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Evaluating Ghanaian Family Carers' Perceptions on the Use of Healthcare Wearable Devices by Dementia Patients

Ebenezer Larnyo*[1], Baozhen Dai[2], Benedicta Akey-Torku[3], Jonathan Aseye Nutakor[4], Ebenezer Ababio Tetteh[5], Abigail Larnyo[6], Naa Morkor-Dzormo Mensah[7]

[1-4]Department of Health Policy and Management, Jiangsu University, School of Management, 301 Xuefu Road, Zhenjiang, Jiangsu Province, China.

larnyoebenezer@yahoo.com [1]

[5, 7] School of Management, Jiangsu University, 301 Xuefu Road, Zhenjiang, Jiangsu Province, China.

[6]Faculty of Applied Sciences, University of Ghana, Legon, Accra, Ghana.

ABSTRACT

This study seeks to assess the perceptions and readiness of family carers of dementia patients in Ghana to recommend for use of healthcare wearable devices by dementia patients.

Using a structured questionnaire, this study sampled and analyzed the views of 355 family carers from thirteen administrative regions of Ghana. The different perceptions of family carers on the use of healthcare wearable devices based on questions adapted from the extended unified theory of acceptance and use of technology model, were assessed using Pearson's correlation and multiple linear regression.

The results of the regression indicated that the model explained 75.4% of the variance of behavioral intention and was a significant predictor of family carers' perception on the use of healthcare wearable devices by patients with dementia in Ghana. In terms of the individual contributions of family carers' perceptions based on the extended Unified Theory of Acceptance and Use of Technology model's indicators, all indicators contributed significantly to the model with p-values less than 0.05 except family carers' perception on social influence and perception on resistance to change, which were not significant with p-values greater than 0.05.

Despite concerns of insufficient disposable income of carers, and existence of inherent issues relating to safety, privacy and security of patients data in their quest to use healthcare wearable devices, our findings suggest that family carers in Ghana are willing and ready to recommend for use of healthcare wearable devices by dementia patients, which may consequently enhance their well-being and help satisfy their desire to live independently.

Keywords : Dementia, Family Carers, Ghana, Healthcare Wearable Devices, Proxy

I. INTRODUCTION

As the world's population continuous to age, and almost every country in the world continue to experience astronomical growth in the number and proportion of older persons in their population, population ageing is poised to become the most significant social transformations of the twenty-first century, with implications for almost every sector of society, including labor and financial markets, increasing demand for goods and services, such as housing, transportation and social protection, family

structures and intergenerational ties, and most importantly healthcare [1]. With this trend, the prevalence of ageing related disease such as dementia and other cognitive and physical related illnesses are inevitable.

Dementia affected about 50 million people globally in 2018, making it the seventh leading cause of death according to the World Health Organization (WHO). This figure is projected to rise to 131.5 million by 2050 [2], with about 10% of people developing the disorder at some point in their lives, and about 9.9 million new cases diagnosed yearly translating into one case every second [3]. In Sub-Saharan Africa, an estimated 2.13 million people were living with dementia as of 2015, with numbers projected to nearly double every 20 years, increasing to 3.48 million by 2030 and 7.62 million by 2050. This translates into over 367,000 new cases of dementia in a year in the region [4].

Ghana as a country is not left out of these great negative impacts of the dementia disease. According to the latest WHO data published in 2017, dementia deaths in Ghana reached 1,701 or 0.81% of total deaths with an age adjusted death rate of 16.47 per 100,000 of population, putting Ghana number 102 in the world in terms of dementia cases (WHO, 2017). Dementia is overwhelming not only for the people who have it, but also for their carers and families; impacting their careers, physical, psychological and economic well-being [5]. Issues such as lack of awareness and understanding of dementia in most countries which ultimately result in stigmatization and barriers to diagnosis and care, further exacerbate the burdens for carers. Economically, the total costs of dementia in sub-Saharan Africa are estimated to be over US$ 6.2 billion, accounting for more than the national Gross Domestic Product (GDP) of 19 of the 49 countries in the region. Almost three-quarter of this is made up of the cost of informal care, predominantly provided by family members (King's College London, 2017). It is expected that, as the population ages over the next several decades, so will dementia cases and their associated costs go up dramatically. The enormous stress of dementia on both carers and patients has led to more intensified research by dementia researchers to investigate ways to manage dementia in order to assist family carers in reducing the burden of the disease while giving these patients their needed independence [5]. Dementia care involves enabling people to live with as much freedom and choice as possible, whilst minimizing risk. This desire can pose particular challenges to carers, particularly when the patient is prone to wandering behavior.

The advancement in technological innovation particularly in the last decade has helped in minimizing these challenges [6]. Healthcare wearable technologies such as sensor based networks for activity monitoring, fall and wandering detection, smart socks, clevercare smartwatch and various eHealth applications have since been introduced to help patients live their lives independently. These wearable devices allow patients to continuously monitor physiological parameters and manage their health and well-being on personal basis, and also grant carers access to their health data, thereby helping patients to receive personalized medical care [4]. As technology continues to advance, it is certain that we will surely see more sophisticated wearable devices designed to help maximize safety whilst providing independence to people with dementia [7-9]. Though the ultimate impact of healthcare wearable devices on consumers as well as on society can be substantial [7, 8], especially in reducing the burden of dementia on family carers, little has been done in terms of research to understand the readiness of family carers to recommend for the use of healthcare wearable devices to their relatives, and by extension an understanding of the mindset of family carers towards the use of these devices in Ghana. Thus, this study seeks to shed light on family carers' perception towards these devices in Ghana.

