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Original Article

Factors Influencing the Adoption of Mobile Health Monitoring and Care Systems by the Elderly Living at Home in South Africa

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Introduction: Technology can improve the health care outcomes of the elderly. However, there are many barriers to the adoption of mobile monitoring and care systems (MMCs) by the elderly reported in literature. The main purpose of this research was to investigate why elderly people do not adopt MMCs to improve the quality of their health care.

Methods: The study made use of semi-structured interviews to collect data in the Buffalo City Metropolitan Municipality, South Africa. The study sample consisted of 15 purposively chosen study participants, representing a diverse racial profile, in order to investigate the adoption of MMCs of the elderly in their home environment. The interviews were analysed thematically.

Results: The study found that social challenges like technology anxiety, the intrusive nature of the technology and attitude towards the technology will affect adoption of MMCs. Government need to address the standardisation, data governance and interoperability of the systems. The cost of MMCs were seen as an inhibitor, but could be off set against the perceived return on investment of health care. While the elderly acknowledged that MMCs can improve their independence, the design of the MMCs and training to use it was identified as barriers to the adoption.

Conclusion: The study, therefore, recommends collaborative engagements amongst government, business and the elderly to facilitate the adoption of MMCs in the elderly community to improve the quality of health care.

Keywords: Adoption, Aging, Home Environment, Health, South Africa

Introduction

South Africa has a population of approximately 4.6 million elderly people (1). The World Health Organization states that, while the number of elderly people is rising globally, developing countries still experience a chronic shortage of infrastructure to house the elderly community. As a result, about 74% of the elderly population in South Africa lives at home, either alone or with family (2).

The health care of the elderly places a significant burden on the family when constant monitoring is needed for that person. Chronic illnesses also add strain on the already overburdened public health resources of a developing country, which often does not have a plan in place for longevity (3).

The ubiquitous and interconnective nature of technology has afforded the elderly, especially those living in rural and remote areas, an opportunity for monitoring and care inside their homes. Mobile monitoring and care (MMC) systems and sensor devices can be used to monitor the elderly in their home environment and prevent travelling to and waiting times at health care center (1). However, the cost of these devices prevents elderly people from accessing technologies which can benefit and improve their quality of health care. The different types of

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MMC systems include mobile testing kits, fall detection devices, bed sensors, vital sign monitors, mobility sensors for frail care, ambient assisted living systems to improve safety, security, health and wellness of the elderly (4, 5).

MMC systems have not been adopted by the elderly to improve their health care. Reasons for this are that MMC systems are considered expensive, lack of trust, privacy and security concerns (6-8, 10-12). Literature indicates that elderly people have a distrust relationship with technology (7, 12). Van Dijk (10) found that there are four kinds of barriers that restrict the adoption of MMC systems for healthcare among the elderly. The first barrier relates to material access where the user does not have access to the technology. This MMC technology in South Africa, a developing country, is very expensive and is not within the financial means of the majority of the elderly (5-6, 10-11). The second barrier, skills access, is linked to the lack of digital skills that prevent the user from using the technology. Often the elderly folk are technologically challenged and not able to use new technology, leading to what is termed technological anxiety (10). The third restriction alludes to usage access where in the user does not have the opportunity to use technology as it is not available in the home environment. Finally, mental access relates to a personal attribute where the user shows no awareness or interest for the health benefit to use the technology (13). These restrictions raise concerns relating to affordability and access to healthcare.

The theoretical perspective of the study is informed by the socio-technical systems (STS) theory as developed by Eric Trist, circa 1940 (14). The STS theory seeks to understand human behaviour in an organization by exploring why people behave in a certain manner and examines the existing relationship between people and technology. The STS theory consists of two subsets, social and technical. The social subset comprises the people and structures' constructs. The technical subset consists of the technology and tasks' constructs (15).

The people construct will deal with the attitudes, behaviours and perceptions identified in the elderly people and how these variables affect the adoption of MMC systems. The procedures' construct discusses how the inadequacy of education and training levels, as well as awareness, affect the manner in which healthcare workers in the elderly arena perform their duties (12, 16, 17).

