does not appear to significantly influence the caregiver of cancer patients to adopt the mHealth technologies. In the findings by Zhang, social influence did show a significant relationship with the behavioral intention [12]. Hence, caregivers of cancer patients in Malaysia may be less focused on opinions or suggestions by other people as a factor to use the mHealth technologies.

Moreover, perceived enjoyment is not a major factor in adopting technology. According to findings by Chao, hedonic motivation showed a significant relationship with behavioral intention [9]. It is suggested that increasing the functioning of mHealth technologies may increase the perceived enjoyment of caregivers of cancer patients, although not supported by this study.

Lastly, the caregivers of cancer patients do not significantly consider the benefits of the mHealth technologies as greater than the actual cost of purchasing. This is supported by similar findings based on the result by Alam that price value shows no significant relationship towards behavioral intention [18]. Alam discussed the quality of software applications as crucial to adopting software applications instead of the cost of software applications. Thus, caregivers of cancer patients in Malaysia should trust the mHealth technologies as a high-quality tool for assisting them in patient care, so they are willing to purchase the mHealth technologies.

CONCLUSION

This study has illustrated factors that significantly impact the behavioral intention among caregivers of cancer patients in Malaysia to use mHealth technologies. The research model has been presented in combination with the awareness factor and perceived privacy risk from the I-Change Model into the UTAUT2 model, to measure the behavioral intention among caregivers of cancer patients in Malaysia to use mHealth technologies with either cancer care, cancer education, or cancer prevention.

The results of this study show that the caregivers of cancer patients in Malaysia will be more likely to adopt the mHealth technologies when the development of the software application is able to provide user-friendly mHealth technologies, when the software application is able to provide functions such as notifications or messages to promote and improve the cancer awareness, medical treatment, and care for cancer patients, and when

the software application is useful, of good quality and performs well. Perceived privacy risk is crucial to ensure the software application is secure and safe without risking the cancer patient's privacy. Furthermore, it is necessary for the technology to match the needs of caregivers, as cancer spans a range of different symptoms, treatments, and needs. Caregivers of cancer patients in Malaysia will be more likely to adopt mHealth technologies when the software application is able to integrate all useful functionality in one interface at a reasonable cost.

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