II. THEORETICAL BASIS

This study relied on the constructs of the extended Unified Theory of Acceptance and Use of Technology as proposed by Dai, Larnyo et. al. 2019 to examine the perception of family carers of dementia patients on the use of healthcare wearable devices in Ghana [5].

The extended UTAUT model was developed by fusing the four constructs from the traditional UTAUT model [10]; performance expectancy, effort expectancy, social influence and facilitating conditions, with two additional constructs proposed by Dai, Larnyo et. al. 2019; technology anxiety and resistance to change.

Performance expectancy, also referred to as "perceived usefulness" as was originally used in TAM, is defined as "the degree to which an individual believes that using the system will help him or her to attain gains in job performance" [10]. In order to get family carers to recommend the use of healthcare wearable devices to patients, it is imperative to determine the perception of how useful the use of healthcare wearable devices will be in the lives of patients, the perception of how using healthcare wearable device will help patients accomplish things more quickly and how using healthcare wearable device will improve the quality of daily healthcare of dementia patients. It is anticipated that, the cumulative strength of these questions will ultimately determine whether or not carers will recommend the use of these devices in Ghana.

The Effort expectancy construct derived from the perceived ease of use (PEOU) of technology acceptance model (TAM) is defined as "the degree of ease associated with the use of the system" [10]. A study by Boontarig et. al., 2012 and Sun et. al. 2013 has identified effort expectancy as an important factor directly influencing users' intention to use mobile health monitoring systems, e-Health services via a smartphone, clinical decision support systems and mobile health [11, 12].

It is believed that technology adoption among elderly population reduce with aging due to issues such as memory loss, eye problems and other aging complications, thus, any technology that is developed for elderly needs to make design considerations that tends to make the use of such technologies easy by using more graphical interfaces and easily accessible buttons and icon.

Since dementia is mostly correlated with aging, this constructs helps to test what family carers perceive of "how easily usable wearable devices" are for dementia patients. In all four questions were adapted from literature and modified to test this construct; "I perceive learning how to use healthcare wearable device will be easy for patient", "I perceive patient find healthcare wearable devices easy to use", "I perceive it is easy for patient to become skillful at using healthcare wearable devices" and "I perceive patient's interaction with wearable devices is clear and understandable".

Another construct that was used to examine the perception of family carers was the social influence construct. Social influence in technology adoption defined as how strongly an end user perceives that others (family, community and society) believe they should use the new system, is a very important constructs [5, 10]. In a highly collective country like Ghana, where a sense of community is embedded into the socialization process of family members, the opinions and advice of other members of the family are considered relevant and play a significant role in the decision making process of whether or not to adopt healthcare wearable devices. Previous studies have shown that the attitudes and behaviors of other individuals in a user's social and work circles significantly impact that end user's use of technology [13-15].

Thus, in order to ascertain the degree to which, social influence impacts adoption of healthcare wearable devices, four questions were adapted from literature and modified to test this construct; "I perceive that people who are important to patient think that he/she

should use healthcare wearable devices", "I perceive that people who influence patient think he/she should uses healthcare wearable devices", "I perceive that people whose opinions are valuable to patient would prefer that he/she uses healthcare wearable devices" and finally, family carers where asked what they perceived medical practitioners think using healthcare wearable devices will enhance patient's quality of life.

Facilitating conditions according to Venkatesh et al. 2003 is defined as the degree to which an individual believes that an organizational and technical infrastructure exists to support their use of a particular system [10]. This construct comprise of three factors: training and support; shared belief in the system; and project communication. A study by Dai, Larnyo et. al. 2019 revealed that, facilitating conditions such as an individual's intellectual and cognitive abilities and perceived cost of learning new technologies, have effect on the adoption of technology [5]. In their study, facilitating condition was the highest predictor of use behavior of healthcare wearable devices among dementia patients in sub-Saharan Africa [5]. This study sought to examine carers' perception in four key areas; perceived availability of necessary resources to (money, technical infrastructure and technical support services), perceived acquired knowledge necessary to use healthcare wearable devices, adequacy of the necessary knowledge possessed by medical practitioners to help patients use healthcare wearable devices and finally, the perceived compatibility of the healthcare wearable devices with other technologies the dementia patient uses.

Research has shown that, technology anxiety can be key a factor that determines whether or not an elderly uses technology due to their declining physical and cognitive capabilities, thus potentially reducing their intention to use innovative technology [16]. Technology anxiety is affective, emotional response arising from the use of or the thought of using healthcare wearable devices. These affective, emotional response consists of nervousness when using technology, being worried when using technology, confusion, issues of discomfort relating to the use of technology.

For elderly populations particularly, there are perceptions relating to increase in the chances of loss of cognitive abilities completely due to the use of technology, perceptions of feeling "less human" when using technologies such as wearable devices and issues of safety arising from security concerns such as hacking and data theft since healthcare wearable devices are hooked on to the internet. Thus, it is important to determine how carers feel about these issues in their quest to recommend the use of healthcare wearable devices to their relatives.

Several research on the relationship between the behavioral intention and actual use behavior in many research fields on technology adoption has shown behavioral intention is a valid predictor of actual use behavior [17, 18]. Behavioral intention defined as the intention of an individual to use a particular technological system that directly affects their actual use behavior [19]. Empirically, behavioral intention has been tested and found to be able to explain user's actual use behavior of technology [10]. In technology adoption among dementia patients, behavioral intention was found to significantly predict actual use behavior [5]. This study posed three question; the perception that "patient intends to use healthcare wearable devices in the near future", perception that patient "intends to use healthcare wearable devices at every opportunity in the future" and finally, the perception that "patient plans to increase his or her use of healthcare wearable devices in the future", with the aim of evaluating the perception of family carers on the behavioral intention of their relatives to actually use healthcare wearable devices.