The technology construct is related to how the costs of technological infrastructure are an impediment to the adoption of MMC systems (6, 8, 18, 19). Collaboration between government and business can lower technology costs, either through the implementation of a subsidy system for the elderly or via a sponsoring method (18). The task construct refer to the health monitoring that can take place through the use of MMCs in the home environment of the elderly (7-9).

Due to the importance of the use of MMC systems in improving the level of care in the elderly and very limited studies in this field, the objective of this study is to investigate the factors that will improve the adoption of MMC systems for healthcare monitoring by the elderly living at home in South Africa.

Methods

Study design and prticipants

This study made use of a qualitative research approach and an inductive approach. The population of this study was derived from the Buffalo City Metropolitan Municipal (BCMM) area in the Eastern Cape, a province in South Africa where the biggest population of the elderly resides in 2021 (3). The sample size consisted of 15 elderly people from different socio-economic conditions and racial orientations, living in their home environments. The researcher made use of purposive sampling to select participants for the information they possessed about the research topic and knowledge they could contribute to the study.

Procedure

The participants were interviewed making use of a semi-structured interview guide developed from the STS theory. The interviews were conducted at the place of residence of the elderly and continued until saturation was achieved. The interviews were conducted by one researcher and lasted approximately 45 minutes. Participants gave consent prior to the interview that the interview could be recorded.

Data analysis

After transcribing the interviews, the data was analysed through directed content analysis making use of the STS Theory.

Ethical considerations

This research conformed with the ethical guidelines specified by the University Research Ethics' Committee. The participants were given a full explanation of the reason the data was collected and how the data would be used. The participants were also made aware that participation was voluntary and they could withdraw at any time with no repercussions. Participants were asked to sign an informed consent form prior to the interviews.

Trustworthiness

Credibility was established by conducting member checks. Member checks allows participants to go through their interviews after it was captured and verify that the information is accurate. To ensure transferability in this study, detailed descriptions of the research process and findings was provided so that any researcher wishing to use a larger sample from the population for a future study will be able to follow the steps to the letter. Similarly, dependability was obtained by a detailed explanation of the selected design, research process, and included instruments for data collection. To minimize the influence of the researcher's judgment, a confirm ability audit was conducted by the second researcher.

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Results

Semi-structured interviews were conducted with 15 participants across BCMM in their living spaces. The mean age of the participants were 72.7 years (SD of 6.83). The participants consisted of 93.3% women and 6. 7% males. The marital status of the participants consisted of 53, 3% widowed, 40% married and 6.67% divorced. The educational level of the participants ranged from 53.3% that did not complete grade 12, 60% that did obtain grade 12 and 20% that obtained a post-grade 12 qualification. Seventy three percent of participants classified themselves as pensioners, while 26.7% of the participants were still employed.

Two participants used mobile devices to obtain health information. Eight participants use MMC devices for health monitoring while five participants do not own mobile devices for healthcare due to lack of affordability.

Directed content analysis was adopted to analyze the data. Four main themes, and 11 sub themes were identified as can be seen by Table 1.

Five sub-themes emerged from the people construct, two themes from the procedures construct, three themes from the technology construct and task construct respectively.

Table 1. Initial emerging categories from interview

People construct	Technology construct
• Minimal resistance • Technology anxiety • Intrusive nature of technology • Attitude	• Affordability of MMC systems • Return on investment
Procedures construct	**Tasks construct**
• Standardization of MMC systems • Data governance • Interoperability of MMC systems	• Independence of the elderly • Insufficient training • Design of mobile devices is not user friendly

The data analysis generated four themes, as can be seen in Table 1, to understand the lack of adoption of MMC systems by the elderly to improve the quality of their health care. These themes were founded on the STS theory and included (1) the People construct, (2) Procedures construct, (3) Technology construct and (4) the Task construct. Within each of these four main themes, a number of sub-themes were developed.

1. People construct

Only one participant in the study displayed trust issues with technology based on a previous personal experience. Paradoxically, his mobile phone has a health app to help him monitor his health issues to avoid going for monthly check-up at the clinic.