The study also examines the perception of family carers on the issue of resistance to change. Resistance to change is the perceive threat associated with the use of a system. According to a study by Deng et. al. 2014,

resistance to change acts as one of the key factors that influences whether or not an elderly uses technology due to their declining physical and cognitive capabilities thus potentially reducing their intention to use innovative technology [16]. Since dementia is more common among elderly aged 60 and above, there is the need to test this construct to determine the role this construct plays in the decision making process of dementia patients' family carers. In doing so, this study posed four questions adapted and modified from Venkatesh, Thong et al. 2012, Hoque and Sorwar 2017; perception regarding the fact that, patient does not want healthcare wearable devices to interfere with the way he or she deals with relevant health problems, perception regarding how patient does not want healthcare wearable devices to change the way he or she lived his or her life before, perception regarding how patient does not want healthcare wearable devices to change the way he or she interact with other people and lastly, the perception that patient does not want healthcare wearable devices to change the way medical practitioners handle his or her health issues [20, 21].

III. METHODS AND MATERIAL

A structured questionnaire was developed in English using instruments adapted and modified from existing literature for purposes of this study drawing from the theoretical basis above using a 5-point Likert scale ranging from (1) "strongly agree to (5) "strongly disagree". Because most of the respondents did not understand English, professional translators were recruited to translate the questionnaire items from English to the various local dialects (Ewe, Twi and Fante, Bono, Ga, Damgbe) depending on the particular setting (location) of the data collection. The samples were collected from thirteen out of the sixteen administrative regions; Ahafo, Ashanti, Bono, Bono East, Central, Eastern, Greater Accra, Northern, Oti, Upper West, Volta, Western and Western North regions respectively from July to December, 2019. Reponses elicited from respondents who could neither read nor write were inputted onto the questionnaire form, however, those who could read and write were made to input their responses directly onto the questionnaire without an intermediary. The selection of carers for the study was purely based on their availability and readiness to take part in the survey. Firstly, it was assumed that the respondents were capable of providing answers to the relevant questions knowledgeably and accurately. Also, it was perceived that carers were expert informants due to their experience and insight about dementia and its care. This study relied on carers as proxies as opposed to dementia patients themselves in responding to the survey question due to the peculiar characteristic of the dementia disease; issues of cognitive decline (in thinking, memory, and reasoning), inability to perform certain physical functions. Research over the years focused on the use of proxies to measure health and physical related outcomes of elderly, have shown close correlation between results of studies that have used subjects themselves and studies that have used proxies. One of such studies aimed at examining the extent to which retrospective proxy reports of well-being mirror participant's self-reports revealed that, there is moderate agreement between self-reports and proxy reports (r = .42) [22]. Thus, it is expected that the results of this current study would not deviate significantly if it was to use dementia patients themselves. Additionally, the questions posed were closed-ended in order to eliminate issues of biases in the responses.

The questionnaire was divided into two parts with the first part containing the demographic information. Respondents were asked information about their age, gender, educational qualifications, place of residence, marital status, and the number of years they have dealt with patients with dementia. The second part included questions that were used to evaluate carers' perceptions on the perceived degree of ease associated with the use of healthcare wearable devices; effort expectancy, performance expectancy, facilitating conditions, social influence, technology anxiety, and resistance to change.

Respondents were made aware that, there were no risks anticipated by agreeing to be part of the study. A confidentiality statement was also included prompting respondents that their data will not be connected to their names or other personal information, all personal data they wish to provide will be treated strictly confidential unless they explicitly give the researchers permission to disclose such personal information. Respondents were also made aware that their participation in the study was completely voluntary, and that should they at any time decide to withdraw by exiting the questionnaire, any response they had provided up to that point will be retained. Contact information of the researchers was also provided, so as to give respondents the opportunity to freely contact should they have further questions regarding the study. Finally, a checkbox capturing "Consent Agreement" was provided for respondents to check, agreeing to participate in this study. Respondents were also made to understand that they were free to withdraw at any time without incurring any penalties or liabilities.

A total of 427 responses were received, out of which 355 were used for further analysis giving a response rate of 83.14% which was considered to be very good. The unusable responses that were excluded from the study were 72; 29 were excluded due to either substantially incomplete responses or missing values, while the remaining 43 were excluded for not meeting the criteria for number of years the respondents had worked with dementia patients. Missing values, outliers, and normality were assessed, to ensure the quality of data to be used for further analysis.

A. Data Analysis

The different perceptions of family carers on the constructs; perceived performance expectancy, perceived effort expectancy, perceived social influence, perceived behavioral intention, perceived resistance to change, perceived technology anxiety, perceived actual use behavior, and perceived facilitating conditions, and the relationships between each pair of constructs were assessed using Pearson's correlation and multiple linear regression respectively. IBM SPSS version 23 and The Intellectus Statistics™ were used to perform the data analysis, setting the significance (alpha) level at 0.05.

In assessing the descriptive statistics, the following assumptions where made; when the Skewness is greater than 2 in absolute value, the variable is considered to be asymmetrical about its mean. Also, when the kurtosis is greater than or equal to 3, then the variable's distribution is markedly different than a normal distribution in its tendency to produce outliers [23].

The following assumptions were also made in order to determine the strength of the relationships between the constructs; coefficients between .10 and .29 represent a small effect size, coefficients between .30 and .49 represent a moderate effect size, and coefficients above .50 indicate a large effect size [24]. The correlations were also examined using Holm corrections to adjust for multiple comparisons based on an alpha value of 0.05.

The final predictive model for the regression analysis was computed as:

$$Y = B_0 + B_1 X_1 + B_2 X_2 \ldots B_n X_n \quad \text{Eqn. 1}$$

where Y is the predicted or expected value of the dependent variable; X_1 through X_n are p distinct independent or predictor variables; B_0 is the value of Y when all of the independent variables (X_1 through X_n) are equal to zero; and B_1 through B_n are the estimated regression coefficients. Each regression coefficient represents the change in Y relative to a one unit change in the respective independent variable.

IV. RESULTS

Descriptive analyses for carers' demographic characteristics including means, standard deviations

for continuous variables, and frequencies or proportions for categorical variables were assessed.

A. Descriptive Statistics

Summary statistics were calculated for age, perception on performance expectancy, perception on effort expectancy, perception on social influence, perception on behavioral intention, perception on resistance to change, perception on technology anxiety, perception on actual use behavior, perception on facilitating conditions, and gender as shown in appendix table A.1 and A.2 (See appendix table A.1 and A.2).

B. Correlation and Multiple Regression Analyses

Correlation and multiple regression analyses were conducted to examine the relationship between carers' perception of actual use behavior and various potential predictors; age, carers perception on performance expectancy, perception on effort expectancy, social influence, behavioral intention, resistance to change, technology anxiety, facilitating conditions, and gender.

A significant positive correlation was observed between carers' age and their perception on perceived effort expectancy ($rs = 0.88, p = .049$), age and perception on actual use behavior ($rs = 0.14, p = .003$), and between age and perception on facilitating conditions ($rs = 0.13, p = .007$). The correlation coefficients 0.14 and 0.13 for perception on actual use behavior and perception on facilitating conditions respectively indicated a small effect size, while 0.88 for perception on effort expectancy indicated a large effect size. These correlations indicate that, as age of carers' increases, their perception on effort expectancy, perception on actual use behavior and perception on facilitating conditions tend to increase.

A significant positive correlation was observed between perception on performance expectancy and perception on technology anxiety ($rs = 0.600, p < .001$), between perceived effort expectancy and perception on resistance to change ($rs = 0.739, p < .001$), and between perception on resistance to change and perception on facilitating conditions ($rs = 0.604, p < .001$) indicating a large effect size. A significant positive correlation was observed between perception on performance expectancy and perception on effort expectancy ($rs = 0.652, p < .001$), perception on performance expectancy and perception on social influence ($rs = 0.768, p < .001$), perception on performance expectancy and perception on behavioral intention ($rs = 0.703, p < .001$), perception on performance expectancy and perception on resistance to change ($rs = 0.738, p < .001$), perception on effort expectancy and perception on technology anxiety ($rs = 0.643, p < .001$), perception on effort expectancy and perception on actual use behavior ($rs = 0.754, p < .001$) and between perception on effort expectancy and perception on facilitating conditions ($rs = 0.739, p < .001$), respectively, indicating a large effect size.

Also, a significant positive correlation was observed between perception on social influence and perception on behavioral intention ($rs = 0.723, p < .001$), perception on social influence and perception on resistance to change ($rs = 0.695, p < .001$), perception on social influence and perception on technology anxiety ($rs = 0.613, p < .001$), perception on social influence and perception on actual use behavior ($rs = 0.640, p < .001$) and between perception on social influence and perception on facilitating conditions ($rs = 0.595, p < .001$) indicating a large effect size. These correlations indicate that, as perception on social influence increases, perception on behavioral intention, perception on resistance to change, perception on technology anxiety, perception on actual use behavior, and perception on facilitating conditions tend to increase.

A significant positive correlation was observed between perception on behavioral intention and perception on resistance to change ($rs = 0.725, p < .001$), perception on behavioral intention and perception on technology anxiety ($rs = 0.682, p < .001$), perception on behavioral intention and perception on actual use behavior ($rs = 0.719, p < .001$), and perception on

behavioral intention and perception on facilitating conditions (*rs = 0.676, p < .001*), indicating a large effect size. These correlations show that, as perception on behavioral intention increases, perception on resistance to change, perception on technology anxiety, perception on actual use behavior, and perception on facilitating conditions also increases.

A significant positive relationship with large effect size was observed between perception on resistance to change and perception on technology anxiety (*rs = 0.806, p < .001*), and between perception on resistance to change and perception on actual use behavior (*rs = 0.645, p < .001*), suggesting that as perception on resistance to change increases, perception on technology anxiety and perception on actual use behavior tends to also increase.