"I don't really trust this technology talk, but if it means not going to the clinic, then so be it". (Participant 8)

Technology anxiety was linked to the lack of education, especially for females, during their time at school.

"During my time at school there were no computers, only type-writers". (Participant 2)

There is an assertion that mobile devices are intrusive and will invade the privacy of the elderly people but is tolerated due to the benefits it provides for health care.

"Sometimes I am wary about how the information I divulge on my app is used, but the knowledge that my health is under constant surveillance brings me and my family greater comfort". (Participant 15)

Initially, one of the perceived challenges to the adoption of MMC systems for the elderly's healthcare were issues relating to affordability of the technology.

"I wish I had enough money to afford these machines that check sugar levels so that I don't have to go to the clinic for monthly check-ups, the clinics are always full!" (Participant 14)

However, elderly people who own mobile devices report an attitude change as they witness the associated benefits of using MMC systems for their health care (22, 5). The associated benefits include less visits to health facilities, reduced transportation costs, remote consultations and monitoring, reduced social isolation as well as consistency in adherence.

2. Procedures construct

If MMC systems are standardized by government, the cost of these systems will decrease and allow interoperability between different brands or devices. Participants 1, a diabetes patient, alluded to a need for government to contribute and provide some form of assistance to the resource-constrained elderly to access MMC systems for healthcare.

"I would like to buy the machine that monitors my diabetes so that I don't have to visit the clinic every month, but all my pension money goes towards my daily living costs". (Participant 1)

Data concerns relating to access, as raised by some participants, led to the conclusion that there is very little awareness about data governance during data sharing especially given the fragmented Health Information Systems in South Africa.

"I noticed that every time I use my health app., I would receive messages about available products, is that even allowed?" (Participant 11)

Elderly people were concerned that MMC systems did not appear to interoperable. The reported fragmentation may have adverse effects on the elderly who prefer to spend less time in healthcare centers, according to participant 7.

"I visited another hospital in Cape Town and before I could see a doctor, I had to give information all over again. Apparently, I was supposed to bring my previous blood results with me because the Cape Town hospital doesn't have the same system as Frere

Hospital in East London. Whose problem is that?" (Participant 9)

3. Technology construct

Participants 1, 2 and 3 echoed similar sentiments regarding affordability issues. Participant 1 reflected, *"My neighbour recently showed me how her cell phone reminds her to take medication, but unfortunately I cannot afford that kind of phone on my government pension". (Participant 1)*

Participant 10 relies on the internet for health information, but is challenged by the expensiveness of data. The participant stated:

"It is so disheartening not being able to find information because my pension money does not stretch far into the month and data is too expensive". (Participant 12)

The value benefit associated with higher adoption levels of MMC systems for the elderly's healthcare cuts across the entire care spectrum from family to caregiver to physician. During the interview process, elderly people commended the return of investment of MMC systems for healthcare on how they made their lives better.

"I am no longer afraid of moving around my bed because I know help is readily available in cases of an emergency, thanks to my monitor". (Participant 4)

4. Tasks construct

The lack of technical skills is noticeable in elderly people. Lack of education is a challenge facing most elderly people. This challenge is corroborated by the sentiments expressed by Participant 4,

"At my age, I cannot be bothered with learning how to use a mobile device. That is why I have a permanent caregiver who helps me with such things". (Participant 4)

For elderly people living at home, the use of MMC systems can improve their independence and relieve the pressure on government public health resources. The MMC systems can assist in monitoring, tracking, as well as fall detection of the elderly. Participant 11 echoed this sentiment as well and reflected,

"As an elderly woman living alone, it is important that I surround myself with all these gadgets even though they may sometimes be expensive. However, the cost is outweighed by the peace of mind in knowing I am taken care of even in my sleep". (Participant 11)

Smart phones, access to data and understanding the operational instructions of mobile devices have proven to be a challenge to both the healthcare workers and the elderly. One of the participants expressed the same sentiment and chose not to use the mobile device instead of learning how to navigate a complicated user interface.