A significant positive correlation was observed with regards to perception on performance expectancy and perception on actual use behavior (*rs = 0.669, p < .001*), and perception on performance expectancy and perception on facilitating conditions (*rs = 0.630, p < .001*). These correlation coefficients indicated a large effect size, meaning that as perception on perceived performance expectancy, perception on actual use behavior and perception on facilitating conditions also tend to increase respectively. A significant positive correlation was observed between perception on effort expectancy and perception on social influence (*rs = 0.682, p < .001*) and between perception on effort expectancy and perception on behavioral intention (*rs = 0.739, p < .001*), indicating a large effect size. Correlation between perception on technology anxiety and perception on actual use behavior, and between perception on technology anxiety and perception on facilitating conditions had a significant positive correlation of (*rs = 0.682, p < .001*) and (*rs = 0.671, p < .001*) respectively. These correlation coefficients indicate a large effect size. Thus, as perception on technology anxiety increases, its correlation between perception on actual use behavior, and perception on facilitating conditions increases as well. Finally, a significant positive correlation was observed between perception on actual use behavior and perception on facilitating conditions (*rs = 0.820, p < .001*). The correlation coefficient between perception on actual use behavior and perception on facilitating conditions was 0.820, indicating a large effect size. This correlation indicates that as perception on actual use behavior increases, perception on facilitating conditions tends to increase. No other significant correlations were found. Tabulation of the results of the correlations are presented in appendix table A.3 (See appendix).

A multiple regression analysis was carried out to investigate whether perception on performance expectancy, perception on effort expectancy, age, gender, perception on social influence, perception on behavioral intention, perception on resistance to change, perception on technology anxiety, and perception on facilitating conditions could significantly predict perception on actual use of healthcare wearable devices (See Appendix Table A.4). The results of the regression indicated that the model explained 75.4% of the variance and that the model was a significant predictor of carers' perception on actual use behavior, with all nine predictors producing $F(9,345) = 117.37$, $p < .001$ (See Appendix Table A.5).

While perception on performance expectancy (*β=0.100, p=0.024; where p<0.05*), perception on effort expectancy (*β=0.170, p=0.001; where p<0.001*), perception on behavioral intention (*β=0.122,p=0.009; where p<0.05*), perception on technology anxiety (*β=0.116,p=0.030; where p<0.05*), perception on facilitating condition (*β=0.464,p=0.000; where p<0.001*) and age (*β=0.005, p=0.033; where p<0.05*) contributed significantly to the model, perception on social influence (*β=0.009, p=0.854; where p>0.05*), perception on resistance to change (*β=-0.009,p=0.867; where p>0.05*) and gender (*β=0.019,p=0.708; where p>0.05*) did not (See Appendix Table A.6). Based on the above results, perceived actual use behavior is calculated as:

Perception on Actual Use Behavior = **(-0.45) + (0.100*PPE) + (0.170*PEE) + (0.009*PSI) + (0.122*PBI) + (-0.009*PRC) + (0.116*PTA) + (0.464* PFC) + (0.005*Age) + (0.019* Gender)**

V. DISCUSSION

The successful adoption of healthcare wearable devices amongst patients with dementia will largely depend on the preparedness of carers to recommend for the use of these devices. Thus, it is imperative that the perceptions of family carers be examined to understand the factors that will propel them to recommend these devices to their patients.

Our study revealed that, most carers perceive the use of healthcare wearable device will be useful in the daily lives of these patients, as these devices will augment patients' daily activities by providing an ease and speed to their actives and also improve the quality of their daily healthcare needs. However, carers' belief that healthcare wearable devices will be useful for patients with dementia was countered by concerns about cause of anxiety and nervousness to patients, safety, privacy and reliability of these devices. For instance, about 33 percent of carers believed that, wearing healthcare wearable device would make these patients feel nervous. Also, carers perceived that, using healthcare wearable device may make patients more confused, worried and make them feel less human. This concern could possibly be due to the fear that these devices would interfere with the way they deal with relevant health problems, change the way they lived their lives before, change the way they interact with other people or ultimately change the way their medical practitioners and families handle their health issues. These findings are consistent with observation by Woodberry et. al. 2015 in their research on "the use of a wearable camera improves autobiographical memory in patients with Alzheimer's disease" which revealed that, though some patients enjoyed wearing devices, other patients did not because they did not want to draw attention to themselves. According to the study, patients who did not enjoy wearing the device felt that people would know that they had a disability because the device was so conspicuous and hence declined to use the devices [25]. These perceived fear carers believe, may eventually make patients feel uncomfortable which might cause an increase in the chances of them further losing their cognitive abilities. These feelings are also captured in literature where rehabilitation specialists have constantly stressed the need for introducing devices or aids that are acceptable to the patient [26]. It is therefore imperative for development of smaller, less conspicuous, miniaturized devices which would be made available in the form of jewellery and or clothes, which will not only serve the purpose of enhancing independent living, but also collecting the needed data in a way that would decrease the burden that hitherto a conspicuous system may pose on the patients.

Our findings also observed that, about 34 percent of carers perceived that, using healthcare wearable device may make patients feel unsafe due to security issues such as hacking. Although the potential of these devices are huge in terms of lessening the burden of carers in their quests of providing care to dementia patients by aiding in independent living and thereby reducing their over reliance on carers; reducing the cost of institutional care, and how useful the active and passive collection of massive amounts of data by these wearable devices may be in understanding disease progression and response to intervention, all these technologies present ethical challenges that can cause setbacks when used by these dementia patients. While there are technologies available to mask data, they risk upsetting the delicate balance between the benefits of open data and the hazards of exploitation [27].

Thus, ethical issues including privacy and data sharing policies, informed consent, disclosure, conflicts of interest, and ownership of data should be considered during the development of new technology. Additionally, stakeholders would have to increase education on these issues and concerns so as to

alleviate the fears of these patients and carers which will further be a source of encouragement for carers to recommend the use of these healthcare wearable devices to patients with dementia.

VI. LIMITATION OF THE STUDY

As this is a quantitative study with a relatively small sample (i.e. due to the fact that as of the time of conducting this study, no official record exists of the exact number of dementia patients and their carers in Ghana, where the sampled population based on probability distribution could be computed against the total number of patients), the result is not suggested that carers' recommendation for use of health care wearable devices by dementia patients be generalized in the context of a larger population. However, the study provides useful insight into the views of carers and reinforces the need to the need for the adoption of healthcare wearable devices amongst patients with dementia. Further areas of research related to this study could examine the views of dementia patients themselves on the use of healthcare wearable devices and also compare results of responses to this study's results to determine whether or not there is a divergence or convergence of views on the use of healthcare wearable devices. The further study could also determine whether the use of carers as proxies is constantly with other studies that employ proxies to assess the health needs of elderly patients and patients with other neurocognitive degenerated diseases.

VII. CONCLUSION

Despite the degenerative nature of the dementia disease and the prominent nature of the memory deficit characteristic of the condition, lack of significant disposable income of carers, and existence of inherent issues relating to safety, privacy and security of patients data in their quest to use healthcare wearable devices, our findings suggest that carers are willing and ready to recommend for use of healthcare wearable devices by dementia patients, which may consequently enhance their well-being and help satisfy their desire to live independently. Whether or not this state of well-being and independent living through the use of healthcare wearable devices can somehow slow down the rate of progression or have other longer-term effects either on the economic, social, health or cognitive of both patients and carers is yet known, but nevertheless, even short-term outcomes may be helpful in the lives of these dementia patients and their carers.

VIII. REFERENCES

[1] United Nations. *Global Issues Overview-Ageing*. 2019 [cited 2019 September, 20]; Available from: https://www.un.org/en/sections/issues-depth/ageing/index.html.

[2] WHO. *Dementia*. 2017 [cited 2018 December 19,]; Available from: https://www.who.int/en/news-room/fact-sheets/detail/dementia.

[3] Anderson, P., *World Alzheimer's Report 2015: Global Impact of Dementia*. 2017.

[4] Guerchet, M., et al. *Dementia in sub-Saharan Africa, Challenges and opportunities*. 2017 [cited 2019 April, 4]; Available from: https://www.alz.co.uk/research/dementia-in-africa.

[5] Dai, B., et al., *Factors Affecting Caregivers' Acceptance of the Use of Wearable Devices by Patients With Dementia: An Extension of the Unified Theory of Acceptance and Use of Technology Model.* American Journal of Alzheimers Disease and Other Dementias, 2019. **35**: p. 1-11.

[6] Larnyo, E., et al., *Impact of Technological Innovation Management on Health Care Service Delivery: A Systematic Review.* Journal of Information Engineering and Applications, 2018. **8**(9).

[7] Andersson, P. and L.-G. Mattsson, *Service innovations enabled by the "internet of things".* IMP Journal, 2015. **9**(1): p. 85-106.

[8] Atzori, L., A. Iera, and G. Morabito, *The internet of things: A survey.* Computer networks, 2010. **54**(15): p. 2787-2805.

[9] AutumnUKAdmin. *Innovation and Technology for Dementia Care*. 2018 [cited 2019 September, 20]; Available from: https://uk.autumn.care/wearable-devices/.

[10] Venkatesh, V., et al., *User acceptance of information technology: Toward a unified view.* MIS quarterly, 2003: p. 425-478.

[11] Boontarig, W., et al. *Factors influencing the Thai elderly intention to use smartphone for e-Health services*. in *Humanities, Science and Engineering Research (SHUSER), 2012 IEEE Symposium on*. 2012. IEEE.

[12] Sun, Y., et al., *Understanding the acceptance of mobile health services: a comparison and integration of alternative models.* Journal of Electronic Commerce Research, 2013. **14**(2): p. 183.

[13] Kraut, R.E., et al., *Varieties of social influence: The role of utility and norms in the success of a new communication medium.* Organization Science, 1998. **9**(4): p. 437-453.

[14] Rice, R.E., et al., *Individual and network influences on the adoption and perceived outcomes of electronic messaging.* Social networks, 1990. **12**(1): p. 27-55.

[15] Yuan, Y., et al., *Individual participation in organizational information commons.* Human Communication Research, 2005. **31**(2): p. 212-240.

[16] Deng, Z., X. Mo, and S. Liu, *Comparison of the middle-aged and older users' adoption of mobile health services in China.* International journal of medical informatics, 2014. **83**(3): p. 210-224.

[17] Sheppard, B.H., J. Hartwick, and P.R. Warshaw, *The theory of reasoned action: A meta-analysis of past research with recommendations for modifications and future research.* Journal of consumer research, 1988. **15**(3): p. 325-343.

[18] Venkatesh, V. and F.D. Davis, *A theoretical extension of the technology acceptance model: Four longitudinal field studies.* Management science, 2000. **46**(2): p. 186-204.

[19] Ajzen, I., *The theory of planned behavior.* Organizational behavior and human decision processes, 1991. **50**(2): p. 179-211.

[20] Hoque, R. and G. Sorwar, *Understanding factors influencing the adoption of mHealth by the elderly: an extension of the UTAUT model.* International journal of medical informatics, 2017. **101**: p. 75-84.

[21] Venkatesh, V., J.Y. Thong, and X. Xu, *Consumer acceptance and use of information technology: extending the unified theory of acceptance and use of technology.* MIS quarterly, 2012: p. 157-178.

[22] Infurna, F.J., et al., *Linking concurrent self-reports and retrospective proxy reports about the last year of life: A prevailing picture of life satisfaction decline.* Journals of Gerontology Series B: Psychological Sciences and Social Sciences, 2013. **69**(5): p. 695-709.