"Going through the user manual is an inconvenience, I am unable to understand the instructions because I am not well-educated". (Participant 4)

Discussion

The objective of this study is to investigate the factors that will improve the adoption of MMC systems for healthcare monitoring by the elderly living at home in South Africa. Barriers identified in the previous section that may hinder the adoption of MMC systems for elderly. Enhanced access to healthcare for the elderly becomes the key factor under consideration since the elderly are mostly worried about their healthcare needs as they progress with age (1). In addition, suitable living arrangements that enhance social facilitation in elderly communities carry the benefit of an improved quality of life designed to provide the elderly with a sense of belonging and improved social cohesion (3). The social inclusion created from being a part of elderly communities encourages the elderly to be more proactive towards their healthcare. South Africa has a fragmented health information system and thus elderly people are subjected to the same procedures when visiting healthcare facilities (7). This invokes anxieties in the elderly who at some stage admit to defaulting on health appointments to avoid repetitive procedures (10). Integration of the MMC systems could lead to less time spent at a healthcare center, improved adherence levels and therefore a healthier elderly community that assumes a pro-active approach to their health.

There were concerns raised in relation to privacy, trust and data governance issues within elderly communities. Although there was only one participant in this study that resisted technology, education and training campaigns are very important to improve the adoption of MMCs amongst the elderly. Healthcare workers need technical training to improve productivity levels. A fully resourced health worker develops a positive attitude and thus increased productivity. The elderly community stands to benefit from a high morale associated with a conducive working environment for the healthcare workers (20). The intensification of technical training would allow the elderly to be pro-active about their health. Adherence levels may increase thereby lessening the burden currently felt by healthcare resources. The technological anxiety encountered by the elderly may also be reduced as they realize the return on investment of the intrusive technology is worth the increase in their quality of health care (10).

Information and Communications Technology (ICT) infrastructure plays a pivotal role in the elderly's healthcare. As an agent of change, ICT enables the provision of proactive, personalized healthcare to the elderly living at home. Such ICT therefore assists the healthcare sector in resource allocation. All the above need organizations to re-engineer and redesign normal business processes to maximize the potential benefits of ICT (21). The ubiquity of ICT infrastructure may improve decision-making during emergencies, especially in remote areas. A proliferated ICT infrastructure also carries the benefit of more open access channels to healthcare mobile devices at reasonable and affordable rates. The

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impact of open access channels could result in a reduced burden to healthcare resources which are currently under severe strain (7). The exorbitant costs of internet in South Africa are an impediment to the elderly's healthcare. Cheaper internet allows for improved usability and interconnectedness as elderly people as well as healthcare workers would have better access to healthcare (21).

Conclusion

Barriers identified to be impediments to the adoption of MMC systems for elderly healthcare led to the development of six critical success factors necessary for increased levels of adoption. According to the quadrants of STS theory upon which this study is based, a comprehensive plan of action regarding the elderly is required to facilitate better quality of life for the elderly communities. The integration of HIS, therefore, is considered a key aspect of alleviating the burden on healthcare resources. All the above arguments therefore solidify the imperative issue of the formation of a data governance framework in relation to the elderly.

Study limitations

There are several factors that proved challenging to the completion of the entire study. These pertain to identification of research participants who needed to be chosen for the information they possessed in fulfillment of the purposive sampling guidelines. Purposive sampling seeks to choose participants to fulfill a particular purpose. The number of participants interviewed, the sector in which it is framed (elderly and mobile technologies) and the geographical component of the study were restricted to one area where adoption of mobile technology may not have been as problematic as others because the availability of MMC technology is not prevalent. Given the population of the research study, the sample size may not truly reflect the national perspective.

Conflict of interest

None

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None

Authors' contributions

YF Substantial contributions to the conception or design of the work; and the acquisition, analysis, or interpretation of the data.
LC Substantial contributions to the conception or design of the work; and the acquisition, analysis, or interpretation of the data. All authors have an equal share in this study, have read the manuscript, approved the final version and agreed to be accountable for all aspects of the work.

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