[23] Westfall, P. and K.S. Henning, *Understanding advanced statistical methods*. 2013: Chapman and Hall/CRC.

[24] Cohen, J., *Set correlation and contingency tables.* Applied Psychological Measurement, 1988. **12**(4): p. 425-434.

[25] Woodberry, E., et al., *The use of a wearable camera improves autobiographical memory in patients with Alzheimer's disease.* Memory, 2015. **23**(3): p. 340-349.

[26] Baldwin, V.N., T. Powell, and L. Lorenc, *Factors influencing the uptake of memory compensations: A qualitative analysis.* Neuropsychological rehabilitation, 2011. **21**(4): p. 484-501.

[27] Gold, M., et al., *Digital technologies as biomarkers, clinical outcomes assessment, and recruitment tools in Alzheimer's disease clinical trials.* Alzheimer's & Dementia: Translational Research & Clinical Interventions, 2018. **4**: p. 234-242.

APPENDIX

Table A. 1 *Summary Statistics Table for Interval and Ratio Variables*

Variable	M	SD	n	SEM	Min	Max	Skewness	Kurtosis
PAUB	2.79	0.93	357	0.05	1.00	5.00	0.45	-0.67
Age	35.77	11.52	357	0.61	19.00	71.00	1.01	0.65
PBI	2.56	0.98	357	0.05	1.00	5.00	0.44	-0.82
PFC	2.82	0.91	357	0.05	1.00	4.75	0.22	-0.86
Gender	1.54	0.50	357	0.03	1.00	2.00	-0.14	-1.98
PEE	2.66	0.97	357	0.05	1.00	4.75	0.48	-0.81
PPE	2.43	1.04	357	0.05	1.00	5.00	0.82	-0.39
PRC	2.57	0.98	356	0.05	1.00	4.75	0.64	-0.86
PSI	2.44	0.92	357	0.05	1.00	5.00	0.54	-0.71
PTA	2.76	0.88	356	0.05	1.00	4.57	0.34	-1.18

Note. Perception on Performance Expectancy=PPE, Perception on Effort Expectancy= PEE, Perception on Social Influence =PSI, Perception on Facilitating Conditions=PFC, Perception on Actual Use Behavior=PAUB, Perception on Behavioral Intention= PBI, Perception on Technology Anxiety= PTA, Perception on Resistance to Change=PRC.

Table A.2 Correlations

		PAUB	PPE	PEE	PSI	PBI	PRC	PTA	PFC	Age	Gender
Pearson Correlation	**PAUB**	1.000	.669	.754	.640	.719	.645	.682	.820	.144	-.005
	PPE	.669	1.000	.652	.768	.703	.738	.600	.630	.024	.042
	PEE	.754	.652	1.000	.682	.739	.623	.643	.739	.088	-.026
	PSI	.640	.768	.682	1.000	.723	.695	.613	.595	.036	.031
	PBI	.719	.703	.739	.723	1.000	.725	.682	.676	.026	.005
	PRC	.645	.738	.623	.695	.725	1.000	.806	.604	.017	.009
	PTA	.682	.600	.643	.613	.682	.806	1.000	.671	.056	-.007
	PFC	.820	.630	.739	.595	.676	.604	.671	1.000	.130	-.012
	Age	.144	.024	.088	.036	.026	.017	.056	.130	1.000	-.174
	Gender	-.005	.042	-.026	.031	.005	.009	-.007	-.012	-.174	1.000
Sig. (1-tailed)	**PAUB**	.	.000	.000	.000	.000	.000	.000	.000	.003	.461
	PPE	.000	.	.000	.000	.000	.000	.000	.000	.325	.217
	PEE	.000	.000	.	.000	.000	.000	.000	.000	.049	.311
	PSI	.000	.000	.000	.	.000	.000	.000	.000	.249	.278
	PBI	.000	.000	.000	.000	.	.000	.000	.000	.309	.460
	PRC	.000	.000	.000	.000	.000	.	.000	.000	.371	.434
	PTA	.000	.000	.000	.000	.000	.000	.	.000	.148	.451
	PFC	.000	.000	.000	.000	.000	.000	.000	.	.007	.414
	Age	.003	.325	.049	.249	.309	.371	.148	.007	.	.001
	Gender	.461	.217	.311	.278	.460	.434	.451	.414	.001	.
N	**PAUB**	355	355	355	355	355	355	355	355	355	355
	PPE	355	355	355	355	355	355	355	355	355	355
	PEE	355	355	355	355	355	355	355	355	355	355
	PSI	355	355	355	355	355	355	355	355	355	355
	PBI	355	355	355	355	355	355	355	355	355	355
	PRC	355	355	355	355	355	355	355	355	355	355
	PTA	355	355	355	355	355	355	355	355	355	355
	PFC	355	355	355	355	355	355	355	355	355	355
	Age	355	355	355	355	355	355	355	355	355	355
	Gender	355	355	355	355	355	355	355	355	355	355

Note: Perception on Performance Expectancy=PPE Perception on Effort Expectancy= PEE, Perception on Social Influence =PSI, Perception on Facilitating Conditions=PFC, Perception on Actual Use Behavior=PAUB, Perception on Behavioral Intention= PBI, Perception on Technology Anxiety= PTA, Perception on Resistance to Change=PRC.

Table A.3 Frequencies and percentages of responses

N=355	Strongly Agree		Agree		Neither Agree nor Disagree		Disagree		Strongly Disagree	
Construct	**Freq**	**%**	**Freq**	**%**	**Freq**	**%**	**Freq**	**%**	**Freq**	**%**
PPE1	98	27.5	111	31.1	93	26.1	26	7.3	29	8.1
PPE 2	79	22.1	135	37.8	81	22.7	26	7.3	36	10.1
PPE 3	71	19.9	146	40.9	73	20.4	37	10.4	30	8.4
PEE 1	61	17.1	136	38.1	77	21.6	44	12.3	39	10.9
PEE 2	75	21.0	86	24.1	122	34.2	53	14.8	21	5.9
PEE 3	61	17.1	109	30.5	106	29.7	47	13.2	34	9.5
PEE 4	57	16.0	119	33.3	84	23.5	47	13.2	50	14.0
PSI 1	87	24.4	94	26.3	109	30.5	52	14.6	15	4.2
PSI 2	70	19.6	128	35.9	80	22.4	50	14.0	29	8.1
PSI 3	67	18.8	111	31.1	135	37.8	24	6.7	20	5.6
PSI 4	122	34.2	104	29.1	71	19.9	51	14.3	9	2.5
PBI 1	68	19.0	120	33.6	99	27.7	22	6.2	48	13.4
PBI 2	58	16.2	102	28.6	126	35.3	65	18.2	6	1.7
PBI 3	98	27.5	92	25.8	102	28.6	34	9.5	31	8.7
PRC 1	63	17.6	113	31.7	95	26.6	49	13.7	37	10.4
PRC 2	80	22.4	103	28.9	106	29.7	33	9.2	35	9.8
PRC 3	58	16.2	124	34.7	112	31.4	29	8.1	33	9.2
PRC 4	73	20.4	149	41.7	65	18.2	36	10.1	34	9.5
PTA 1	70	19.6	120	33.6	69	19.3	47	13.2	51	14.3
PTA 2	51	14.3	94	26.3	116	32.5	67	18.8	29	8.1
PTA 3	75	21.0	72	20.2	104	29.1	81	22.7	24	6.7
PTA 4	56	15.7	93	26.1	137	38.4	43	12.0	28	7.8
PTA 5	45	12.6	102	28.6	121	33.9	50	14.0	39	10.9

PTA 6	67	18.8	67	18.8	133	37.3	58	16.2	32	9.0
PTA 7	38	10.6	121	33.9	104	29.1	77	21.6	17	4.8
PAUB 1	36	10.1	106	29.7	136	38.1	44	12.3	35	9.8
PAUB 2	48	13.4	98	27.5	131	36.7	55	15.4	25	7.0
PAUB 3	38	10.6	125	35.0	105	29.4	53	14.8	36	10.1
PFC 1	52	14.6	90	25.2	98	27.5	61	17.1	56	15.7
PFC 2	29	8.1	94	26.3	107	30.0	83	23.2	44	12.3
PFC 3	94	26.3	98	27.5	103	28.9	33	9.2	29	8.1
PFC 4	49	13.7	93	26.1	143	40.1	17	4.8	55	15.4

Note. Freq. =Frequency, %=Percentage, Perception on Performance Expectancy=PPU, Perception on Effort Expectancy= PEE, Perception on Social Influence =PSI, Perception on Facilitating Conditions=PFC, Perception on Actual Use Behavior=PAUB, Perception on Behavioral Intention= PBI, Perception on Technology Anxiety= PTA, Perception on Resistance to Change=PRC

Table A.4 Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics				
					R Square Change	F Change	df1	df2	Sig. F Change
1	.868[a]	.754	.747	.46806	.754	117.369	9	345	.000

a. Predictors: (Constant), Gender, Perception on Behavioral Intention, Age, Perception on Performance Expectancy, Perception on Effort Expectancy, Perception on Social Influence, Perception on Facilitating Conditions, Perception on Technology Anxiety, Perception on Resistance to Change

Table A.5 **ANOVA[a]**

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	231.417	9	25.713	117.369	.000[b]
	Residual	75.582	345	.219		
	Total	306.998	354			

a. Dependent Variable: Perception on Actual Use Behavior

b. Predictors: (Constant), Gender, Perception on Behavioral Intention , Age, Perception on Technology Anxiety , Perception on Performance Expectancy , Perception on Facilitating Conditions , Perception on Social Influence , Perception on Effort Expectancy , Perception on Resistance to Change

Table A.6 **Coefficients[a]**

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	95.0% Confidence Interval for B	
		B	Std. Error	Beta			Lower Bound	Upper Bound
1	(Constant)	-.045	.145		-.307	.759	-.330	.241
	PPU	.100	.044	.111	2.272	.024	.013	.186
	PPEoU	.170	.045	.178	3.776	.000	.081	.258
	PSI	.009	.048	.009	.185	.854	-.085	.102
	PBI	.122	.046	.129	2.639	.009	.031	.212
	PRC	-.009	.053	-.009	-.168	.867	-.112	.095
	PTA	.116	.053	.110	2.183	.030	.011	.220
	PFC	.464	.046	.451	10.114	.000	.374	.554
	Age	.005	.002	.059	2.140	.033	.000	.009
	Gender	.019	.051	.010	.374	.708	-.081	.119

a. Dependent Variable: Perception on Actual Use Behavior

Perception on Performance Expectancy=PPE, Perception on Effort Expectancy= PEE, Perception on Social Influence =PSI, Perception on Facilitating Conditions=PFC, Perception on Actual Use Behavior=PAUB, Perception on Behavioral Intention= PBI, Perception on Technology Anxiety= PTA, Perception on Resistance to Change=PRC

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